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Use of Guatemalan Household Consumption and Expenditure Survey (HCES) Data to Develop Optifood Food-Based Recommendations

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Abbreviations and Acronyms

AME	adult male equivalent
APN	absolute problem nutrient
BF	breastfed (child)
CSB	corn-soy blend
CSM	corn-soy milk
ENCOVI	Encuesta Nacional de Condiciones de Vida
FANTA	Food and Nutrition Technical Assistance III Project
FAO	Food and Agriculture Organization of the United Nations
FBF	fortified blended flour
FBR	food-based recommendation
FCT	food composition table
FFQ	food frequency questionnaire
FG	food group
FSG	food subgroup
g	grams
GLV	green leafy vegetables
GTQ	Guatemalan quetzal
HCES	Household Consumption and Expenditure Survey
HIES	Household Income and Expenditure Survey
INCAP	Institute of Nutrition of Central America and Panama
INE	National Institute of Statistics (Instituto Nacional de Estadística)
IYCF	infant and young child feeding
kcal	kilocalorie
LSHTM	London School of Hygiene and Tropical Medicine
LSMS	Living Standards Measurement Survey
µg	micrograms
max	maxium
mg	milligrams
min	mininum
MNP	multiple micronutrient powder
MPE	meat, poultry, eggs
MSPAS	Ministerio de Salud Pública y Asistencia Social (Ministry of Health and Social Assistance)

NBF	non-breastfed (child)
NHBS	National Household Budget Survey
PAL	physical activity level
PLW	pregnant and lactating women
PPN	partial problem nutrient
RAE	retinol activity equivalents
RE	retinol equivalents
RNI	recommended nutrient intake
SBCC	social and behavior change communication
TIPs	Trials of Improved Practices
USAID	U.S. Agency for International Development
WHO	World Health Organization

Glossary of Terms Used in Reference to Optifood and the Household Consumption and Expenditure Surveys (HCES)

Adult male equivalent (AME): The expression of energy requirements on the basis of gender, age, and physiological status as a proportion of the energy requirements of an average adult male.

Apparent consumption: The available food within a household that is assumed to have been consumed by the household in a defined period, for example, 7 days or 14 days, as determined by household data on food acquired through purchase, home production, gift, donation or barter during the same period.

Food composition table (FCT): Optifood has a built-in core food composition database of 1,937 foods. The primary source of these data is the USDA National Nutrient Database for Standard Reference, Release 23 (USDA 2010). Secondary sources are from Tanzania (Lukmanji et al. 2008), Zambia (National Food and Nutrition Commission 2007), Mali (Barikmo et al. 2004), West Africa (Stadlmayr et al. 2010), Southeast Asia (Puwastien et al. 2000), the English-speaking Caribbean (Caribbean Food and Nutrition Institute 2000), and Central America (INCAP 2007), as well as McCance and Widdowson's Composition of Foods (Food Standards Agency 2002).

Food groups: Foods in Optifood are organized into predefined groups. Each food in the Optifood FCT is categorized into one of 17 food groups, which include added fats; added sugars; bakery and breakfast cereals; beverages (nondairy or blended dairy); composites (mixed food groups, e.g. recipes); dairy products; fruits; grains and grain products; human milk; legumes, nuts, and seeds; meat, fish, and eggs; miscellaneous (such as condiments, herbs, and sauces); savory snacks (such as salty, spicy, or fried snacks); special fortified products (such as multiple micronutrient powders [MNPs], lipid-based nutrient supplements); starchy roots and other starchy plant foods; sweetened snacks and desserts; and vegetables.

Food pattern: Food patterns are defined by the locally available foods that are most commonly consumed by the target group, the quantities of these foods most commonly consumed by the target group, and the frequency of consumption of these foods by the target group during a one-week period.

Food subgroups: Foods within each food group are also categorized into predefined subgroups. An example of a food subgroup includes, for fruits: vitamin A-source fruits; vitamin C-rich fruits; and other fruits. Each food group has at least one food subgroup called "Myfoods_Special [NAME OF FOOD GROUP]" for special categories—for example, there is a fruit subgroup call "Myfoods_Special Fruits." The purpose of this "special" food group is to allow users to be able to use it to create their own food subgroup category, if needed.

Lowest-cost diet: In the lowest-cost diet, Optifood uses cost data to minimize cost while meeting (or coming as close as possible to meeting) nutrient needs in the target population's diet.

Maximized diet: In Optifood analysis, the maximized diet represents the best-case scenario for an individual nutrient for the target group. This diet considers the quantity of a nutrient provided by a food-based recommendation or combination of recommendations, as well as the maximum quantity of the nutrient that could be provided by other local foods within set constraints. This maximized diet value is used to assess and define problem nutrients for the target population. If it is not possible to reach 100 percent of the recommended nutrient intake (RNI) for a nutrient, even when using the maximized diet, this signifies that even with an optimized combination of local foods (within maximum constraints), the target population would likely not achieve adequacy for the chosen nutrient and alternative interventions may be required.

Minimized diet: In Optifood analysis, the minimized diet is the worst-case scenario for the target group. It represents the lower tail (approximately the 5th percentile) of the intake distribution of an individual nutrient for the population. A cutoff of 65 percent or more of RNI in the minimized diets would mean that the level of nutrient inadequacy would probably be below 2–3 percent for the population. If less than 65 percent of RNI is achieved for a modeled nutrient, the number of individuals in the target population at risk of nutrient inadequacy would likely be higher, meaning that nutrient adequacy would likely not be met.

Model constraints (servings per week): Lower and upper constraints, or limits in terms of servings per week, for each food, food group and food subgroup for each target group in the population. The lower constraint (low number of servings per week) for a food, food group, and food subgroup is determined by taking the 10th percentile of consumption for the food, or for food groups or food subgroups, the 10^{th} percentile of consumption for the foods in the food group or food subgroup, for the population. The upper constraint (high number of servings per week) for a food, food group, or food subgroup is determined by taking the 90th percentile of the consumption of the food/food group/food subgroup for the target population.

Problem nutrient: A nutrient whose requirement will be difficult to achieve given the local food supply and food intake patterns.

Recommended nutrient intake (RNI): The RNI is the daily amount of a nutrient that will likely ensure that the needs of nearly all individuals in the target group (97.5 percent) are met.

Executive Summary

Introduction

At least 165 million children under 5 years are stunted globally. Stunted children are at increased risk of morbidity and mortality and impaired cognitive ability. Cumulatively, over the long term this reduces human capital and economic productivity at the national level (Black et al. 2013; Mendez and Adair 1999; Miller et al. 2015; Grantham-McGregor et al. 2007; Hoddinott et al. 2008; Maluccio et al. 2009). The period from pregnancy through the first two years of life (known as the first 1,000 days) is a critical window of opportunity to prevent stunting (Victora et al. 2010; Martorell et al. 1994). The promotion of appropriate complementary feeding has been identified as one of the most effective strategies for reducing stunting and the associated burden of disease (Bhutta et al. 2008). To support age-appropriate complementary feeding, locally developed food-based dietary recommendations can help ensure and promote diet adequacy for young children. The World Health Organization (WHO) recommends that food-based recommendations (FBRs) be locally developed and tested, and subsequently used in social and behavior change communication to promote the consumption of nutrient-dense, diverse, locally available foods to the extent possible, and promote the use of supplements only if necessary to address critical nutrient gaps (WHO 2008).

To develop FBRs, a tool known as Optifood can be used (WHO et al. 2014). Optifood analyzes the dietary patterns of target groups (such as children under two years) and the costs of local foods to identify the lowest-cost combination of foods that will meet or come as close as possible to meeting the nutrient needs of each specific group. Developing FBRs using Optifood involves collecting 24-hour dietary recall and food frequency data among target groups located in specific regions or agro-ecological areas, when relevant secondary dietary recall and food frequency data is not available. The collection, preparation, and analysis of primary dietary data to develop the inputs for Optifood analysis can take a great deal of time and human and financial resources, can be time-consuming and invasive for participants, and is subject to measurement error (Fiedler 2009). Alternative sources for dietary data, including surveys that are routinely conducted and are representative at the subnational level, which could serve as a proxy for primary data, would reduce time and costs needed for the development of the inputs for use in Optifood. One type of routinely conducted survey used to collect data on food consumption that is often representative at the subnational level and could potentially serve as a proxy for primary data is the Household Consumption and Expenditure Survey (HCES).

Steps in the Development of Final FBRs

Final, validated FBRs are developed through a process that includes collecting dietary data or using secondary data sources to develop inputs for the Optifood tool, completing the analysis in Optifood to develop pilot FBRs, validating the pilot FBRs through testing at the household level, e.g. through Trials of Improved Practices (TIPs), and adjusting the FBRs based on the results of the TIPs trials and further analysis in Optifood. Optifood is used to develop pilot FBRs in the first two steps in the process. Time and resources must be dedicated to test pilot Optifood FBRs with the target population at the field level for acceptability, feasibility, and ultimately, adoption of these improved dietary practices. In this report, the comparative analysis between the Optifood inputs and results obtained using HCES data and the primary 24-hour recall and food frequency data collected by FANTA and partners in Guatemala in 2012 applies to and informs an alternative approach to undertaking steps 1 and 2. Importantly, if secondary data can be used for steps 1 and 2, all the subsequent steps (steps 3–5) would still need to be completed to arrive at a set of FBRs that are adopted at the community level.

Step 1
Collect dietary data and/or adapt secondary data to develop model parameters in Optifood

Step 2
Complete analysis in Optifood for development of pilot FBRs

Step 3
Validate pilot FBRs through testing at the household level, e.g. using trials of improved practices (TIPs), and adapt as needed

Step 4
Review results with local key stakeholders and make final adjustments to FBRs

Paso 5
Develop and implement SBCC strategy to promote final FBRs*

[a] SBCC = social and behavior change communication

This report presents the results of a study to test and compare Optifood inputs and outputs developed through secondary analysis of HCES data from the 2011 Guatemala Encuesta Nacional de Condiciones de Vida (national living conditions survey, INE 2011) with inputs and outputs developed using primary data from a 2012 Optifood study that included 24-hour recall and food frequency data, which was conducted by the Food and Nutrition Technical Assistance III Project (FANTA) in collaboration with the Institute of Nutrition of Central America and Panama (INCAP) and the London School of Hygiene and Tropical Medicine (LSHTM) and funded by the U.S. Agency for International Development (USAID)/Guatemala. The two datasets included the same target groups—children 6–24 months and pregnant and lactating women—from the same departments, Huehuetenango and Quiché, but did not include the same households. This comparative analysis was conducted to determine the feasibility of using HCES data to create proxy values to enter in Optifood to generate pilot FBRs.[1] However, regardless of whether primary or secondary data are used, the pilot FBRs developed using Optifood need to be tested at the household level—for example, using Trials of Improved Practices (TIPs)—and working directly with and within communities in the specific regions or agro-ecological zones to assess and validate their acceptability and

[1] Pilot FBRs are initial FBRs developed using Optifood that require testing with members of target groups in their households at the community level to determine FBR acceptability, feasibility, and potential for adoption. After validation of pilot FBRs, the validation results are reviewed with key local stakeholders, and as needed, the FBRs are adjusted, further analyzed in Optifood, and finalized.

feasibility, since the objective is a tailored set of FBRs that can be adopted by vulnerable families to improve their diets.[2]

Methods

To compare the feasibility of using HCES survey data as a proxy for primary 24-hour recall and food frequency data, a subset of data was extracted from the 2011 Guatemala HCES that represented target groups comparable to those included in the primary data from the 2012 FANTA Optifood study. The data selected from the HCES included households in rural areas in the departments of Huehuetenango and Quiché with a breastfed child age 6–8 months (n = 38), 9–11 months (n = 35), or 12–23 months (n = 91); or a non-breastfed child 12–23 months (n = 26); and/or a pregnant (n = 69) or lactating woman (n = 166). The data from the 2012 FANTA Optifood study (primary 24-hour recall and food frequency data) included breastfed children 6–8 months (n = 110), 9–11 months (n = 82), and 12–23 months (n = 141); non-breastfed children 12–23 months (n = 48); and pregnant women (n = 68) and lactating women (n = 79), also from rural areas of Huehuetenango and Quiché. To develop the inputs for Optifood from the secondary data, individual apparent consumption was estimated by using the Food and Agricultural Organization (FAO) adult male equivalent (AME) method, which apportions household apparent consumption by caloric need expressed as a proportion of an adult male's energy requirement. For children 6–23 months, breast milk intake for the HCES Optifood analysis was estimated by using the recommended percentage of energy intake from breast milk consumption for each relevant target group, as suggested by Dewey and Brown (Brown et al. 1998; Dewey and Brown 2003), and recommended energy intake from the Institute of Nutrition of Central America and Panama (INCAP 2012a). Food lists were derived from the closed questionnaire lists of foods reportedly purchased or produced by HCES households, and final lists were reviewed by a group of experts in Guatemala. Inputs and results from the secondary analysis of HCES data in Optifood were compared with inputs and results from the analysis of the primary 2012 FANTA Optifood study data.

Results

The results of developing Optifood inputs using the 2011 Guatemala HCES (secondary) data and the outputs (modeled diets) in Optifood using these inputs were compared to the corresponding input and output results from the 2012 FANTA Optifood study that used 24-hour recall and food frequency (primary) data. Optifood inputs, including the food lists, serving sizes, and servings per week for food groups and food subgroups (FSGs) using secondary and primary data are compared below, followed by a comparison of Optifood outputs using the two datasets.

Optifood Inputs

Foods available for modeling, serving sizes, and servings per week (model constraints).[3] There was a greater variety of both **foods and food subgroups available for Optifood modeling** using the HCES data compared to the primary 24-hour recall and food frequency data, likely because the apparent consumption data are from a 14-day recall period as opposed to one day for the 24-hour diet recall; and the secondary data collection took place over six months, reflecting seasonal variation in food availability. The results for **portion sizes** indicate that the secondary data, using the proxy data serving sizes, provided

[2] Testing at the household level means working with members of the target group, for example, pregnant women, lactating women, or caregivers of individuals in a target group, such as mothers of children 6–8, 9–11, or 12–23 months of age, in their households, to determine if Optifood-generated FBRs are feasible and acceptable. The TIPs methodology can be used to evaluate whether Optifood-generated FBRs are feasible and acceptable by exploring intention to use and use of FBRs as well as identifying barriers to putting them into practice and motivations for their use (Daelmans et al. 2013; Dickin et al. 1997; Lutter et al. 2013; PAHO 2013).

[3] For the definition of the model constraints please see the glossary of terms in Appendix 1.

reasonably good estimates of serving sizes for foods that tend to be relatively less expensive and more commonly consumed, such as Incaparina (a fortified blended flour, FBF),[4] beans, eggs, and green leafy vegetables (GLV), but may have overestimated consumption of foods that are relatively more expensive and less commonly consumed, or foods that are purchased/acquired less frequently, such as fresh milk, powdered milk, organ meat, red meat, or processed meat, particularly for young children, and in some cases for pregnant women and lactating women. Secondary data proxy values might also have underestimated serving sizes for foods such as fruits and other vegetables and whole grain products, for which there may be a greater variety represented in secondary data compared to the primary data. The **model constraints for servings per week** were relatively comparable between the secondary and primary data. In many cases, the secondary data allowed for equal or greater flexibility in modeling, given higher upper constraints. In some cases, the lower constraints for some food groups using the primary data were zero, which allows the Optifood tool the option of not including the food group in the model, while the lower constraints in the secondary data target groups for the same foods were 7 or 14 servings per week, for which Optifood would include, at a minimum, daily consumption (7) or and twice-daily consumption (14). The results demonstrate the importance of testing the validity of pilot FBRs, including foods available for consumption by target groups within a household, portion sizes, and recommended servings per week, in a local context to verify the local diet, understand the local challenges, and address any problems that may prevent adoption of improved recommended dietary practices.

Optifood Outputs

Best diets, problem nutrients,[5] and best food sources for nutrients were similar between the secondary and primary data. Across both sets of analyses, diets were often optimized with legumes and meat, poultry, and eggs (MPE), although with fewer servings of MPE in the secondary data compared to the primary data, perhaps due to less costly and more nutrient-dense options to model in the secondary data. The problem nutrients identified with Optifood using the secondary and primary data were the same for the youngest target group of children 6–8 months, but differed slighty for older children and pregnant women, with Optifood not identifying any problem nutrients for these groups using the secondary data. In contrast, using the primary data, Optifood identified one partial problem nutrient[6] (PPN) for children 9–11 months (zinc), one PPN for breastfed children 12–23 months (iron), and two PPNs (folate and zinc) and one absolute problem nutrient (APN)[7] (iron) for pregnant women. These slight differences are likely due to the greater availability of nutrient-dense foods for modeling using the secondary data. Despite these differences, the similarities in the problem nutrients, especially for young children, are very promising. Comparing the results using the secondary and primary data, Optifood identified over one-half of the same best food sources for each nutrient, and for iron and folate, the foods selected were all, or nearly all, the same. Given that pilot food-based recommendations developed with Optifood need to be tested at the household level, the results presented here indicate that the Optifood outputs from the secondary data would provide a solid basis for the development of pilot FBRs for household-level testing.

Pilot food-based recommendations without micronutrient supplements. A comparison of the pilot FBRs for children without micronutrient supplementation showed that they were similar across the target groups for the two datasets, and both included Incaparina; beans; meat, poultry and eggs; and maize.

[4] Incaparina is a fortified corn- and soy-based flour commercially produced in Guatemala by Alimentos S.A. It is fortified with iron, zinc, calcium, thiamin, riboflavin, niacin, folic acid, vitamin A, and vitamin B12.
[5] Problem nutrients, as defined in Optifood, are nutrients for which dietary requirements would be difficult to meet based on availability and/or access to local food sources and existing diet intake patterns.
[6] A partial problem nutrient is a nutrient for which adequacy was attainable using local foods in some combination, but this would probably compromise the intake of other nutrients.
[7] An absolute problem nutrient is a nutrient for which requirements could not be met using local foods within the set model parameters and for which micronutrient supplements or fortified foods would likely be needed.

However, the frequency of consumption of some secondary data FBRs appears somewhat high and would require scrutiny during household-level testing (e.g., consumption of eggs and beans daily) (FANTA 2015). Based on the INCAP Daily Dietary Recommendations (INCAP 2012), the FBRs derived from the secondary data would require micronutrient supplementation for children 6–8 months of age to meet iron needs, while the FBRs from the primary data would require micronutrient supplementation to meet the needs for iron and zinc of this age group, and the nutrient needs of other child target groups (9–11 and 12–23 months) would be met through the diet for both datasets.

For the FBRs for pregnant and lactating women (PLW) without micronutrient supplementation, there were also similarities across the target groups for the two datasets, and both included Incaparina, beans, liver, and maize. However, feasibility of the recommended frequency of consumption of Incaparina and beans using the secondary data would require testing at the household level given that the frequency appears relatively high, requiring daily consumption. The FBRs developed using the secondary data would not require micronutrient supplementation for PLW to meet nutrient needs, while the FBRs developed using the primary data would require micronutrient supplementation for pregnant women to meet iron needs.

Pilot food-based recommendations with micronutrient supplements. A comparison between the final Optifood FBRs with micronutrient supplementation developed for each target group using the secondary and primary data demonstrated that the results were highly comparable. Both datasets produced FBRs that met requirements for modeled nutrients if micronutrient supplements were provided. Both sets of FBRs recommended Incaparina, beans, and maize for all child target groups, and GLV for breastfed and non-breastfed children 12–23 months. In the case of the FBR for maize for breastfed children 12–23 months, the secondary data FBR may be more feasible than the primary data FBR (25 grams 2x/day vs. 25 grams 4x/day). However, the secondary data FBR for daily Incaparina intake for breastfed children 9–11 and 12–23 months and twice-daily intake for non-breastfed children 12–23 months, as well as daily dairy consumption for non-breastfed children 12–23 months, will require special attention during testing at the household level to ensure their feasibility, as prior feasibility trials found economic constraints limited family access to purchased FBF such as Incaparina and animal-source foods (FANTA 2015).

The FBRs for PLW using the secondary and the primary data both recommended Incaparina, liver, and maize. The secondary data FBRs include beans for PLW, which is reasonable, but the recommended frequency for pregnant women is daily, which will require attention during household-level testing, as prior feasibility testing results demonstrated constraints to daily bean consumption, including cost, difficulties in production (drought), and dietary preferences (FANTA 2015). The FBRs for pregnant women developed using the primary data did not include a recommendation for bean consumption, perhaps because the diet was optimized using more nutrient-dense foods, such as liver and Incaparina, while a greater variety of nutrient-dense foods in the food list used for the secondary data may have allowed for including a bean FBR. The secondary data FBR for GLV consumption may be very practical given a prior FANTA study that validated the feasibility and acceptability of the primary data at the household level and found families could easily produce or forage for GLV throughout the year. As with child FBRs, the secondary data dairy FBR and twice-daily Incaparina FBR for PLW will need testing at the household level to determine their feasibility given potential cost constaints. Although costs may appear feasible, families in the previous FANTA study shared that food items must be purchased for the entire family to consume, and family sizes are large, so feasibility of FBR implementation may be limited (FANTA 2015).

Final pilot FBRs. Table ES-1 shows the final pilot FBRs developed using the primary (2012 FANTA Optifood study) data and the secondary (2011 Guatemala HCES) data with micronutrient supplementation, and cost in Guatemala quetzales (GTQ) per target group member per day for families to comply with the FBRs. Key differences between the FBRs are highlighted in bold and outlined in Table ES-2. Both sets of FBRs with micronutrient supplementation meet nutrient needs. A critical next step would be testing their feasibility and acceptability at the household level, including the recommended foods, serving sizes, and frequency of consumption.

Table ES-1. Final Pilot FBRs with Micronutrient Supplementation (Entries in bold represent differences between the FBRs from the two datasets)

Target Group	FBRs: Primary Data—2012 FANTA Optifood Study	Cost (GTQ/Day)	FBRs: Secondary Data—2011 Guatemala HCES	Cost (GTQ/Day)
Infants 6–8 months, breastfed	1. Breastfeed on demand 2. Eat Incaparina 3 times per week, serving size 20 g 3. Eat beans 3 times per week, serving size 25 g 4. Eat maize products 2 times per day, serving size 20 g **5. Eat potatoes 3 times per week, serving size 55 g** **6. Eat eggs 3 times per week, serving size 25 g**	1.2	1. Breastfeed on demand 2. Eat Incaparina 4 times per week, serving size 10 g 3. Eat beans 4 times per week, serving size 17 g 4. Eat maize products 2 times per day, serving size 20 g **5. Eat green leafy vegetables every day, serving size 9.6 g**	0.8
Infants 9–11 months, breastfed	1. Breastfeed on demand **2. Eat Incaparina 3 times per week, serving size 20 g** 3. Eat beans 3 times per week, serving size 25 g 4. Eat maize products 2 times per day, serving size 25 g **5. Eat potatoes 3 times per week, serving size 60 g** **6. Eat eggs 3 times per week, serving size 20 g**	1.5	1. Breastfeed on demand **2. Eat Incaparina every day, serving size 15 g** 3. Eat beans 4 times per week, serving size 26 g 4. Eat maize products 2 times per day, serving size 20 g **5. Eat green leafy vegetables 4 times a week, serving size 18 g**	1.1
Infants 12–23 months, breastfed	1. Breastfeed on demand **2. Eat Incaparina 4 times per week, serving size 30 g** 3. Eat beans 4 times per week, serving size 30 g **4. Eat maize products 4 times per day, serving size 25 g** **5. Eat potatoes 4 times per week, serving size 60 g** **6. Eat eggs 4 times per week, serving size 50 g** 7. Eat green leafy vegetables 4 times per week, serving size 30 g	2.5	1. Breastfeed on demand **2. Eat Incaparina every day, serving size 19 g** 3. Eat beans 4 times per week, serving size 45 g **4. Eat maize products 2 times per day, serving size 25 g** 5. Eat green leafy vegetables 4 times per week, serving size 38 g	2.0
Infants 12–23 months, non-breastfed	**1. Eat Incaparina 5 times per week, serving size 30 g** 2. Eat beans 4 times per week, serving size 60 g **3. Eat maize products 4 times per day, serving size 50 g** **4. Eat potatoes 4 times per week, serving size 75 g** **5. Eat eggs 5 times per week, serving size 50 g** 6. Eat green leafy vegetables 4 times per week, serving size 30 g	3.5	**1. Eat Incaparina 2 times per day, serving size 20 g** 2. Eat beans 5 times per week, serving size 49 g **3. Eat maize products 2 times per day, serving size 30 g** 4. Eat green leafy vegetables 5 times per week, serving size 37 g **5. Eat dairy foods every day, serving size 30 g**	4.9
Lactating women	**1. Eat Incaparina every day, serving size 30 g** 2. Eat maize products 3 times per day, serving size 150 g 3. Eat liver once per week, serving size 90 g **4. Eat vegetables 4 times per day, serving size 85 g** **5. Eat potatoes every day, serving size 170 g** 6. Eat oranges 3 times per week, serving size 205 g	10	**1. Eat Incaparina 2 times per day, serving size 25 g** 2. Eat maize products 3 times per day, serving size 87 g 3. Eat liver once per week, serving size 25 g **4. Eat green leafy vegetables every day, serving sie 79 g** **5. Eat beans 4 times per week, serving size 96 g** **6. Eat dairy foods 4 times per week, serving size 25 g** 7. Eat vitamin C rich fruit 4 times per week, serving size 75 g	11.6
Pregnant women	**1. Eat Incaparina every day, serving size 25 g** **2. Eat maize products 4 times per day, serving size 150 g** 3. Eat liver once per week, serving size 90 g **4. Eat vegetables 4 times per day, serving size 85 g** **5. Eat potatoes every day, serving size 120 g** 6. Eat oranges 3 times per week, serving size 205 g	11.3	**1. Eat Incaparina 2 times per day, serving size 25 g** **2. Eat maize products 3 times per day, serving size 87 g** 3. Eat liver once per week, serving size 78 g **4. Eat green leafy vegetables every day, serving size 77 g** **5. Eat beans every day, serving size 98 g** **6. Eat dairy foods 4 times per week, serving size 25 g** 7. Eat vitamin C–rich fruit 4 times per week, serving size 75 g	12.9

Table ES-2. Key Differences between FBRs with Micronutrient Supplementation for Each Target Group for the Primary and Secondary Datasets

Target Group	Differences in FBRs	
	FBRs: Primary Data—2012 FANTA Optifood Study	**FBRs: Secondary Data—2011 Guatemala HCES**
Infants 6–8 months, breastfed	Potatoes and eggs 3 times per week	Green leafy vegetables once per day
Infants 9–11 months, breastfed	Incaparina 3 times per week Potatoes and eggs 3 times per week	Incaparina once per day Green leafy vegetables 4 times per week
Infants 12–23 months, breastfed	Incaparina 4 times per week Maize 4 times per day Potatoes and eggs 4 times per week	Incaparina once per day Maize 2 times per day
Infants 12–23 months, non-breastfed	Incaparina 5 times per week Maize 4 times per day Potatoes and eggs 4–5 times per week	Incaparina 2 times per day Maize 2 times per day Dairy foods once per day
Lactating women	Incaparina once per day Vegetables 4 times per day Potatoes once per day	Incaparina 2 times per day Green leafy vegetables once per day Beans and dairy foods 4 times per week
Pregnant women	Incaparina once per day Maize 4 times per day Vegetables 4 times per day Potatoes once per day	Incaparina 2 times per day Maize 3 times per day Green leafy vegetables once per day Beans once per day Dairy foods 4 times per week

Implications and Key Considerations

This study has demonstrated that HCES data may serve as an adequate proxy to 24-hour dietary recall and food frequency data for use in Optifood for the development of pilot FBRs. However, there are several implications and key considerations to be drawn from the study results.

- Assumptions applied when using HCES data must be clearly defined—for example, regarding intrahousehold food distribution, household use of food during the recall period and other food previously acquired or stored, and estimates of breast milk intake for young children. If feasible, it is important to validate key assumptions by triangulation with relevant secondary data or, if secondary is not available, with primary data collected on a small scale using qualitative methods. Validation of assumptions may help determine if adjustments to input data for Optifood may be needed to better reflect local realities.
- Estimates of breast milk intake from international data available in the literature, based on average percentage of recommended energy intake derived from breast milk, may be the preferred approach for estimating breast milk intake for use in Optifood given limited country-specific data on volume of breast milk intake by child age (Brown, Dewey, and Allen 1998; PAHO and WHO 2004).
- The Optifood tool was designed to be used to develop FBRs at a subnational level, given that there are generally different food intake patterns and varied food supply in different regions of a country (Daelmans et al. 2013). One inherent advantage of HCES data is that the data are representative at the subnational level. The Optifood analysis with HCES data should also be conducted separately per region. It would not be appropriate to develop one set of pilot FBRs for a country as a whole using HCES data on a national level.

- All pilot FBRs developed with Optifood must be validated through qualitative household-level testing working with and within communities directly to determine their feasibility and acceptability.

Conclusions

The analysis presented here suggests that it is possible to use HCES data as a proxy or alternative to primary data, when the data allow for estimation of individual-level apparent consumption, to generate inputs for Optifood analysis and develop pilot food-based recommendations for optimizing diets of key target groups using locally available foods. These results are promising, indicating that primary data collection may not always be necessary for use of Optifood. Optifood may be used to develop pilot FBRs with existing HCES datasets at a lower cost and within a comparatively shorter time frame than when its use involves primary data collection. This activity found additional and unexpected advantages of using HCES data, including greater food list variety and the enhanced ability to model FBRs at the subgroup level. Still, confidence in pilot FBRs developed with HCES data may be limited by the assumption that intrahousehold food distribution is equitable and by the need to access other secondary data to estimate and/or validate typical serving sizes. Further analyses are needed to: validate these findings in other contexts; explore possible methods to adjust AMEs to better reflect local realities; and test the application of HCES data in Optifood for other target groups, such as adolescent girls. The results have implications for improving nutrition program planning and evaluation through the development of pilot food-based recommendations based on HCES data for validation through household-level testing, and incorporation into nutrition program design and implementation for vulnerable target populations. Results could also potentially influence the design of future HCES data collection to facilitate data use in Optifood.

1 Introduction

Globally, stunting affects at least 165 million children under 5 (Black et al. 2013). Stunted children are at an increased risk of mortality and infections, and once they reach adulthood, may be more likely to develop chronic diseases (Black et al. 2013; MSPAS et al. 2017). Stunting is also associated with impaired cognitive ability in children as well as poor school performance, which at an aggregate level, results in reduced human capital and economic productivity (Mendez and Adair 1999; Miller et al. 2015; Grantham-McGregor et al. 2007; Hoddinott et al. 2008; Maluccio et al. 2009). The economic impact of chronic malnutrition is significant. Follow-up studies of a randomized controlled nutrition intervention trial conducted in Guatemala during the 1960s–1970s showed that improved nutrition by age 3, but not after age 3, had long-term positive effects on education and wages (Dewey and Begum 2011; Victora et al. 2008).

Research evidence shows that the period from pregnancy through the first 2 years of life (known as the first 1,000 days) is a critical window of opportunity to prevent stunting, as after a child’s second birthday it becomes increasingly difficult to reverse growth faltering (Victora et al. 2010; Martorell et al. 1994). Children are most vulnerable to stunting during the period of 6–11 months of age (Shrimpton et al. 2001), when exclusive breastfeeding is no longer enough to meet nutrient requirements and complementary feeding begins. The promotion of appropriate complementary feeding has been identified as one of the most effective strategies for reducing stunting and the associated burden of disease (Bhutta et al. 2008). Improving infant and young child feeding (IYCF) includes continued breastfeeding and adequate frequency of feeding complementary foods; responsive feeding; food hygiene and handwashing practices; and quantity, quality, and variety of foods offered in the diet overall and of each meal.

In addition to the set of IYCF practices, the World Health Organization (WHO) recommends that food-based recommendations (FBRs) be locally developed and tested, and used in social and behavior change communication (SBCC) to promote the consumption of nutrient-dense, diverse locally available foods to the extent possible, and to promote the use of supplements only if necessary to address critical nutrient gaps (WHO 2008). FBRs are recommendations targeting a specific group to promote consumption of specific foods or food groups, and can also include the recommended frequency of consumption of the foods or food groups in a 1-day or 1-week period (FAO and WHO 2001). The nature of stunting and the pattern of onset strongly suggest that improving maternal nutrition in addition to IYCF practices, along with hygiene and sanitation practices, could significantly reduce the prevalence of stunting (Black et al. 2013).

FBRs can be developed using a tool called Optifood. Optifood analyzes the actual dietary patterns of target groups and the costs of local foods to identify the lowest-cost combination of local foods that will meet or come as close as possible to meeting the nutrient needs of each specific group. Optifood can also be used to identify “problem nutrients,” nutrients for which dietary requirements would be difficult to meet based on locally available foods and diet intake patterns; identify local foods that are good sources for specific nutrients; analyze diet costs; and compare and test different FBRs or interventions. Optifood was developed by WHO in collaboration with the London School of Hygiene and Tropical Medicine (LSHTM), the Food and Nutrition Technical Assistance Project (FANTA), and Blue-Infinity, an information technology company.

Developing FBRs using Optifood, however, involves collecting dietary data using 24-hour dietary recalls and food frequency questionnaires among target population groups located in specific regions or agro-ecological areas, when relevant secondary dietary recall and food frequency data is not available. The dietary data are used to develop data inputs for analysis in Optifood to develop a pilot set of FBRs, which are then validated through testing at the household level—for example, using Trials of Improved Practices (TIPs).[8] The pilot FBRs are modified as needed taking into consideration the results of the household testing, reviewed with local stakeholders to make final adjustments, and integrated into a social and behavior change communication strategy that is implemented to promote the adoption of optimal dietary practices in the target group.

The Optifood Tool

The Optifood tool is a computer software program that analyzes the quality and content of local diets and facilitates the development of evidence-based, population-specific recommendations for improving nutrient intake. Optifood uses a linear programming approach to simultaneously consider numerous parameters, including the dietary patterns and nutrient requirements of specific target groups as well as local food availability, costs, and nutrient content. Based on this analysis, Optifood can identify "problem nutrients" (nutrients that will be difficult to acquire in sufficient quantities using locally-available foods within acceptable amounts) and the best local food sources of such nutrients. It can also analyze diet costs as well as compare and test various food-based recommendations (FBRs) and interventions. In addition, Optifood can be used to analyze the potential impact, in terms of nutrient provision, of adding new foods to the local diet, and test potential FBRs around these new foods to improve nutrient adequacy.

However, the collection of primary dietary data to develop the inputs for Optifood analysis can take a great deal of time and resources (financial and human) from researchers, can be time consuming and invasive for participants, and is subject to measurement error (Fiedler 2009). Dietary data must be collected for each specific target group in each region or agro-ecological area that may have distinct food intake patterns. Target groups may include, for example, infants 6–8 months and infants 9–11 months, given their different stages in complementary food intake, as well as children 12–23 months, and pregnant and lactating women (PLW). A total of 50–100 24-hour dietary recalls and food frequency questionnaires would need to be conducted with each target group in each distinct region or area where FBRs are being developed. Although a potential source of rich information, the collection of new data for an Optifood analysis is not always feasible.

Although the Optifood tool has received broad acceptance within the nutrition community and raised interest among development actors, the significant cost, time, and effort involved in gathering the necessary data inputs have limited its broader use. In addition, 24-hour recalls, although considered the "gold standard" for estimating food and nutrient intake, are not routinely conducted in developing countries, meaning that few representative secondary 24-hour recall datasets exist (Neufield and Tolentino 2013). The time and funds needed for primary data collection for Optifood and the scarcity of secondary 24-hour recall data have motivated researchers to look at possible alternative sources for the dietary data, including surveys that are routinely conducted and representative at the subnational level, to

[8] Pilot FBRs are initial FBRs developed using Optifood that require testing at the household level. Testing at the household level means working with members of the target group, for example, pregnant women, lactating women, or caregivers of individuals in a target group, such as mothers of children 6–8, 9–11, or 12–23 months of age, in their households, to determine if Optifood-generated FBRs are feasible and acceptable. The TIPs methodology can be used to evaluate whether Optifood-generated FBRs are feasible and acceptable by exploring intention to use and use of FBRs as well as identifying barriers to putting them into practice and motivations for their use (Daelmans et al. 2013; Dickin et al. 1997; Lutter et al. 2013; PAHO 2013).

reduce the time and costs for developing the inputs for use in Optifood. Existing datasets would need to include data that represent current dietary patterns in the target group of interest, which may include recent data collected within the past 1–2 years; alternatively, older data from the past 3–5 years could be used if they remain relevant and reflect dietary patterns.

There is a type of routinely conducted survey used to collect data on food consumption that is often representative at the subnational level and/or by population strata—the Household Consumption and Expenditure Survey (HCES). By 2012, there were 116 low- and middle-income countries that had conducted an HCES (Fiedler et al. 2012b). These surveys are usually conducted every 3–5 years. The survey includes the collection of data on household-level food consumption and expenditures. If the data from the HCES could be used to develop inputs for Optifood analysis, this would most likely result in significant savings in time and costs needed in developing pilot FBRs.

A method of validating the use of secondary data such as HCES data as an input for Optifood would be to compare whether these data generate Optifood inputs similar to those developed using primary 24-hour recall and food frequency data for the same target group. The next step would be to determine whether the Optifood analysis using these inputs identifies similar nutrient gaps and food-based nutrient sources and generates food-based recommendations that are comparable to those made using the primary 24-hour recall and food frequency data.

To test the possibility of using secondary survey data as a proxy for primary 24-hour dietary recall and food frequency data, FANTA carried out a study using an existing publicly accessible HCES dataset for Guatemala, the 2011 Guatemala Encuesta Nacional de Condiciones de Vida (ENCOVI), or national living conditions survey, and published results from a 2012 FANTA Optifood study that involved collection of primary 24-hour dietary recall and food frequency data in Guatemala. The 2012 FANTA Optifood study data were collected in the departments of Huehuetenango and Quiché. The 2011 Guatemala HCES survey was conducted throughout Guatemala and provided data at a regional and departmental level (INE 2011), and also included representative subnational data for Huehuetenango and Quiché, making a comparison using the two datasets possible.[9]

Specifically, the HCES data from the departments of Huehuetenango and Quiché were used to develop inputs for analysis in Optifood for children 6–8, 9–11, and 12–23 months, and for PLW. The data inputs for Optifood using the HCES dataset, as well as the results of the analysis of the data inputs in Optifood, which included identification of problem nutrients, best food sources of nutrients, and resulting pilot FBRs, were compared to the published results from the 2012 FANTA Optifood study (FANTA 2014).

The purpose of this report is to present the results of this comparative analysis to determine the feasibility of using HCES data to create proxy values to enter in Optifood to generate pilot FBRs. The intended audience for the report includes researchers, program designers, and program managers who wish to use Optifood to develop FBRs and test them to improve nutrient intake. The analysis presented in this report is important because if alternative secondary data sources that already exist and are collected on a regular basis can be used to develop data inputs for Optifood, it may be possible to develop pilot FBRs at the subnational level and/or among population strata at the subnational level more quickly and with lower costs compared to development of pilot FBRs that depend on primary data collected for every target population in each subnational area.

This report provides a description of the background and context for the analysis that was conducted, the aims and objectives of the analysis, the methods used to adjust and use HCES data in Optifood; it also

[9] The 2011 Guatemala HCES datasets are available at: http://www.ine.gob.gt/index.php/encuestas-de-hogares-y-personas/condiciones-de-vida.

provides the results of the Optifood analysis using the HCES data, including a comparison with Optifood results using primary data collected with 24-hour dietary recall and food frequency questionnaires among the same target groups in the same region for children 6–24 months and PLW.[10] The report also includes a discussion of the results, assumptions, and limitations of using secondary data as an alternate source of inputs for Optifood, as well as implications of the results and recommendations for further work using alternative secondary data sources for analysis in Optifood.

[10] It is important to note that the two datasets do not represent the same households in the population, although data being compared are from the same target groups (defined by age, sex, and biological state) in the same regions.

2 Background and Context for the Study

The study presented in this report provides the results of an analysis in Optifood using secondary data from routinely collected surveys—specifically, the HCES, to develop inputs for Optifood—and looks at the resulting Optifood outputs, which include pilot FBRs, an analysis of problem nutrients, local food sources for key nutrients, and cost of a diet that meets or come as close as possible to meeting nutrient needs in specific target groups. If the Optifood results using HCES data are comparable to the results from primary data using 24-hour dietary recalls and food frequency questionnaires among similar target groups in the same regions, this will indicate that it may be feasible to use HCES data to develop Optifood inputs, rather than collecting primary dietary data. This would allow for developing localized FBRs more rapidly and at lower cost than when primary data need to be collected. To provide background for this study, this section of the report provides an overview of 1) Optifood, what it is, what it does, and the data needs for an Optifood analysis; 2) background on the original 2012 FANTA study in Guatemala that used 24-hour dietary recall and food frequency data for analysis in Optifood to develop pilot FBRs, and a description of key nutrition indicators for Guatemala; 3) HCES, what the survey consists of and its limitations; 4) background on the original 2011 HCES conducted in Guatemala, which was used as the alternative secondary data source for the development of Optifood inputs for this study; 5) how individual food intake data can be approximated based on the concept of adult male equivalents (AMEs), the importance and evidence for AME use with HCES data, and its relevance for analyses in Optifood; and 6) a comparison of key characteristics of the data collected in the 2012 FANTA Optifood study in Guatemala and the 2011 Guatemala HCES.

2.1 Optifood

Optifood was created to optimize local diets and improve dietary intake in contexts where achieving an adequate diet is challenging. The tool is used to estimate gaps in nutrient intake from diets based on locally available and commonly consumed foods; identify optimal combinations of local foods to fill, or come as close as possible to filling, these gaps; estimate the relative cost of optimal diets; and use results to elaborate realistic and cost-effective FBRs for target groups that can then be supported by nutrition programs. These results can further be used to inform a range of nutrition-specific and nutrition-sensitive interventions aimed at improving nutrient diversity and intake such as agriculture programs, social assistance programs, food fortification, and micronutrient supplementation. Optifood is not designed to assess if the diet of specific target populations is adequate. Rather, Optifood is used to optimize diets and show what could be achieved if certain recommendations were adopted in a local diet.

Figure 1 shows the process for development of final, validated FBRs. The use of Optifood to develop pilot FBRs is one step in the process. Time and resources must be dedicated to test pilot Optifood FBRs with the target population at the field level for acceptability, feasibility, and ultimately, adoption of these improved dietary practices. As such, in this report the comparative analysis between the HCES data and the primary Optifood study applies to and informs an alternative approach to undertaking steps 1 and 2. Importantly, if HCES data can be used for steps 1 and 2, all the subsequent steps (steps 3-5) would still need to be completed to arrive at a set of FBRs that are adopted at the community level.

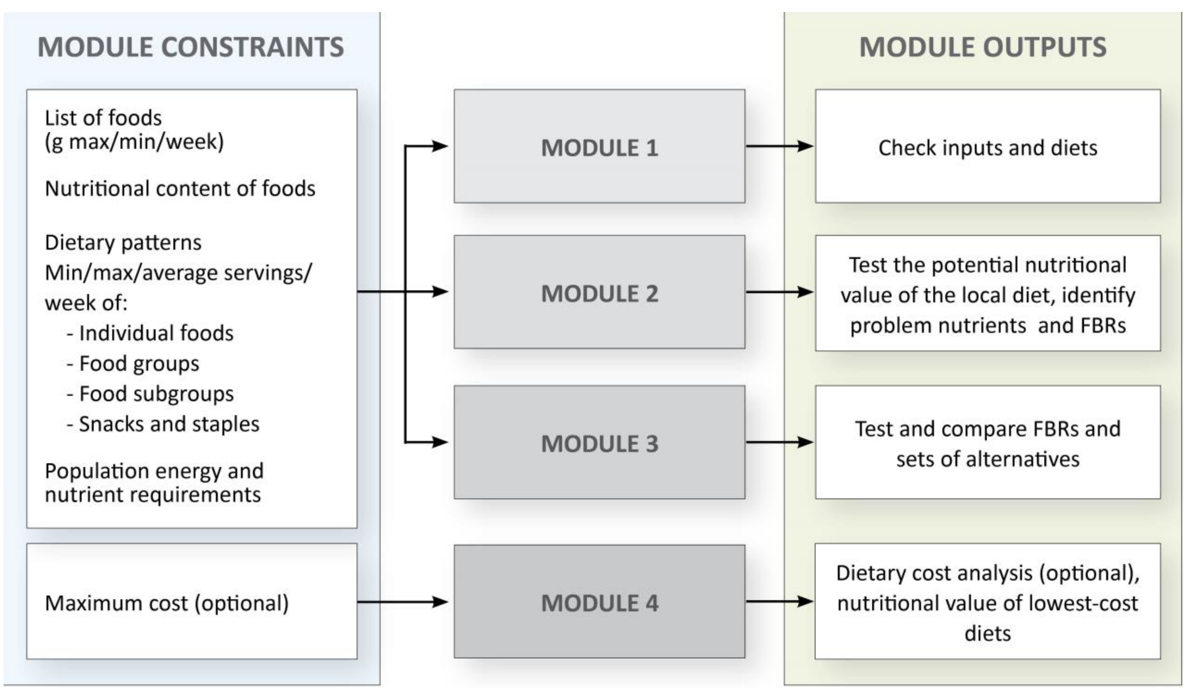
Figure 1. Steps in Development of Final FBRs

Step 1	Step 2	Step 3	Step 4	Step 5
Collect dietary data and/or adapt secondary data to develop model parameters in Optifood	Complete analysis in Optifood for development of pilot FBRs	Validate pilot FBRs through testing at the household level, e.g. using Trials of Improved Practices (TIPs), and adapt as needed	Review results with local key stakeholders and make final adjustments to FBRs	Develop and implement SBCC strategy to promote final FBRs

Thirteen key nutrients are considered by the Optifood analysis: total fat, total protein, iron, zinc, calcium, vitamin A, vitamin C, thiamin, riboflavin, niacin, vitamin B6, folate, and vitamin B12. Some important nutrients in the diet cannot yet be analyzed in Optifood due to a lack of adequate food composition table (FCT) data or because exact requirements have not yet been established. These include selenium, iodine, biotin, vitamins K and D, essential fatty acids, and protein quality.

Figure 2 describes the data used by Optifood to set the model parameters and Optifood's four modules of data analysis. Data used to develop pilot FBRs include actual dietary patterns and portions consumed by the target population, reference values for recommended nutrient intakes (RNIs), and costs of foods consumed by the target population, if the cost module, which is optional, is used. The first Optifood analysis module checks that the model parameters are realistic. The second module identifies the diet that would meet or come as close as possible to meeting nutrient needs, within the model parameters, as well as the best possible diet regardless of these parameters. This module is also used to identify problem nutrients and food sources of problem nutrients, for drafting FBRs. The third module is used to test and compare alternative FBRs, taking into consideration current practices, nutrient needs, and cost, if cost is included in the analysis. Last, a cost analysis may be used (Module 4) to identify the lowest-cost diet that meets or comes as close as possible to meeting nutrient needs. A more detailed description of each Optifood module can be found in Appendix 1.

Figure 2. The Four Modules of the Optifood Analysis



Optifood requires data inputs related to local dietary patterns and food supply to model diets to identify problem nutrients, key food sources, and to develop pilot FBRs. In addition, data are needed on the nutrient composition of foods the regularly consumed by the population and on the nutritional requirements of the target group studied (Daelmans et al. 2013). These inputs are entered to set up the model parameters for linear programming analyses using Optifood.[11] A list of required data and standard sources for the data is provided in Table 1.

Table 1. Data Requirements and Use, and Primary Data Sources (Standard) for Dietary Analysis and FBR Development Using Optifood

Required Data in Optifood	Why These Data Are Needed and How They Are Used by Optifood	Primary Data Source and Sample Size (Where Relevant)
Age and physiological state (pregnant, breastfeeding, etc.) of individuals in dataset	To determine nutrient requirements	Survey instrument used during data collection to record whether women are pregnant or lactating and whether children are receiving breast milk (50–100 cases per target group)
Child's age in months	To estimate breast milk intake and expected nutrient contributions from breast milk	Survey instrument used during data collection to record age (in months) for children and/or date of birth (50–100 cases per target group)
List of all foods consumed by at least 5–10% of the target population	To identify potential foods for FBRs	Single 24-hour dietary recall (50–100 cases per target group)
Median serving size of foods consumed	To determine serving size for FBRs	Single 24-hour dietary recall (50–100 cases per target group)
Maximum and minimum consumption frequencies for individual foods	To develop constraints (ranges for frequency of consumption of foods) for analysis in Optifood	24-hour recall data or food frequency questionnaire (50–100 cases per target group)
90th, 50th, and 10th percentile of consumption of food groups and food subgroups	To develop constraints (ranges for frequency of consumption of food groups and food subgroups) for analysis in Optifood	24-hour recall data (50–100 cases per target group
Mean price of edible 100 g of each food in the food list used in Optifood	To determine the cost of a diet that meets, or comes as close as possible to meeting, nutrient requirements	Market survey of study area
RNIs for target group for the 11 modeled nutrients[a]	To be able to determine nutrients whose recommended intakes can be met with optimized diets	WHO/FAO/UNU[b] RNIs, which are preloaded into Optifood, or location-specific RNIs, which would need to be added in Optifood
Median weight and physical	To determine energy	Anthropometric survey of study

[11] All linear programming analyses are conducted in Optifood using Matlab (2013) (The MathWorks, Inc., Natick, MA).

activity level (PAL) (where relevant) of target group OR standard energy requirements for target population	requirements	population and relevant secondary data (50–100 cases per target group)
Nutrition composition (for the 11 modeled nutrients[a]) of each food consumed by target group in 24-hour recall	To determine nutrients provided by each food	Locally relevant food composition data from U.S. Department of Agriculture, Harvest Plus, or other institutions

[a] Calcium, vitamin C, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin A, vitamin B12, iron, and zinc.
[b] Food and Agriculture Organization of the United Nations (FAO), WHO, and United Nations University (UNU).

The target population for which dietary data are collected may include individuals of a defined age (e.g., infants 6–11 months) and/or physiological status (e.g., PLW) residing in a specified geographical area and/or agro-ecological zone with distinct food intake patterns. At present, it is recommended that these data inputs be derived from one 24-hour recall and a food frequency questionnaire from approximately 50–100 individuals in each target group; anthropometric measures from these individuals,[12] specifically, average weight of each target group for the determination of energy and protein requirements[13]; and market surveys in the population of interest if the cost module is to be applied (Singh et al. 2013).[14] To date, these data have been collected through surveys of separate, randomized samples of the diverse segments of a population by age/sex/physiological groups of interest (infants 6–8 months, pregnant women, etc.) and through market surveys (to estimate food prices) at the location of interest (Daelmans et al. 2013; FANTA 2014; Kloppeborg et al. 2013; Santika et al. 2009). The data inputs for Optifood must be collected for each target group in each distinct geographic area or agro-ecological zone; given differences in dietary patterns may result in different food-based recommendations for each group in each area. These parameters provide a platform for testing the possibility of maximizing nutrient content and identifying best food sources and problem nutrients, leading to the development and testing of pilot FBRs that would be further validated using qualitative methods before they are promoted.

Optifood uses mathematical optimization to select the best possible outcome—the nutritionally best diet for each target group—from a list of all possible outcomes given the set model parameters (food list, dietary patterns, energy and nutrient requirements, etc.) and constraints (minimum and maximum frequencies of consumption of individual foods, food groups, and food subgroups (FSGs), upper energy limits, and maximum cost) (see Figure 3). This analysis is used to identify problem nutrients (nutrients for which the requirements are difficult to meet using local diets); select the lowest-cost nutritionally best diet; and formulate and test FBRs to improve diets. The model constraints used to ensure that diets selected in Optifood are realistic are summarized in Table 2.

[12] Anthropometric data, specifically, average body weight for each target group from the target population, may also be used from secondary data sources as a proxy for primary data on anthropometry.
[13] If energy and protein requirements for each target group are available, they can be entered directly into Optifood instead of determing energy and protein requirements from average weight of the target group. For example, estimates of energy and protein requirements used in the 2012 FANTA Optifood study were from INCAP's 2012 daily dietary recommendations.
[14] Ideally, the 24-hour recall would be accompanied by a 7-day food frequency questionnaire, but if food frequency data are not collected, it is possible to conduct additional analyses of the 24-hour recall data to estimate frequency of food intake to use as a proxy value in Optifood (see Skau et al. 2014; Vossennar et al. 2016).

Figure 3. Example of Optimization Process Conducted Using Optifood

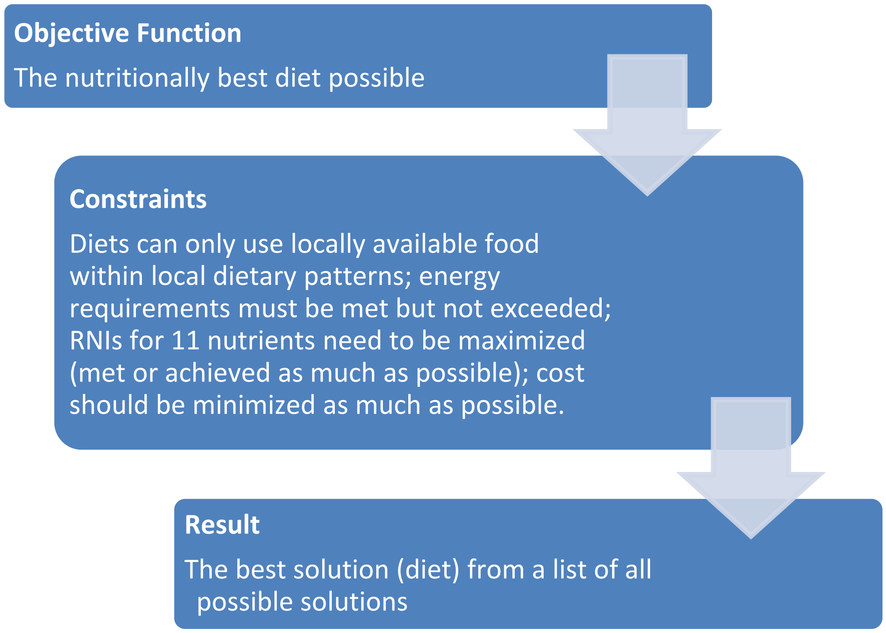


Table 2. Model Constraints for a 7-Day Diet Applied in an Optifood Analysis to Ensure That Only Realistic Diets Are Generated[a]

Constraint	Summary Description
Energy content	Energy content of a 7-day diet must equal the average 7-day energy requirement for the target group.
Individual food items	The number of servings of an individual food item included in the 7-day diet is ≤ maximum number of servings per week for that food item and ≥ minimum number of servings per week for that food item.
Food group patterns	In all diets throughout all modules, the sum of servings of food items from each food group must equal the *average* number of servings for food items from that food group, as determined by the intake data. In the “no food pattern” diet in Module 2, the sum of servings of food items from each food group is ≤ the high number of servings per week for that group and ≥ the low number of servings.
Food subgroup patterns	In all diets, the sum of servings of food items from each FSG is ≤ the maximum number of servings per week for that FSG and ≥ the minimum number of servings.
Cost (optional)	If used, the cost of the 7-day diet will not exceed a specified amount in the local currency.

[a]Aside from the “no food pattern diet” (Module 2: Diet B) constraints, the constraints above are applied to all four Optifood modules.

Optifood contains preloaded values of FAO/WHO RNIs for male and female infants, children, adolescents, adults and older adults of various ages, and PLW, but local RNIs can be used in Optifood. Optifood also contains a preloaded FCT, but the nutrient composition of additional foods can be used in the Optifood program.[15] Data are entered and analyzed separately for each target group in Optifood. Population information is set for each group in each area of geographic location, including mean weight, physical activity level (PAL) if applicable, average age, and RNI source. A corresponding food list (see example in Appendix 5 developed from the 2011 Guatemala HCES data) is then imported, and model parameters for food groups and FSGs are entered manually. Three different levels of iron RNI and two levels for zinc RNI can be selected as a proxy for phytate content of the diet and iron and zinc absorption, with higher requirements when aborption is lower, depending on the type of diets consumed by the population.

Limitations of the use of the 24-hour dietary recall method to collect dietary data for use in Optifood include that it is based on one dietary recall per participant per target group, which may result in a limited variety of foods for use in analysis in Optifood (FANTA 2014). In addition, the collection of 24-hour dietary recall data during one season of the year may not capture seasonal variation in food availability and access. The method is costly, time-consuming, and requires well-trained staff for both fieldwork and data processing. Further, due mostly to cost and time restrictions, data are usually collected only from the minimum sample necessary for an Optifood analysis, meaning that data collection is largely limited to a narrow geographical area and sample size (FANTA 2014).

2.1.1 Background on the 2012 FANTA Optifood Study in Guatemala

Guatemala has the sixth-highest prevalence of stunting among children under 5 in the world, and in the Western Highland departments of Huehuetenango and Quiché, as many as 7 of 10 children under 5 are stunted (UNICEF 2016; MSPAS et al. 2017). Anemia and iron deficiency are also problems in Guatemala. The 2014-2015 Guatemala National Maternal and Child Health Survey showed that in the Western Highland departments of Huehuetenango and Quiché, 35 percent (n=981) and 28 percent (n=878) of children 6–59 months of age suffered from anemia, respectively, while among pregnant women, 18 percent (n=138) in Huehuetenango and 22 percent (n=94) in Quiché had anemia (MSPAS et al. 2017). According to 2011 nutrition surveillance data collected in the Western Highlands, iron deficiency affected 32 percent of children 6–11 months (n=29), 28 percent of children 12–23 months (n=64), and 32 percent of pregnant women (n=30) (INCAP 2012b).[16] Iron deficiency anemia in young children increases the risk of infectious disease and can impair cognitive development and limit achievement in school, while in pregnancy it is associated with maternal and neonatal deaths and is a major cause of low birth weight (WHO 2016, Black et al. 2013; WHO 2001, and Grantham-McGregor et al. 1999). Zinc deficiency affects over one-third of children 6–59 months in Guatemala, and is associated with poor child growth and increased risk of infection and mortality (MSPAS 2010a). Vitamin B12 and folate deficiency among women may also be common, especially among the poorest in the population, increasing the risk of fetal nueral tube defects and pregnancy complications (MSPAS 2010a; Black et al. 2013; Finkelstein et al. 2015).

In response to this poor nutrition situation, USAID/Guatemala requested FANTA's assistance to identify strategies to improve the nutritional quality of the diet in the Western Highlands for PLW and children 6–23 months of age based on locally available foods. In partnership with the Institute of Nutrition of Central America and Panama (Instituto de Nutrición de Centro América y Panamá, INCAP) and the LSHTM,

[15] Although this report focuses on the use of Optifood for young children and PLW, Optifood can be used to conduct analyses for any target group for which input data and RNIs exist.

[16] Data was collected in five Western Highlands departments: San Marcos, Quetzaltenango, Totonicapán, Huehuetenango, and Quiché. Iron deficiency anemia was measured through serum ferritin. Data represents results among individuals without indicators of inflammation above specified limits, given inflammation can increase levels of serum ferritin (WHO 2007). Iron deficiency among both those with and without inflammation was 22 percent (n=43) among children 6-11 months of age; 27 percent (n=82) among children 12-23 months of age; and 32 percent (n=48) among pregnant women.

FANTA initiated an activity to use Optifood to identify a set of evidence-based, population-specific FBRs for these target populations.

To establish the dietary patterns of the target groups, data were collected using a cross-sectional survey of randomly selected children 6–11 months of age (n = 202) and children 12–23 months of age (n = 190), pregnant women (n = 75), and lactating women (n = 80), across 40 rural communities in the departments of Huehuetenango and Quiché between July and September 2012. A 24-hour dietary recall tool that included a question on food frequency for each food mentioned in the recall was used to collect information on foods commonly consumed by the target populations, serving sizes, and consumption patterns[17]; an anthropometric survey of study participants was conducted to determine nutritional status and calculate energy and protein requirements of the population in Optifood; and a market price instrument was used to collect data on the local names for foods, local costs, seasonality, and availability of food. The assumptions in the use of the 24-hour dietary recall and food frequency method included 1) no or minimal bias exists in the 24-hour recall data regarding accuracy of recall; 2) food patterns remain relatively static over a 7-day period for every individual; and 3) overestimation errors are balanced by underestimation errors at the population level.

Prior to entering the data into Optifood, the dietary patterns of children 6–8 months of age and children 9–11 months of age were compared and found to be significantly different. The original target group of children 6–11 months of age was split into two groups (6–8 months and 9–11 months). In addition, almost all the children 6–11 months of age were breastfeeding, so those who were not breastfeeding were excluded from the analysis. The dietary pattern of children 12–23 months of age who were not breastfeeding was also found to be different than children of the same age who were breastfeeding, so this age group was split into breastfed and non-breastfed children 12–23 months of age. For breastfed children, determination of energy intake from breast milk was estimated as the median estimated energy requirements minus the median energy intakes from complementary foods for each breastfed target group.

Because the children were separated into age groupings, the sample size for each age group was very small for each department. To obtain sufficient data to define the model parameters, it was necessary to combine data for the two departments. Before combining the departments, the dietary patterns of the target groups across the two departments were compared. The most commonly consumed foods were very similar for all the target groups; there were no region-specific foods. Therefore, it was assumed that FBRs developed using Optifood could be applicable to both departments. The first set of FBRs developed with Optifood for children 6–23 months of age and PLW can be found in the Tables 3 and 4. Further details regarding the study can be found in the study report (FANTA 2014).

[17] Fieldwork was conducted from Monday through Saturday to ensure representation of normal weekdays and market days (FANTA 2014).

Table 3. Optifood FBRs for Children 6–23 Months of Age in Guatemala (with Micronutrient Supplementation/Multiple Micronutrient Powder)[a]

Food	Frequency per Week	Servings per Day	Estimated Serving Size (g)[b]	Total Quantity per Day (g)
In combination with other foods, breastfed children 6–8 months should consume at a minimum:				
Tortilla or other maize products	7	2	20	40
Potatoes	3	1	55	55
Beans	3	1	25	25
Eggs	3	1	25	25
FBF as porridge[c]	3	1	20	20
Meat, poultry, or fish[d]	7	1	20	20
In combination with other foods, breastfed children 9–11 months should consume at a minimum:				
Food	**Frequency per Week**	**Servings per Day**	**Estimated Serving Size (g)[b]**	**Total Quantity per Day (g)**
Tortilla or other maize products	7	2	25	50
Potatoes	3	1	60	60
Beans	3	1	25	25
Eggs	3	1	30	30
FBF as porridge[c]	3	1	20	20
Meat, poultry, or fish[d]	7	1	30	30
In combination with other foods, breastfed children 12–23 months should consume at a minimum:				
Food	**Frequency per Week**	**Servings per Day**	**Estimated Serving Size (g)[b]**	**Total Quantity per Day (g)**
Tortilla or other maize products	7	4	25	100
Potatoes	4	1	60	60
Beans	4	1	30	30
Eggs	4	1	50	50
GLVs	4	1	30	30
FBF as porridge[c]	4	1	30	30
Meat, poultry, or fish[d]	7	1	35	35
In combination with other foods, non-breastfed children 12–23 months should consume at a minimum:				
Food	**Frequency per Week**	**Servings per Day**	**Estimated Serving Size (g)[b]**	**Total Quantity per Day (g)**
Tortilla or other maize products	7	4	50	200
Potatoes	4	1	75	75
Beans	4	1	60	60
Eggs	5	1	50	50

GLVs	4	1	30	30
FBF as porridge[c]	5	1	30	30
Meat, poultry, or fish[d]	7	1	40	40

[a] FANTA 2014. Supplement content and dosage is based on Ministry of Health and Social Assistance (MSPAS) 2004.

[b] Estimated serving sizes are based on the dietary data collected in Huehuetenango and Quiché.

[c] The fortified blended flour (FBF) should have similar micronutrient content to Incaparina.

[d] This recommendation is not necessary to meet micronutrient requirements if a multiple micronutrient powder is consumed. However, the recommendation is included because WHO recommends that children 6–23 months of age consume meat, poultry, fish, or eggs daily, or if daily consumption is not feasible, as frequently as possible.

Table 4. Optifood FBRs for Pregnant and Lactating Women in Guatemala (with Micronutrient Supplementation)[a]

In combination with other foods, pregnant women should consume at a minimum:				
Food	**Frequency per Week**	**Servings per Day**	**Estimated Serving Size (g)[b]**	**Total Quantity per Day (g)**
Fortified cereal[c]	7	1	25	25
Vegetables	7	4	85	340
Potatoes	7	1	120	120
Liver[d]	1	1	90	90
In combination with other foods, lactating women should consume at a minimum:				
Food	**Frequency per Week**	**Servings per Day**	**Estimated Serving Size (g)[b]**	**Total Quantity per Day (g)**
Fortified cereal[c]	7	1	30	30
Vegetables	7	4	80	320
Potatoes	7	1	170	170
Liver[d]	1	1	90	90
Oranges[e]	3	1	205	205

[a] FANTA 2014. Supplement content and dosage is based on MSPAS 2004.

[b] Estimated serving sizes are based on the dietary data collected in Huehuetenango and Quiché.

[c] The fortified cereal should have similar micronutrient content to Incaparina.

[d] Liver is included in the FBRs so that PLW can meet vitamin B12 requirements.

[e] Oranges could be replaced with another fruit or vegetable with high vitamin C content.

2.2 Household Consumption and Expenditures Survey

The most common types of HCES are Household Income and Expenditure Surveys (HIES), Living Standards Measurement Studies (LSMS), and National Household Budget Surveys (NHBS). While there is no current standard for HCES, efforts are being made to standardize HCES data collection to allow for greater comparability of data between and within countries (Fiedler et al. 2012b). HCES include collection of data on household-level food consumption and expenditures that are generally representative at the subnational (regional or state) level and/or population strata, such as wealth quintiles, ethnic groups, and urban and rural, and are usually based on a 7- or 14-day recall of food acquired in the household—

that is, purchased, produced, or provided to the household as a gift. Respondents are asked questions about purchase, production, or receipt of foods from a defined food list. HCES often also include collection of information on household composition, housing characteristics, income, assets, wealth, livelihoods, and individual-level data such as age, sex, and education. In most countries, the HCES is conducted every 3–5 years (Fiedler et al. 2012b). HCES food consumption data are often referred to as "apparent consumption" because consumption is estimated based on available food within a household that is assumed to have been consumed by the household in a defined period, for example, 7 days or 14 days, as determined by household data on food acquired through purchase, home production, gift, donation or barter during the same period (Weissel and Dop 2012, Fiedler et al. 2012a, Fiedler et al. 2013, and Coates et al. 2017). HCES surveys also collect data on income and wealth, and although it may be feasible to analyze data by wealth quintiles in a specific region, in some regions the sample sizes may be too small to produce meaningful results.

Limitations to the use of HCES data include recall bias with the 7-day or 14-day recall of food use; variations in the level of detail in food lists used, which can affect specificity in terms of nutrient analysis (e.g., general "bean" versus different kinds of beans that can have very different nutrient contents); over- or underestimation of consumption due to various factors, as noted above, such as not considering wastage or spoilage, or foods eaten outside the home; and the use of nonstandard quantities such as "bunch," "heap," or "handful," which can influence estimates of apparent consumption (Fiedler et al. 2012b). Another limitation in the use of HCES data is the assumption that foods are available to all family members within a household, when this may not be the case. As researchers consider the possible use of HCES data for various purposes, it will be increasingly important to consider the impact of these types of limitations on apparent consumption and consider ways to overcome limitations that have any significant impact on apparent consumption estimates.

2.2.1 Background on the 2011 HCES in Guatemala

The 2011 HCES for Guatemala was a household income and expenditure survey, one of several types of HCES noted above. The 2011 HCES survey included a 14-day recall using a closed food list to collect data on income and consumption. The survey questionnaire was used to collect household-level data on purchase, local production, and cost of food, drink, tobacco, and other products. The data were used to estimate apparent consumption. Respondents were read a list of predefined items and for each item were asked if it was purchased in the past 12 months with the intent to consume it in the home, the number of months during which it was purchased, the amount of money spent per month on the item, and the quantity purchased and amount spent on the item in the past 14 days. Respondents were also asked if at any time during the past 12 months the item was produced in the home or obtained without having to purchase it, the number of months during which this was the case, the monthly amount normally obtained in this way, the amount obtained in this way in the past 14 days, and the usual source of the item (e.g., own production, gift or donation, part of a payment, from a business, or via barter).

Data were also collected on pregnancy status of women in the household and breastfeeding status of children. The lactation status of women in the household was not collected. Data were also not collected on whether food produced or purchased was sold, bartered, wasted, or fed to animals. Anthropometric data of individual household members were not collected. Food cost data were estimated by the family member responding to the survey, so the data are not considered a good reference for food costs. Appendix 2 provides a comparison of some of the general information that most HCES surveys may include, and what the 2011 Guatemala HCES survey included that may be relevant for Optifood analysis. Further information regarding the 2011 Guatemala HCES survey can be found in the survey report (INE 2011).

2.3 Adult Male Equivalent: Application with HCES Data, Evidence for Use with HCES Data, and Relevance for Use with HCES Data in Optifood

HCES do not contain information about how food that is apparently consumed by the household is distributed among its members (Fiedler et al 2012b). To develop individual-level estimates of apparent consumption from HCES data that could be used in Optifood requires additional information and/or assumptions about intrahousehold food distribution. One way in which individual apparent consumption estimates may be derived from HCES data is by assuming the distribution of food within the household is in direct proportion to individual household members' share of the household's total energy requirement (i.e., biological need), as captured in the Food and Agricultural Organization of the United Nations (FAO) adult male equivalents (AMEs) for consumption, and assuming a specific physical activity level (Fiedler et al. 2012b).

Internationally, there is growing interest in the utility of household-level consumption data for approximating food intake and identifying nutrient inadequacies of population strata and, hopefully, individual target groups within a population (Bermudez et al. 2014; Dary 2014; Jariseta et al. 2012; Sununtnasuk 2014). Several studies have applied AME units to household-level consumption data to estimate individual target group consumption (Jariseta et al. 2012; Sununtnasuk 2014). AMEs are the ratio of the energy requirement of an individual household member to the requirements of an adult male from the same population (Bermudez et al. 2014). Using this method, the estimated food intake per AME is calculated by dividing the total amount of food available for household consumption by the total AME of each household, calculated by combining the proportion of AME of each individual household member (Smith and Subandoro 2007; Weisell and Dop 2012). This approach is considered as providing better estimates than the traditional per capita intake, as the latter does not take into consideration the different energy expenditures of each member of the family.

Comparisons of analyses conducted with both 24-hour recall and household consumption data using the AME approach in Uganda and Bangladesh suggest that HCES-based estimates can be a relatively good proxy for individual recall data for some target groups and some nutrients (Jariseta et al. 2012; Sununtnasuk 2014). The study in Uganda compared 2006 HCES data representative at the subnational level and 2008 data collected from a single-day 24-hour recall food consumption survey for women of reproductive age and children 24–59 months of age. The 2008 survey was conducted in three regions of Uganda, the Central region, represented by Kampala urban city, and the Southwestern and Northern regions, representing rural areas of the country. HCES data were analyzed from households also located in Kampala urban city and in the Southwestern and Northern regions of Uganda so that the data being compared between the HCES and the 24-hour recall survey were from the same geographic areas. The data collection period for both surveys coincided with food aid program distribution in northern Uganda. (Jariseta et al. 2012). The FAO AME unit method was used to adjust the HCES estimated household intakes in terms of adult equivalent for determining the dietary intake for women of reproductive age and for children 24–59 months of age. The adjusted values were then used to make comparisons with the results of the 24-hour recall for both target populations. The nutrient content per 2,000 kcal of edible portion of each consumed food was calculated. No significant differences were found between the nutrient content determined from the HCES versus the 24-hour dietary recall for protein, fat, fiber, iron, thiamin, riboflavin, and vitamin B6 intakes, while the HCES overestimated intakes of vitamins C and B12 and underestimated intakes of vitamin A, folate, niacin, calcium, and zinc in at least one of the groups.

The study in Bangladesh included an analysis of the 2011–2012 Bangladesh Integrated Household Survey, which included a single 24-hour dietary recall applied to all household members in the nationally representative sample of Bangladeshi households and a 7-day household-level consumption recall. The researchers directly compared individual intakes as reported in the 24-hour dietary recall to the individual intakes calculated using AMEs and the 7-day consumption data. Estimates of energy and nutrient intake, particularly iron and zinc, were comparable for Bangladeshi adolescents and adults. However, there were notable differences in the estimated energy and nutrient intakes for infants and young children in the Bangladeshi study (Sununtnasuk 2014), as for this group the contribution of breast milk is important. The comparison of 7-day HCES recall and 24-hour recall data in Bangladesh suggested that HCES data may overestimate consumption and intrahousehold distribution of foods, particularly for children under 3 years of age, and that, therefore, it is not accurate, particularly for young children (Sununtnasuk 2014).

In nearly all settings, Optifood has been used to develop FBRs for the complementary feeding period (children 6–23 months), while PLW have been analyzed in only a few settings. As seen from the results above, a recognized drawback to using AMEs to convert household-level apparent consumption data is the tendency for nutrient consumption for young children to be overestimated (Dary 2014; Jariseta et al. 2012; Sununtnasuk 2014). A possible explanation is that the redistribution of household consumption does not take energy obtained from breastfeeding into account. Infant household members may be assigned more food than they would be able to consume if they were also receiving energy and nutrients from breast milk. Allowing for energy intake from breastfeeding when calculating AMEs for infants could lead to more realistic redistributed food amounts for this target group. The study presented in this report determines AMEs for young children considering energy from breastfeeding. More details regarding this can be found in the Methods section below.

2.4 Comparison of Key Characteristics of the 2012 FANTA Optifood Study and 2011 HCES in Guatemala

Details of key characteristics of the two data sources, the 2012 Optifood study and the 2011 HCES, used for this activity are provided in Table 5. Further description of datasets and variables used to generate inputs for the Optifood analysis follows in the Methods section of this report.

Table 5. Comparison between the Optifood 2012 and the HCES Survey 2011 Datasets

Description	2012 FANTA Optifood Study	2011 HCES Survey
Dates of data collection	July–September 2012 (rainy season)	March–August 2011 (dry and rainy seasons)
Area of data collection	Huehuetenango and Quiché departments in the Western Highlands	22 departments, including Huehuetenango and Quiché as single representative strata
Sample size	547, including 392 caregivers of children 6–23 months, 75 pregnant women, and 80 lactating women in 40 rural communities across 9 municipalities in Huehuetenango and Quiché	13,531 households from 1,200 geographic sectors nationally Of these, 425 households from Huehuetenango or Quiché included a child 6–23 months or a pregnant or lactating woman, including approximately 381 children 6-23 months, 68 pregnant women, and 79 lactating women.
Representative	No	Yes (nationally and by department and/or population strata)
Purpose of study	To collect data on local dietary patterns and food costs for analysis in Optifood to create FBRs for children 6–23 months and PLW	To calculate the level of poverty in Guatemala using the human poverty index and compare to data collected in 2000 and 2006
Data collection methods of interest	Cross-sectional survey including anthropometric measurements and 24-hour dietary recall with food frequency for children 6–11 months (n = 202) and 12–23	2-week household recall of foods purchased and produced by household (from a list of 116 food items)

	months (n = 190), pregnant women (n = 75), and lactating women (n = 80) and market surveys	
Data format	Report showing Optifood inputs (serving sizes, food lists) and outputs (problem nutrients, nutrient sources, FBRs, and cost analysis)	De-identified, clean dataset
Access	Report publicly accessible from FANTA website; data accessible upon request to USAID/Guatemala	Data publicly accessible from the Guatemala National Institute of Statistics (Instituto Nacional de Estadística [INE]) website

3 Aims and Objectives

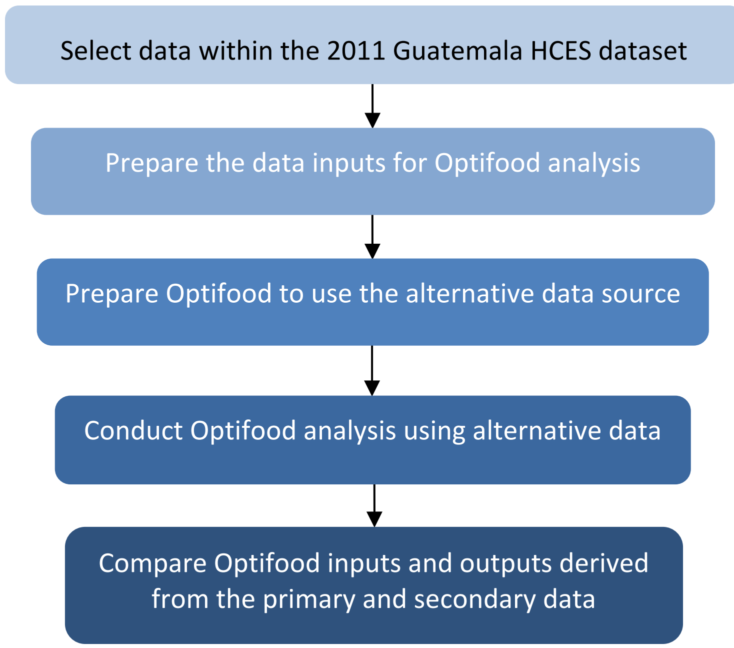
The overall aim of this activity was to test and validate the use of household consumption and expenditure data to develop inputs for use in Optifood. Specifically, the objectives of this activity were to:

- Outline the process for use of household-level apparent consumption data for analysis in Optifood
- Prepare HCES data from young children and PLW in the Western Highlands of Guatemala (Huehuetenango and Quiché) to be entered into Optifood for analysis
- Compare the data inputs and Optifood outputs from the HCES data with inputs and outputs from an analysis in Optifood using primary 24-hour dietary recall and food frequency data collected in the same target groups and geographic area
- Provide recommendations on the possible secondary analysis of HCES data to prepare Optifood inputs and generate Optifood outputs to develop pilot FBRs

4 Methods

Figure 4 shows the steps that were taken to conduct the analysis to compare Optifood inputs and outputs using primary 24-hour recall data collected through the 2012 FANTA Optifood study (primary data) and secondary data from the 2011 Guatemala HCES. Each step is briefly described below. Table 9 in section 4.8 summarizes the assumptions used in each step.

Figure 4. Steps in the Analysis to Compare Optifood Inputs and Outputs Derived from Primary and Secondary Data Sources



4.1 Data Selection within the 2011 Guatemala HCES Dataset

The 2011 Guatemala HCES dataset contained data from 458 households in the department of Huehuetenango and 507 households in the department of Quiché. Urban and rural households containing 3–13 members of varying age, sex, biological status (pregnant, breastfeeding, non-pregnant/ breastfeeding) were included in the dataset. The subset of data from the 2011 Guatemala HCES that was extracted for use to develop the inputs for Optifood consisted of those households from rural areas in Huehuetenango and Quiché who had a child age 6–23 months, and/or a pregnant woman or a lactating woman. The final number of households for each target group that were included in the analysis appears in Table 6, which also provides the final sample size used for the 2012 FANTA Optifood study.

Table 6. Number of Eligible Households from the 2011 Guatemala HCES Dataset Used in Optifood Analysis and Sample Size from the 2012 FANTA Optifood 2012 Study

	2011 Guatemala HCES Dataset			2012 FANTA Optifood Study Dataset		
Target group	Huehuetenango	Quiché	Total	Huehuetenango	Quiché	Total
6–8 months[a]	18	20	38	60	50	110
9–11 months[a]	16	19	35	35	47	82
12–23 months breastfed (BF)	40	51	91	70	71	141
12–23 months non-breastfed (NBF)	11	15	26	27	21	48
Pregnant women	36	33	69	38	30	68
Lactating women	71	95	166	38	41	79
TOTAL	192	233	425	268	260	528

[a] For the 2011 Guatemala HCES dataset, infants 6–8 months and 9–11 months were assumed to be breastfeeding. For the 2012 FANTA Optifood Study, infants in these age ranges included in the dataset were breastfeeding.

4.2 Preparation of 2011 Guatemala HCES Data Inputs for Optifood Analysis

To prepare the 2011 Guatemala HCES data for input into Optifood, three primary steps were taken. The first step was the estimation of individual apparent consumption of food for pregnant women, lactating women, and children 6–8, 9–11, and 12–23 months of age in each household, and then determining the median consumption for each target group. The second step was estimation of breast milk intake for infants and young children. The third step was preparing the list of foods consumed for each target group. Each step is briefly discussed below.

4.2.1 Estimation of Individual-Level Apparent Consumption and Median Consumption for Each Target Group

To estimate individual-level apparent consumption using the 2011 Guatemala HCES data, each food available at the household level was redistributed using the FAO AME method. This method assumes that food is distributed within households in a way that is directly proportional to the energy requirements of each individual in the household (Weisell and Dop 2012). The AME was calculated for all groups based on the INCAP daily energy requirements for each group (INCAP 2012a), divided by the energy requirement for an adult Guatemalan male 30–59 years of age. The AMEs of breastfed children 6–8, 9–11, and 12–23 months of age were calculated by subtracting the recommended amounts of energy from breastfeeding per target group from the energy requirements for that group, leaving only the requirement of energy from complementary foods. Each individual within the dataset was sorted into an AME group and assigned a corresponding AME based on age (determined from date of birth in the dataset), sex, pregnancy or lactation status of women, or breastfeeding status of infants and young children. Women's lactation status was not recorded in the HCES dataset, but for AME determination, was estimated based on the presence of a breastfeeding child in the household. Specifically, in households with a breastfeeding child, a woman 15–40 years of age in the same household was classified as lactating if she was not pregnant and identified herself as the household head or was listed as the household head's spouse. Appendix 3 shows the final AMEs calculated for each target group by age and sex and gives an example of the calculation to determine the amount of food consumed by an individual household member using AMEs. The 2011 Guatemala HCES dataset provides the amount of each food "available" for consumption by each participating household over a 14-day period, so the calculated quantity of food for each person was the amount of food available for their consumption over 14 days. This total amount was divided by 14 to obtain the daily consumption, referred to as “apparent consumption.”

A total household AME was calculated for each household in the dataset by summing the AMEs of all household members. An AME quotient was calculated for each household member by dividing the individual AME by the household AME. The quantity of each food item consumed (apparent consumption) by each household member was estimated by multiplying the total quantity of each food available in the household by the AME quotient for the household member. Next, the median amount of each item consumed per target group was calculated for the six target groups (pregnant women, lactating women, breastfed children 6–8, 9–11, and 12–23 months, and non-breastfed children 12–23 months). The median amount of each food item consumed for each target group is entered in Optifood for analysis.

4.2.2 Estimation of Breast Milk Intake

Breast milk intake was not assessed in the 2011 Guatemala HCES. For analysis in Optifood, breast milk intake was estimated by converting the recommended percentage of energy intake from breast milk consumption relevant to each target group, as suggested by Dewey and Brown (Brown et al. 1998; Dewey and Brown 2003). This method has been used to estimate breast milk intake for Optifood analysis using 24-hour recall data in Kenya and other settings (Briend et al. 2003; Ferguson et al. 2006; Ferguson et al. 2008; Vitta and Dewey 2012; Vossenaar et al. 2016). A summary of the percentage of energy intake from breast milk for breastfed infants by target age group is provided in Table 7.

Table 7. Percentage of Energy Intake from Breast Milk for Breastfed Infants by Target Age Group

	6–8 Months	9–11 Months	12–23 Months
Recommended estimated amount of energy provided by breast milk (as a percentage of total energy requirement of infant/child)[a]	67%	55%	39%

[a] Brown et al. 1998; Dewey and Brown 2003.

The estimated energy intake from breast milk and corresponding amount of breast milk consumption per day are shown in Appendix 4. The estimated energy requirements per target group were derived from the INCAP recommendations (INCAP 2012a). The energy content of breast milk used in these calculations was 0.66 kcal/g (Brown et al. 1998).

4.2.3 Preparation of Food Lists for Input into Optifood

The 2011 Guatemala HCES dataset included all foods from the closed questionnaire food list that were reportedly purchased or produced by study households. This means that in addition to commonly consumed foods, several foods that were rare and only available to a few households in the population appeared in the food list; and there may have been food items on the list that were not consumed by young children and PLW. To model diets that were realistic, only those foods that were usually accessed by each target group and nutrient-rich foods that could be promoted as FBRs were selected for the final food list for analysis in Optifood.

The item “breast milk” was added to the food lists derived from the 2011 Guatemala HCES data for all breastfed child target groups.[18] The list of foods for each target group was reviewed by a group of experts in Guatemala and based on their recommendation, the following were removed[19]:

- Non-food items (e.g., cigarettes)
- Items consumed by less than 5 percent of the households that included target group members (very uncommon foods), as per standard practice with Optifood (FANTA 2014)
- Items with no nutritional value (e.g., water, tea, condiment foods such as salt)
- Items not likely to be consumed by children or PLW (e.g., alcoholic beverages) or specific target groups (e.g., potato chips for children 6–8 months)[20]

The final food list for each target group can be found in Appendix 5.

4.3 Preparing Optifood for Analysis with 2011 Guatemala HCES Data

To prepare Optifood for analysis with the 2011 Guatemala HCES data, seven steps were needed: 1) estimating portion sizes for individual food items; 2) determining minimum and maximum consumption limits for each food; 3) determining model constraints for food groups and FSGs; 4) classifying food items as starchy staples or snacks; 5) determining cost of individual food items; 6) identifying nutrient requirement values to be used; and 7) identifying food composition data to be used in the Optifood analyses. Each step is briefly described below.

4.3.1 Estimation of Portion Sizes for Individual Food Items

The portion size for each item in a food list that is entered in Optifood represents the median amount of food consumed by the target group—for example, children or women, during one meal (g/meal). Portion sizes are used to set model parameters in Optifood and to provide the quantity of food for FBRs. The use of reference portion sizes for individual foods or FSGs depends on the availability of secondary data.

To determine the portion size for each food item for each target group for the Optifood analysis with the 2011 Guatemala HCES data, reference portions for foods or FSGs were obtained from available secondary data by referring to two 24-hour recall datasets covering the same target groups from the Western Highlands department of Quetzaltenango (Vossenaar 2014), which is similar to the two departments used for the 2012 FANTA Optifood analysis, Huehuetenango and Quiché. Secondary data should be sufficiently recent to adequately represent current dietary intake patterns. The estimated daily breast milk intake was used as the “serving size” for breast milk in Optifood. A group of local experts then carefully reviewed the resulting lists of serving sizes and determined them to be realistic given their knowledge of diets in the study area. The final serving sizes used are provided in the food lists for each target group in Appendix 6.

In the case of this analysis, FSG-specific portion sizes were used for most items, meaning that differentiation between portion sizes of foods within the same FSG may be underestimated. The feasibility of the portion sizes used in the Optifood modeling and hence the recommendations would need to be tested using field-based household level FBR testing (e.g., trials of improved practices).

[18] The groups included all children age 6–8 months and 9–11 months in the dataset and all children age 12–23 months who were reportedly receiving breast milk at the time of 2011 Guatemala HCES data collection.
[19] The experts were Guatemalan nutritionists, data analysts, and researchers with significant experience in nutrition, food supply, and dietary analysis of Guatemalan populations.
[20] If a food was considered unlikely to be consumed by a target group, the AME of members of that target group was not taken in to account when redistributing that food to estimate intrahousehold distribution and individual apparent consumption.

4.3.2 Minimum and Maximum Consumption Limits for Individual Foods

The minimum and maximum number of times that a serving of each food item could be selected in a week is used for model parameters in Optifood. The minimum frequency was set at zero for all food items except breast milk. To ensure that Optifood modeled diets for breastfed children included daily breast milk intake, minimum and maximum frequencies of servings per week for "breast milk" were set to 6.9 and 7.1, respectively (7 servings per week was used as the food group "average"), because the minimum and maximum frequency values must differ. It was important to keep the amount of breast milk used across all diets generated in Optifood constant so that any changes in resulting nutrient content could be shown to be only from changes to recommened type and quantity of local foods included in the diet.

The 90th percentile of consumption of individual foods is used to develop the maximum frequency of servings per week of each food for analysis in Optifood. The maximum frequency of servings per week was calculated by dividing the 90th percentile of apparent consumption (g) of each food item by the estimated target-group-specific portion size for that food. An example is provided in Box 1, and the resulting maximum frequency of servings per week for each food item is included in the food lists for each target group shown in Appendix 5.

Outliers in food quantities were removed during processing of the 2011 Guatemala HCES data. This meant that exceptionally large amounts of food that could not realistically be consumed by the household within the recall period, possibly representing production for sale or storage for later use, were not taken into consideration. While it is likely that small amounts of produce were sold/stored instead of/as well as consumed by the family, this would be unlikely to have a significant impact on results.

Box 1. Example of Calculating Maximum Number of Servings per Week for White Rice

90th percentile of weekly consumption by pregnant women: 1,918 g

Estimated portion size for white rice: 149 g

Maximum number of servings of white rice per week for pregnant women: 1,918/149 = 12.9, rounded up to 13

4.3.3 Model Constraints (Servings per Week) for Food Groups and Food Subgroups

In Optifood, each target population has a lower and upper constraint, or number of servings per week, for each food group and FSG. The lower constraint (low number of servings per week) for food groups and FSGs was determined by the taking the 10th percentile of consumption for the foods in the food group or FSG for the target population. The upper constraint (high number of servings per week) for food groups or FSGs was determined by taking the 90th percentile of the consumption of foods in the food group or FSG for the target population. The number of food group servings for each target population group was estimated by taking the apparent consumption per fortnight at each of these percentiles, divided by the median estimated portion size for foods from the food group, adjusted to represent weekly consumption. For several food groups and FSGs, their 10th percentile or lowest level was zero, meaning it is possible for Optifood to model a diet that does not include foods from these groups.

In addition to low and high constraints (servings/week), Optifood also takes *average* dietary patterns into account for food groups. This is used to compare the level of dietary improvement achievable based on usual average intake with that from "optimal" diets that may be within the lower and upper constraints but different enough from the average to necessitate behavior change to be achieved. This average constraint was defined by the 50th percentile (median) of apparent consumption of food groups divided by the median estimated portion size of individual foods from this food group for each target group.

Once calculated, the estimated low, average, and high consumption constraints for food groups and low and high constraints for FSGs were reviewed by local experts who decided whether they were realistic for the chosen target groups. Finally, the ability of the constraints to model realistic diets was examined using Optifood's Check Diets module (Module 1, see Appendix 1) and further review by local experts.

The model contraints entered in Optifood for low, average, and high number of food group servings per week must be different from each other for Optifood's linear programming to function. In cases where the 10th and 50th percentile of consumption were both zero, the average frequency of consumption was set to 0.1 or 1 to both reflect the 2011 HCES data and ensure that Optifood would function. The final constraints used for food groups and FSGs for all target groups are provided in Appendices 9–10. Note that breastmilk was classified into the food group "human milk" and the subgroup "breast milk."

4.3.4 Classification of Snacks and Starchy Staples

The use of the snack or starchy staples criteria in the Optifood analysis is optional but allows for classification of similar foods across groups. Each food item can be classified as a starchy staple, a snack, both, or neither. However, at least one food item in the food list must be selected for each category, if analysis is conducted for snacks and starchy staples. A group of local experts assisted in reviewing the food lists for each target group and determined whether any of the listed foods would be consumed between meals (snacks) and which foods were regularly consumed and contributed a considerable proportion of energy (staples) (Table 8).

Table 8. Foods Classified as Snacks or Staples across 2011 Guatemala HCES Target Groups

Food Items Classified as Snacks			
Mandarins	Mango	Apples	Pineapples
Watermelon	Bananas	Peaches	Melons
Oranges	Strawberries		
Food Items Classified as Staples			
Maize atole[21]	Maize flour (unfortified)	White or yellow maize	Maize tortilla

4.3.5 Cost of Individual Food Items

Every food item from the food lists was assigned a cost per 100 g edible portion for use in the Optifood cost analysis. Food costs (per 100 g edible portion) specific to Huehuetenango and Quiché were taken from the Guatemala National Statistics Institute Consumer Price Index 2015 (INE 2015).

4.3.6 Dietary References

Nutrient requirement values and energy and protein requirements from the INCAP Daily Dietary Recommendations were used to set model parameters for the different target groups in Optifood (INCAP

[21] Atole is a traditional cereal-based hot beverage. It is usually prepared with water, sugar, and a grain/flour base/cereal blend in a diluted form (Estrada et al. 2007).

2012) (Appendix 7). Low bioavailability of zinc and iron were assumed due to the tendency for observed diets of children and PLW in the study areas to be plant-based. The INCAP recommendations were used for all Optifood analyses to be consistent with the analysis conducted for the 2012 FANTA Optifood study.

4.3.7 Food Composition

The source of food composition data for this analysis was the INCAP Central American Food Composition Table (INCAP 2007). The 2011 Guatemala HCES dataset format is general, and many food item names are broad and could refer to several different foods in the INCAP FCT. For example, the item "otros atoles" (other atole [drinks]) could refer to rice *atole,* plantain *atole,* or others; and *hierbas* (native greens) could refer to amaranth, nightshade, or other local greens with different nutrient compositions. The grouping of some foods within similar categories and the resulting loss of detail could lead to inaccuracies in estimated potential nutrient intake. It is important to note that not all foods were grouped in this way and that most fruit and vegetables were presented as individual food items. Further, the 2011 Guatemala HCES data provide no information on cooking methods of foods apparently consumed or which parts of a food (leaves, fruit, roots) were consumed, or brand names of processed foods. To determine which FCT values were most appropriate, the list of 2011 Guatemala HCES food items was reviewed by FANTA Guatemala staff. A list of the foods used in the final FCT was then imported into Optifood. The corresponding entries from the INCAP FCT and nutrition values used are provided in Appendix 8. The food composition values used for breast milk were from WHO, referring to mature milk from mothers in developing countries (Brown et al. 1998).

4.4 Analysis in Optifood Using Alternative Data

Once data entry was complete and the model parameters were set up, the Optifood analysis was conducted via the four Optifood modules. Details regarding this process are provided in Appendix 1.

4.5 Process Used to Compare Optifood Inputs and Outputs from the 2011 Guatemala HCES and the 2012 FANTA Optifood Study

The following process was used to compare Optifood inputs and outputs from the secondary (2011 Guatemala HCES) data and the primary (2012 FANTA Optifood study) data. For data inputs, including foods lists, portion sizes, and low, average, and high servings per week that serve to provide model constraints in Optifood, results were reviewed for comparability, the percentage difference in portion sizes for food types was reviewed, and reasons for and implications of differences were considered.

For Optifood outputs, results were scrutinized for similarities and differences, and similar to results on inputs, the reasons for differences and their implications were analyzed and shared.

4.6 Institutional Review Board Approval

This secondary data analysis activity received ethical approval from the FHI 360 Protection of Human Subjects Committee. The protocol for the collection and analysis of 24-hour recall and food frequency data as part of the 2012 FANTA Optifood study was approved by the INCAP Institutional Ethics Review Committee and the London School of Hygiene and Tropical Medicine Ethics Committee.

4.7 Data Analysis and Processing

Stata Statistical Software 12.1 was used for all data processing (StataCorp, College Station, TX, 2011). Linear programming analysis was conducted in Optifood version 4.0.9.10 (WHO et al. 2014).

4.8 Summary of Assumptions in Each Analysis Step

Table 9 provides a summary of the assumptions for each step of the analysis using the 2011 Guatemala HCES data.

Table 9. Summary of Assumptions in Analysis Steps of 2011 Guatemala HCES Data in Optifood (as Applicable)

Analysis Step	Assumptions
A: Data selection within the 2011 Guatemala HCES dataset	
Data selection	Final data selected for analysis is representative of the population-level target groups to be analyzed (e.g., children 6–8 months, pregnant women).
B: Prepare the data inputs for Optifood analysis	
Estimation of individual-level apparent consumption	Food distribution in households is directly proportional to the energy requirements of each person in the household. All food purchased or acquired during the data recall period is consumed by the household within that same time period and not stored, sold, bartered, given as a gift, fed to animals, or thrown out/wasted. Women's lactation status: In households with a breastfed child, the lactating woman is the female 15–40 years of age who is the household head, or the spouse of the male household head.
Estimation of breast milk intake	Breastmilk intake: The method to estimate breast milk intake provides comparable breast milk estimates to those determined in the 2012 FANTA Optifood study for target groups (children 6–9, 9–11, and 12–23 months) (method used for secondary data applies recommended percent of energy intake from breast milk by Dewey and Brown; INCAP 2012 energy requirements; and a breast milk energy content of 0.66 kcal/g (Brown et al. 1998).
Preparation of food lists for input into Optifood	Foods in food lists are accessible for relevant target population groups.
C: Prepare Optifood to use the alternative data source	
Estimating portion sizes for individual food items	Portion sizes: Estimates of median portion sizes from secondary data are representative of median portion sizes for target population groups (children 6–9, 9–11, and 12–23 months, pregnant women, lactating women).
Determining minimum and maximum consumption limits for each individual food	Minimum and maximum consumption limits for each individual food determined from AME redistributed apparent consumption accurately represent consumption patterns for target population groups (children 6–9, 9–11, and 12–23 months of age, pregnant women, lactating women).
Determining model constraints for food groups and food subgroups	Model constraints for food groups and FSGs determined from AME-redistributed apparent consumption accurately represent consumption patterns for target population groups (children 6–9, 9–11, and 12–23 months of age, pregnant women, lactating women).
Classifying food items as starchy staples or snacks	Classification of starchy snacks and staples by local experts accurately represents each relevant food item as a snack or staple.
Determining cost of individual food items	Food costs (per 100 g edible portion) taken from the Guatemala National Statistics Institute Consumer Price Index 2015 specific to Huehuetenango and Quiché are representative of food costs for the target population groups in these two departments (children 6–9, 9–11, and 12–23 months of age, pregnant women, lactating women).

5 Results

The results of the process of developing Optifood inputs using the 2011 Guatemala HCES data (hereafter referred to as secondary data) and then modeling diets in Optifood using these inputs are presented in this section. The inputs (model constraints) and outputs (Optifood results, including pilot FBRs) from analysis of the secondary data are compared to the corresponding input and output results from the 2012 FANTA Optifood study (hereafter referred to as the primary data) that used 24-hour dietary recall and food frequency data, to determine the extent to which the inputs from the secondary data may serve as a proxy for 24-hour dietary recall and food frequency data. First, the Optifood inputs, specifically, the food lists, serving sizes, and servings per week of foods from food groups and FSGs using secondary and primary data are compared. Second, the output results are presented for each Optifood module from the analysis conducted with the two datasets.

5.1 Optifood Inputs: Model Constraints (Food Lists, Serving Sizes, and Servings per Week)

Food lists. As shown in Table 10, a greater variety of both foods and FSGs were available for modeling when using the secondary data compared to the primary 24-hour recall and food frequency data. This is likely because the apparent consumption data are from a 14-day period as opposed to 1 day for the 24-hour diet recall; the secondary data collection took place over 6 months, reflecting seasonal variation in food availability; and the secondary data included foods from a predefined list of 151 foods, compared to the 24-hour recall method that was open, meaning that it was not limited to foods on a predefined list. Reading a list of foods to the individual being interviewed could affect recall, possibly by helping recall foods consumed that may have been forgotten, but also by possibly introducing bias if listed foods are erroneously identified as having been consumed when they were not consumed. Additionally, the method used to redistribute apparent consumption assumes that foods are available to all family members within a household, while the 24-hour recall method focuses on only the foods consumed by the target groups of interest, which may be less varied. The implication of this result is that with the use of the secondary data, the Optifood tool may have a wider variety of foods to select from to optimize the diet, but an important assumption is that the foods are available to all household members and during all times of the year. Both the 2011 Guatemala HCES and the 2012 FANTA Optifood study included locally available and consumed or "apparently consumed" fortified foods in the food lists, including Incaparina, which is fortified with iron, zinc, calcium, thiamin, riboflavin, niacin, and folate, and with sugar fortified with vitamin A, as per national standards.

Table 10. Comparison of Food Lists Developed Using the Primary (2012 FANTA Optifood Study) Data and Secondary (2011 Guatemala HCES) Data: Number of Foods and FSGs Included for Each Target Group

Target Group	6–8 Months BF	9–11 Months BF	12–23 Months BF	12–23 Months NBF	Lactating Women	Pregnant Women
Primary (2012 FANTA Optifood Study) Data	43 foods from 26 FSGs	34 foods from 23 FSGs	38 foods from 23 FSGs	38 foods from 21 FSGs	43 foods from 26 FSGs	37 foods from 25 FSGs
Secondary (2011 Guatemala HCES) Data	66 foods from 35 FSGs	62 foods from 33 FSGs	53 foods from 30 FSGs	59 foods from 30 FSGs	55 foods from 31 FSGs	55 foods from 33 FSGs

Serving sizes. Table 11 compares the average serving size of foods from each FSG by target group for the primary data and the secondary data. Recall that the secondary data for serving size is from two 24-hour recall datasets covering the same target groups from the Western Highlands department of Quetzaltenango (Vossenaar 2014), which is similar to the two departments used for the 2012 FANTA Optifood analysis, Huehuetenango and Quiché. The serving sizes of condiment vegetables, GLV, other vitamin A vegetables, sugar, eggs, beans, and Incaparina and other *atoles* were mostly comparable across all target groups. For these foods, more than one-half of the individual target group serving sizes between the secondary and primary data were less than 20 percent different, and only four had differences greater than 50 percent. This is important, particularly regarding Incaparina, beans, eggs, and green leafy

Table 11. Average Serving Sizes (g) of Foods per FSG Used in the Primary Data (2012 FANTA Optifood Study—Serving Sizes from 24-Hour Dietary Recall Data) and in the Optifood Analysis Using the Secondary Data (2011 Guatemala HCES Data—Serving Sizes from Proxy Data)

Target Group	6–8 Months BF		9–11 Months BF		12–23 Months BF		12–23 Months NBF		Lactating Women		Pregnant Women	
Data Source	24HR Recall	HCES	24HR Recall	HCES	24HR Recall	HCES	24HR Recall	HCES	24HR Recall	HCES	24HR Recall	HCES
FSG	*Average serving size (g)*											
Beans	24	17	23	28	30	45	61	50	90	96	92	98
Breast milk	503	670	496	550	483	502	*	*	*	*	*	*
Cheese	5	14	25	22	20	36	4	39	230	95	77	98
Powdered milk	2	9	*	15	8	**83**	5	20	5	25	10	25
Fresh milk	*	*	*	**85**	*	**83**	*	**146**	*	**248**	*	*
Eggs	24	20	27	30	52	47	47	50	60	60	58	60
Organ meat (liver)	*	15	*	19	*	25	*	25	90	79	*	78
Poultry (chicken)	14	15	52	19	*	24	38	25	173	79	178	79
Processed meat	*	14	3	19	18	24	*	25	40	79	180	79
Red meat	*	14	*	*	*	*	43	*	*	*	115	*
Refined grain products	9	19	18	20	24	25	*	25	45	**146**	62	**147**
Incaparina	9	10	10	15	20	20	24	20	29	25	26	25
Special grains (other *atoles*)	16	15	9	25	15	20	45	20	27	22	19	26

Whole grain products	22	15	32	17	29	22	47	25	**188**	87	**196**	87
Sugar	8	7	9	10	12	12	22	12	29	20	33	20
Vegetable oil (unfortified)	1	3	1	5	1	10	*	10	2	15	2	15
Condiment vegetables	3	3	4	5	6	7	12	7	24	15	13	15
Vitamin A-source GLV	18	10	36	19	37	38	37	37	96	79	86	77
Other vitamin A vegetables	13	19	94	29	61	48	32	49	226	149	276	143
Vitamin C–rich vegetables	10	19	16	30	36	48	85	50	78	**147**	44	**150**
Other vegetables	**54**	12	45	24	66	40	69	50	144	133	179	133
Other starchy plant foods	55	17	**184**	22	93	37	**252**	49	184	134	185	133
Vitamin C–rich fruit	**115**	14	48	17	**171**	32	**161**	50	**204**	75	**149**	75
Other fruit	**64**	17	**61**	24	**78**	48	**144**	50	173	119	155	118

* FSG was not available for modeling for the selected target group.
Results that show large differences between the primary and secondary data are in bold.

vegetables, because these were some of the key foods included in the pilot FBRs developed with the primary data, which serves as the "gold standard" for this analysis.[22] Regarding eggs, which are an important animal-source food for this population given their relatively lower price compared to other animal-source foods such as meat or chicken, both the primary and secondary egg serving sizes for children 12–23 months and PLW suggest that eggs among these target groups are likely consumed whole and not shared with others. This is important because a feasibility trial of the 2012 FANTA Optifood FBRs found sharing food among all family members is common, and family sizes are large, which can increase the cost of FBR implementation if the FBR foods need to be prepared for all family member.

The average serving sizes of "other vegetables," "fruit," and "other starchy plant foods" were larger for the primary data target groups compared to the secondary data target groups, across all target groups but particularly among young children. This could be because there were a greater variety of vegetables and fruits reported as being consumed in the secondary data, some of which could be eaten in smaller amounts, affecting the averages across FSGs. For "vitamin C–rich vegetables" serving sizes were generally larger for the secondary data compared to the primary data, ranging from 33 percent larger for breastfed children 12–23 months of age to 241 percent larger for pregnant women. This could result from differences in cooking preferences between the areas of data collection; it was found that there were strong preferences for preparing food, such as the most common vitamin C–rich vegetable tomatoes, as thin broths in Huehuetenango and Quiché, while this may not be the case in Quetzaltenango, the department of origin for the secondary data on serving sizes (FANTA 2014; FANTA 2015; Vossenaar et al. 2014). The implications are particularly important for young children, given limited gastric capacity, to ensure portion sizes are feasible.

Serving sizes for chicken meat were generally larger in the primary data target groups, which may be because chicken was not present in large quantities in the secondary data. The average serving sizes of whole grain products were also larger in the primary data target groups, especially for PLW. This is likely

[22] In the 2012 FANTA Optifood study, the final Incaparina serving sizes were adjusted to ensure a "thick porridge" for children and a "thick *atole*" for PLW, which is not reflected in Table 11.

because the secondary data included several *atole* products not present in the primary data that would be eaten in smaller quantities than tortilla and other maize products reported in the 24-hour recall data.

Serving sizes of oil were significantly higher in the secondary data target groups, especially for children 12–23 months of age and PLW. This may reflect differences in preferences for or access to oil between the different areas from which data originated (Quetzaltenango for the secondary data versus Huehuetenango and Quiché for the primary data). The consequences of higher oil serving sizes for Optifood modeling would be that Optifood would most likely model fewer servings of oil for the secondary data target groups because, if Optifood modeled more servings of oil, the servings would quickly fill energy requirements, which in the model would prevent other foods from being added, including nutrient-dense foods. This is because Optifood always optimizes up to 100 percent of energy needs. Similarly, the serving sizes of refined grains for PLW and children 6–8 months of age were greater for the secondary data target groups.[23] This suggests that foods from the refined grains FSG may be consumed less by the target groups in the primary 24-hour recall data in Huehuetenango and Quiché compared to the secondary data from Quetzaltenango.

Powdered milk, cheese, and processed meat seving sizes were generally significantly higher in the secondary data target groups compared to the primary data target groups, particularly for young children regarding cheese, all target groups for powdered milk, and all groups except pregnant women for processed meat. This possibly reflects a higher consumption of these items in Quetzaltenango, the department from which the secondary data on serving sizes came, compared to Hueheutenango or Quiché, due to greater access and/or difference in preferences in Quetzaltenango.

There were a few foods for which there were no serving sizes for some target groups for the secondary data, the primary data, or both because they were not consumed. The primary data target groups did not have serving sizes for fresh milk, nor did children 6–8 months of age and pregnant women in the secondary data. The primary data target groups did not have serving sizes for liver, except for lactating women. The only target groups with serving sizes for red meat were the secondary data target group for children 6–8 months of age, and the primary data target groups for non-breastfed children 12–23 months of age and pregnant women. The results for animal-source foods is not surprising because these types of foods would generally not be consumed on a regular basis by these populations because of, for example, high cost and lack of refrigeration for storage (FANTA 2015).

The estimated daily intake of breast milk was comparable for children 9–23 months, but 33 percent higher for children 6–8 months in the secondary dataset than in the primary data. In the primary data, breast milk was estimated to provide 57, 50, and 40 percent of total energy, respectively, in children 6–8, 9–11, and 12–23 months of age, compared to 67, 55, and 39 percent for the respective age groups in the secondary data. Considering the different methods[24] used to calculate the two intakes, the reported amount of complementary foods eaten by children in the primary data may have been higher than the recommended proportion or could represent children at the older end of the age range, who were accustomed to consuming more solids. Almost one-half of the children 6–8 months of age in the primary dataset were 8 months of age, while about 34 percent were 7 months of age, and only 19 percent were 6 months of age, which may explain why complementary food consumption may have been higher, and breast milk intake

[23] Refined grains included, e.g., rice, prepared cereals, pastas, corn flour, and wheat flour.

[24] As noted, for the primary data, the 2012 FANTA Optifood study target group, the energy from breast milk was estimated as the median estimated energy requirements minus the median energy intakes from complementary foods. For the secondary data target groups using the 2011 Guatemala HCES data, energy from breast milk was assumed to be 67 percent, 55 percent, and 39 percent of the median estimated energy requirements for children 6–8, 9–11, and 12–23 months, respectively. The energy content used for calculations was 0.66 kcal/g (Brown et al. 1998).

calculated as lower, in the primary data compared to the secondary data. The method used in the primary data assumes that the remaining energy and nutrient requirements, apart from complementary foods, are met by breast milk. The implication of this result is that FBRs developed with the primary data depend on lower breast milk intake to meet nutrient requirements for children 6–8 months of age compared to those developed using the secondary data. The secondary data models for children 6–8 months of age would allow less flexibility for including complementary foods to meet nutrient requirements. The ability of resulting FBRs to meet at least 65 percent of RNI in the Optifood minimized diet would depend on adequate breastfeeding. More details regarding breastfeeding and the FBR results using the two datasets is presented in the Optifood Outputs section below. These results demonstrate the importance of information on breastfeeding practices in the target population to inform Optifood assumptions, and the critical importance of promoting FBRs alongside messages for continued responsive breastfeeding, especially for children 6–8 months of age.

In summary, these results for portion sizes appear to indicate that the secondary data, using the proxy data serving sizes, provided reasonably good estimates of serving sizes for foods that tend to be relatively less expensive and more commonly consumed, such as Incaparina, beans, eggs, and GLV. The results also seem to indicate that relatively more expensive and less commonly consumed foods, or foods that are purchased/acquired less frequently, such as fresh milk, powdered milk, organ meat, red meat, or processed meat, may have overestimated serving sizes using proxy serving sizes with secondary data, particularly for young children, and in some cases for PLW. Secondary data proxy values might also have underestimated serving sizes for foods such as fruits and other vegetables and whole grain products, for which there may be a greater variety represented in secondary data compared to the primary data. There were also some differences in serving sizes between the primary and secondary data that may reflect differences in food preferences, preparation practices, or access and availability between the target groups in the two datasets. It is possible that neither the primary data nor the secondary data serving sizes adequately represent usual dietary practices of the target population. The results from both analyses do point to the critical need to test preliminary portion sizes with target groups, which can be conducted as part of field testing pilot FBRs in households.

Servings per week (low, average, and high constraints for food groups, and low and high constraints for FSGs). Appendix 9 compares the final constraints for the secondary data target groups with those from the primary data target groups, defining the low, average, and high number of servings per week of foods from each food group. For children, the constraints for the food groups dairy foods; grains (which includes Incaparina); meat, poultry, and eggs; and legumes were mostly similar except for higher inclusion of dairy foods for non-breastfed children using the secondary data and higher average legume consumption and slightly higher upper constraints for legumes in the secondary data target groups. These differences would mean slightly more flexibility in secondary data modeling for legumes for children and dairy for non-breastfed children 12–23 months. Following the set constraints, average diets using the primary data would include more sugar and less added fats than the diets using the secondary data. For both fruit and vegetable food groups, the minimum, average, and upper limits were generally higher in the secondary data target groups compared to the primary data target groups, which would mean that more portions and variety could be modeled. This is likely a result of the greater variety of fruit and vegetables in the secondary dataset due to the lengthier data collection and longer recall period. Although the minimum and maximum constraints for the meat, poultry, and eggs food group were largely similar for all target groups, some secondary data target groups had higher consumption averages, meaning that more meat and eggs could be modeled in the Module 2 best diets with food patterns. For the starchy roots food group, the lower constraints were similar across target groups for both datasets, but average consumption and upper constraints were higher among the secondary data target groups compared to the primary data target groups, allowing for more flexibility in secondary data modeling for this food group.

The model constraint results for PLW were similar to those for children. The primary data would include more sugar and less added fats, but also less refined grains than the diets using the secondary data. The constraints for grains for lactating women were the same using the two datasets, but for pregnant women the secondary data would model fewer servings of grains compared to the primary data. Constraints for dairy; legumes; meat, poultry, and eggs; and starchy roots were similar, except for a slightly higher inclusion of starchy roots for pregnant women using the secondary data. Like the results for children, for the fruit food group the low, average, and high constraints of servings per week were higher using the secondary data compared to the primary data. For vegetables for PLW, the upper constraints were higher compared to the primary data, allowing more flexibility in modeling using the secondary data.

The constraints for FSGs are provided in Appendix 10. Lower constraints were generally the same across all groups, and both lower and upper constraints were similar for beans. The secondary data generally had higher upper constraints for servings per week of cheese, fruit, vegetables, green leafy vegetables, and bread but lower upper constraints for eggs, Incaparina, and milk.

In general, the results show that the model constraints for servings per week were relatively comparable between the secondary and the primary data. In many cases, the secondary data allowed for equal or greater flexibility in modeling, given higher upper constraints. In some cases, the lower constraints for some food groups using the primary data were zero, which allows the Optifood tool the option of not including the food group in the model, while the lower constraints in the secondary data target groups for the same foods were "7" or "14" servings per week—for example, fruit (7), grains (14), and vegetables (7). This means that for the secondary data target groups, Optifood would include, at a minimum, daily consumption of fruits and vegetables and twice-daily consumption of grains. The results also demonstrate the importance of testing the validity of pilot FBRs, including recommended servings per week, in a local context to verify the local diet, understand the local challenges, and address any problems that may prevent adoption of improved dietary practices.

5.2 Optifood Outputs: Results of the Optifood Analysis

5.2.1 Module 1: Checking Diets

The first Optifood module was used to assess whether the model parameters entered (upper and lower limits of consumption for individual foods, food groups, and FSGs) would generate realistic diets and allow sufficient flexibility given energy constraints. Some of the resulting test diets had levels of servings per week of vegetables and foods from the meat and eggs food group that were deemed too high to be realistic by local experts. The upper limits for the vegetable and meat and eggs food groups were reduced for some target groups. Running the Check Diets module again led to results that were considered feasible by the researchers.

Module 1. Check Diets

Purpose: To check that the model parameters entered will lead to the generation of realistic diets.

Provides information on whether the diets generated are realistic and if changes are needed to the model parameters to ensure generated diets are realistic.

5.2.2 Module 2: Identifying Draft Recommendations

Generation of best diets. Module 2 in Optifood was used to generate the two best diets possible within the set model parameters. The numbers of servings (per week) by food group in the Best Diet A (following average dietary patterns) and Best Diet B (outside of average dietary patterns but within minimum and maximum model constraints) for all target groups appear in Tables 12–13. Module 2 results were examined to compare the number of servings per week of the best food/FSG sources in Diet A to those in Diet B. If the number of servings per week of a food, food group, or FSG increased from Diet A to Diet B, then it indicated that Optifood chose this food or food group as it was a significant source of nutrients.

Module 2. Identify Draft Recommendations

Purpose: To identify the best diet possible given local foods and dietary patterns; identify problem nutrients and best food sources, and formulate FBRs.

Provides information about whether it is possible to meet nutrient requirements for all target groups using local foods per dietary patterns and per any combination of local foods (not following dietary patterns); which nutrients are problem nutrients; which local foods are the best sources of necessary nutrients; and which foods should be tested as part of FBRs.

In the analysis conducted with the primary data using the 24-hour dietary recall, to optimize the nutrient content of local diets, the number of servings of vegetables for all target groups was increased from two or three servings/day in Best Diet A to three or five servings/day in Best Diet B, depending on the target group. The observed median intakes of dairy foods were low in all target groups (less than one serving/week) and was increased to one serving per day in the optimized diets of most target groups. Other food groups that showed an increase in the number of servings per week from the observed median intakes were meat, poultry, or eggs (MPE) (four target groups), fruits (two target groups), legumes (three target groups), and roots (two target groups). Bakery products and composites (e.g., tacos, tostadas, and tamales) increased in the optimized diets of non-breastfed children and PLW, presumably to increase the dietary fat content to meet the recommended percentage of energy intake from fat.

The results using the secondary apparent consumption data showed that diets were optimized by increasing the number of servings per week from the legumes and nuts food group (from two to six servings per week to four to nine servings, with increases in five of the six target groups), probably to optimize folate, iron, zinc, and calcium content. Increases were also seen in the meat, poultry and eggs (MPE) group for two target groups. Across nearly all target groups, Optifood reduced the servings from the added fats, starchy roots, and added sugars food groups, possibly to allow for modeling nutrient-rich foods that are less energy-dense. All diets either maintained or increased the servings per week of grain foods. Overall, for the secondary data, the number of servings per week in the optimized diets and the median intakes of foods were similar—except for lower-than-average intakes in optimized diets for children 6–8 months of age for added fats, added sugar, grains, and roots, and higher than average intakes in the optimized diets for children 9–23 months of age for grains and starchy roots, the latter perhaps due to the fortified product Incaparina in the grains group, and potato in the roots group to meet niacin and vitamin B6 needs. However, Optifood does not consider niacin from tryptophan, so niacin needs may be overestimated.

Comparing optimized diets that were modeled outside of average dietary patterns (Diet B) between the two data sources, a key difference was that for most target groups the secondary data best diets had fewer servings per week of animal-source foods (meat and dairy) than the primary data best diets, except for MPE for children 6–8 months of age. This could be due to the greater availability of other nutrient-dense, yet cheaper foods, such as fruit and nuts/seeds, in the secondary dataset. Another difference was that most of the best diets outside of average dietary patterns modeled using the primary data had between one to two servings of vegetables per day more than the diets modeled using secondary data. This may be because the secondary data models could include more nutrient-dense vegetables, such as green leafy vegetables or vitamin A–rich vegetables, or other foods to maximize nutrient intake without including as many vegetables. Furthermore, for three of the target groups, more fruit was included in the secondary data “no food pattern” diet (Diet B), possibly meaning that fewer vegetables were needed in the model. Aside from non-breastfed children, the number of servings of legumes per week in the “no food pattern” diets (Diet B) were similar from both data sources.

Table 12. Number of Servings per Week by Food Group in the Module 2 Best Diet A (Diet within Average Food Pattern) and Best Diet B (Diet without Average Food Pattern) in Child Target Groups from the Primary (2012 FANTA Optifood Study) and the Secondary (2011 Guatemala HCES) Datasets[a]

	6–8 Months BF				9–11 Months BF				12–23 Months BF				12–23 Months NBF			
	Primary 2012 FANTA		Secondary 2011 HCES		Primary 2012 FANTA		Secondary 2011 HCES		Primary 2012 FANTA		Secondary 2011 HCES		Primary 2012 FANTA		Secondary 2011 HCES	
Food Group	Best Diet A	Best Diet B	Best Diet A	Best Diet B	Best Diet A	Best Diet B	Best Diet A	Best Diet B	Best Diet A	Best Diet B	Best Diet A	Best Diet B	Best Diet A	Best Diet B	Best Diet A	Best Diet B
Added fats	0	**0**	0	**0**	0	**0**	3	**0**	0	**0**	3	**0**	2	**3**	3	**2**
Added sugars	6	**3**	0	**0**	7	**5**	4	**0**	7	**5**	3	**0**	7	**5**	3	**7**
Bakery and breakfast cereals	0	**0**	3	**0**	0	**0**	4	**0**	0	**0**	4	**0**	6	**7**	6	**4**
Beverages (nondairy or blended dairy)	7	**0**	0	**0**	7	**0**	0	**0**	7	**7**	0	**0**	7	**7**	0	**0**
Composites (mixed food groups)	7	**0**	1	**0**	7	**4**	1	**0**	7	**0**	0	**0**	11	**14**	0	**0**
Dairy foods	7	**7**	1	**1**	7	**7**	4	**4**	6	**2**	2	**0**	7	**7**	4	**3**
Fruits	1	**1**	10	**7**	0	**0**	7	**7**	4	**7**	8	**7**	7	**7**	9	**7**
Grains and grain products	28	**29**	14	**18**	28	**35**	20	**20**	28	**35**	16	**29**	35	**30**	33	**42**
Human milk	7	**7**	7	**7**	7	**7**	7	**7**	7	**7**	7	**6**	-	**-**	-	**-**
Legumes, nuts, seeds	7	**7**	5	**5**	7	**7**	3	**7**	7	**7**	2	**4**	0	**0**	3	**5**
Meat, poultry, eggs	2	**2**	3	**5**	6	**5**	3	**2**	5	**7**	3	**2**	6	**6**	3	**2**
Starchy roots, and other starchy plant foods	6	**6**	5	**0**	7	**4**	7	**7**	0	**3**	8	**7**	4	**0**	9	**8**
Vegetables	14	**28**	21	**33**	14	**23**	14	**7**	14	**24**	14	**7**	21	**35**	18	**14**

[a]Note: Best Diet B diets are shown in bold.

Table 13. Number of Servings per Week by Food Group in the Module 2 Best Diet A (Diet Within Average Food Pattern) and Best Diet B (Diet without Average Food Pattern) in PLW Target Groups from the primary (2012 FANTA Optifood Study) and Secondary (2011 Guatemala HCES) Datasets[a]

	Lactating Women				Pregnant Women			
	Primary 2012 FANTA		Secondary 2011 Guatemala		Primary 2012 FANTA		Secondary 2011 Guatemala	
Food Group	Best Diet A	Best Diet B	Best Diet A	Best Diet B	Best Diet A	Best Diet B	Best Diet A	Best Diet B
Added fats	5	**5**	4	**3**	4	**4**	4	**3**
Added sugars	7	**5**	4	**3**	7	**5**	3	**3**
Bakery and breakfast cereals	7	**7**	4	**4**	7	**7**	3	**2**
Beverages (nondairy or blended dairy)	7	**7**	0	**0**	7	**7**	0	**0**
Composites (mixed food groups)	7	**14**	0	**3**	7	**12**	0	**0**
Dairy foods	6	**6**	3	**1**	7	**7**	2	**1**
Fruits	0	**0**	6	**6**	4	**8**	7	**6**
Grains and grain products	35	**39**	35	**37**	28	**40**	28	**40**
Legumes, nuts, seeds	7	**7**	3	**9**	7	**8**	6	**7**
Meat, fish, eggs	7	**8**	4	**7**	4	**8**	5	**4**
Starchy roots and other starchy plant foods	7	**0**	6	**6**	7	**7**	7	**6**
Sweetened snacks and desserts	—	—	0	**0**	—	—	0	**0**
Vegetables	21	**28**	16	**14**	21	**27**	14	**11**

[a]Note: Best Diet B diets are shown in bold.

Identification of problem nutrients. Module 2 results were also used to identify problem nutrients for all target groups. For both the secondary and primary data, results show that iron, zinc, and calcium were problem nutrients for children 6–8 months (see Table 14). Zinc was also a problem nutrient for children 9–11 months in the primary data but was sufficient for all target groups when using the secondary data. Iron was similarly a problem nutrient for breastfed children 12–23 months using the primary data but not with the secondary data; however, the percentage of RNI met with the primary data was high (97 percent). A key difference between the two datasets was that three problem nutrients were identified for pregnant women using the primary data (iron, folate, and zinc) while none were identified when the secondary data were used. This suggests that slightly better diet options (food type or quantity) were available for modeling for the secondary data pregnant women target groups. This could be attributed to the energy intake for PLW assumed by the AME method and the actual energy intake of PLW observed in the primary data, the latter which may be lower than the RNI. This means there could be an overestimation of actual energy intake by PLW in the secondary data. Given that anemia affects almost one-quarter of pregnant women in Huehuetentango and Quiché, it is possible that women's access to or consumption of iron-rich foods and consumption of iron is low (MSPAS et al. 2017).

To categorize problem nutrients as absolute and partial problem nutrients, the Module 3 maximized diet, without testing any FBRs, was analyzed. All problem nutrients for children 6–8 months (zinc, iron, and calcium) using both the primary and secondary data and iron for pregnant women from the primary data were absolute problem nutrients (APN), meaning that requirements could not be met using local foods within the set model parameters and that micronutrient supplements or other fortified foods would likely be needed. All other problem nutrients identified for pregnant women, children 9–11 months, and children 12–23 months using the primary data were partial problem nutrients (PPN), meaning that adequacy was attainable using local foods in some combination, but this would probably compromise the intake of other nutrients. For PPN, requirements would be difficult to meet without significant behavior change or the use of micronutrient supplements or fortified products. These findings suggest that nutrient adequacy for children 6–8 months of age using either dataset would likely be difficult to meet using diets based on local foods but that micronutrient supplementation or food fortification may be required, especially if changing dietary patterns is not feasible, acceptable, or sustainable.

Best food sources for nutrients. The main sources (individual foods or FSGs) for each modeled nutrient, contributing at least 5 percent of the daily intake using the secondary and the primary data, are summarized in Table 15.[25] With a few exceptions, the same best food sources were identified using both the primary and secondary data for all modeled nutrients. Breast milk, Incaparina, whole grains, liver (organ meats FSG), beans, and GLV were the best sources of multiple nutrients across both datasets. Differences in the best FSGs between the datasets reflect the greater variety of foods or FSGs for modeling in the secondary data.

For some nutrients, chicken was a best food source for the primary data target groups but not the secondary data target groups. This was likely because chicken meat was not widely available in the secondary data food lists. Similarly, cheese was a good source of nutrients in the secondary data target groups but not always available for modeling in the primary data groups, likely because cheese was more widely available in the secondary data food lists. Foods from the starchy roots FSG, specifically potatoes, contributed 5 percent or more to the RNI for vitamin C, vitamin B6, and niacin in the primary data target groups only. While potatoes were on the secondary data food lists, due to the wider range of items available for modeling in general, Optifood selected other more nutrient-dense FSGs in the best diets for these target groups. Eggs and GLV were also identified as best sources of some nutrients in the primary data target groups only, even though they were available in the secondary data food lists, indicating that more nutrient-dense foods could be modeled with the secondary data. Finally, it is important to note that some foods that are known “good sources” of specific nutrients may not appear as a best source in Table 15 because it may not have been possible to model the quantity needed to form a significant contribution, due to model constraints based on local food patterns.

[25] The best food sources for each individual target group were first listed separately and then compared and listed across the target groups. Listing common sources (a “best source” for three or more target groups) was especially relevant given that the secondary (2011 Guatemala HCES) apparent consumption data used to generate individual target group analyses was collected at the household level.

Table 14. Partial Problem Nutrients and Absolute Problem Nutrients Identified from Analyses from Optifood Modules 2 and 3 for Child and Woman Target Groups, Primary Data (2012 FANTA Optifood Study) and Secondary Data (2011 Guatemala HCES), and Highest % RNI Met in Module 2 Maximized Diets[a]

	6–8 Months BF		9–11 Months BF		12–23 Months BF		12–23 Months NBF		Pregnant Women		Lactating Women	
	Primary 2012 FANTA	Secondary 2011 HCES	Primary 2012 FANTA	Secondary 2011 HCES	Primary 2012 FANTA	Secondary 2011 HCES	Primary 2012 FANTA	Secondary 2011 HCES	Primary 2012 FANTA	Secondary 2011 HCES	Primary 2012 FANTA	Secondary 2011 HCES
Calcium	APN (97%)	APN (86%)	—	—	—	—	—	—	—	—	—	—
Folate	—	—	—	—	—	—	—	—	PPN (92%)	—	—	—
Iron	APN (95%)	APN (49%)	—	—	PPN (97%)	—	—	—	APN (81%)	—	—	—
Zinc	APN (80%)	APN (79%)	PPN (76%)	—	—	—	—	—	PPN (86%)	—	—	—
No. of problem nutrients	3	3	1	0	1	0	0	0	3	0	0	0

[a] Thiamin, riboflavin, niacin, and vitamins A, B6, B12, and C were not problem nutrients.

Table 15. Best[a] FSG Sources[b] of Nutrients for Children and Women as Determined Using the Secondary (2011 Guatemala HCES) Apparent Consumption Data and the Primary (2012 FANTA Optifood study) 24-Hour Dietary Recall Data

KEY to table:	Vitamin C	Thiamin	Niacin	Vitamin B6	Iron
Foods in bold: **Best source using both primary and secondary data**	**Breast milk[c]**	**Breast milk**	**Breast milk**	**Breast milk**	**Incaparina**
	GLV	**Incaparina**	**Incaparina**	**Whole grains**	**Whole grains**
	Vitamin C fruit	**Whole grains[e]**	**Whole grains**	**Beans**	**GLV**
Foods not in bold: Best source using secondary data only	**Vitamin C vegetables**	**Vitamin C fruit**	**Refined grains**	**Incaparina**	**Beans**
	Vitamin A fruit	**Refined grains**	**Liver**	**Other vegetables**	**Refined grains**
	Starchy roots[d]	Other vegetables	Beans	Liver	**Refined bread**
Foods in underlined italics: *Best source using primary data only*	*Other vegetables*	Refined bread	*Chicken*	*Starchy roots*	**Liver**
			Starchy roots	*GLV*	

Folate	Vitamin B12	Vitamin A	Riboflavin	Zinc	Calcium
Breast milk	**Breast milk**	**Breast milk**	**Breast milk**	**Incaparina**	**Breast milk**
Beans	**Incaparina**	**Incaparina**	**Incaparina**	**Whole grains**	**Cheese**
Refined grains	**Liver**	**Fortified sugar**	**Refined grains**	**Beans**	**Incaparina**
Whole grains	**Milk**	**GLV**	**Liver**	Nuts and seeds	**GLV**
GLV	**Eggs**	**Other vitamin A vegetables**	**Whole grains**	*GLV*	**Whole grains**
Other vegetables	**Processed meat**	**Liver**	**Milk**		**Milk**
Vitamin C fruit	Cheese	Cheese	Cheese		Beans
Liver	*Chicken*	*Eggs*	*Eggs*		*Other vegetables*

[a] These are sources that provide >=5% of RNI for each nutrient for at least three target groups.

[b] These are based on the best Module 2 diet that does not take dietary patterns into account (Diet B).

[c] Breast milk was modeled for breastfed children 6–23 months only.

[d] Foods from the starchy roots FSG were mainly potatoes.

[e] "Whole grains" refers largely to maize products, such as corn tortillas.

Note: FSG names may represent one food if it was the only food in the subgroup.

Table A21 in Appendix 11 shows for each target group the number of nutrients for which individual food items from each FSG were a top source (contributed 5 percent or more of RNI) in the diet without food patterns (Diet B) using the secondary data. These results were used to highlight the best foods available in the local area for each target group. A list of the best FSG sources—especially those providing 5 percent or more of RNI for problem nutrients—and the number of servings per week of these foods included in Diet B were used to generate draft FBRs for testing in Optifood Module 3.

In summary, Module 2 results, including the best diets, problem nutrients, and best food sources for nutrients, were similar between the secondary and primary data. Across both sets of analyses, diets were often optimized with legumes and meat, poultry and eggs, although with fewer servings of MPE in the secondary data compared to the primary data, perhaps due to less costly and more nutrient-dense options to model in the secondary data. The problem nutrients identified by the secondary and primary data were the same for the youngest target group of children 6–8 months of age, but differed slightly for older children and pregnant women, with the secondary data not identifying any problem nutrients for these groups, while the primary data identified one PPN for children 9–11 months (zinc), one PPN for breastfed children 12–23 months (iron), and two PPNs (folate and zinc) and one APN (iron) for pregnant women.

These slight differences are likely due to the greater availability of nutrient-dense foods for modeling using the secondary data diets. Despite these differences, the similarities in the problem nutrients, especially for young children, are very promising. The secondary and primary data identified over half of the same best food sources for each nutrient, and for iron and folate the foods selected were all, or nearly all, the same. Given that pilot food-based recommendations developed with Optifood need to be tested at the household level, the results presented here indicate that the Optifood outputs from the secondary data would provide a solid basis for the development of pilot FBRs for household-level testing. The results of testing and development of pilot FBRs using the two datasets in Optifood Module 3 are presented below.

5.2.3 Module 3: Testing Food-Based Recommendations for Individual Target Groups

Using Module 3 in Optifood, all possible combinations of FBRs identified using the results from the Module 2 best diets were tested as well as any reasonable modifications that could maximize nutrient intake using the fewest FBRs for the lowest cost. As noted, the level of a nutrient in an FBR or set of FBRs was considered acceptable when it provided at least 65 percent of the RNI in a minimized, or worst-case scenario diet.[26] Only micronutrients are considered when testing FBRs, in addition to meeting 100 percent of energy requirements and meeting or optimizing protein content.[27] A second set of analyses was also run in Module 3 to develop and test FBRs for the target groups in diets that included micronutrient supplements, as per Guatemala Ministry of Health guidelines.

Module 3. Test Food-Based Recommendations

Purpose: To test and compare alternative sets of FBRs and classify problem nutrients as partial or absolute.

Provides information regarding which sets of FBRs is best for the target population and if FBRs are likely to ensure nutrient requirements are met.

The final sets of FBRs for individual target groups using the secondary data with and without micronutrients are presented below, along with the FBRs developed using the primary data for these target groups. Appendices 12–17 provide examples of the process used, the individual FBRs and combinations of FBRs tested for each secondary target group, the cost of the FBRs, and their potential for meeting at least 65 percent of the RNI in the minimized diet for the 11 modeled nutrients.

It is important to note that breast milk consumption is included in the minimized diets for all breastfed target groups, as per the minimum food group constraints presented in Appendix 9. Similarly, consumption of about two to three servings of maize products (staples)/day was automatically modeled in all diets and did not need to be tested as a separate recommendation.

5.2.3.1 Food-Based Recommendations without Micronutrient Supplements

Tables 16–18 present the FBRs developed using the secondary data for each target group and compare them with the published findings from the primary data. Using the secondary data, there were five FBRs (in addition to the message to continue breastfeeding) for breastfed children 6–23 months, six FBRs for non-breastfed children, and seven FBRs for women. The primary data had six FBRs for all target groups except PLW, who required seven FBRs. It was possible to model FBRs providing nutritionally acceptable

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[26] The worst-case scenario is the minimized diet, where the lowest possible amount of a nutrient is provided. It is the worst-case scenario in terms of food sources and serving sizes modeled in Optifood in Module 3. In the minimized diet, foods and serving sizes that would provide the lowest amount of a nutrient would be modeled first when testing a recommendation rather than modeling an average amount. The worst-case scenario, or minimized diet, represents the lower tail (approximately 5th percentile) of a nutrient intake distribution for the population. See Appendix 1.

[27] While fat content was low in the modeled diets for women and non-breastfed children, dietary requirements for fat intake are not well established and it is difficult to develop recommendations.

diets meeting at least 65 percent of the micronutrient RNIs for all target groups except children 6–8 months (both datasets) and pregnant women (primary data only).

During the development of FBRs using the primary 24-hour dietary recall data, the final set included a recommendation for young children to consume MPE daily because WHO recommends that children 6–23 months consume these every day or, if daily consumption is not possible, as frequently as possible (FANTA 2014). While Optifood identified MPE as a good source of nutrients, daily consumption (seven servings per week) was more than the maximum number of servings allowed for that food group by the model constraints, and adjustments were needed so this FBR could be modeled. Given that this external recommendation was used with the primary data in 2012, the same constraint changes were made and an FBR for daily MPE consumption was included in the sets of FBRs for children 6–23 months using the secondary data.

Table 16. Food-Based Recommendations without Micronutrient Supplements for Breastfed Children 6–11 Months Using the Primary (2012 FANTA Optifood study) and Secondary (2011 Guatemala HCES) Datasets

	6–8 Months						9–11 Months					
	Primary 2012 FANTA Optifood Study[a]			Secondary 2011 Guatemala HCES			Primary 2012 FANTA Optifood Study[a]			Secondary 2011 Guatemala HCES		
Recommended Food or FSG	Freq.[b]	Serv. Size (g)[c]	Total/ week (g)	Freq.	Serv. Size (g)	Total/ week (g)	Freq.	Serv. Size (g)	Total/ week (g)	Freq.	Serv. Size (g)	Total/ week (g)
Incaparina	14	10	140	4	10	40	14	10	140	7	15	105
Beans	7	25	175	4	17	68	7	25	175	7	26	182
GLV	—	—	—	7	9.6	67.2	—	—	—	7	18	126
Vegetables	28	20	560	—	—	—	28	25	700	—	—	—
Maize products	21	20	420	14	20	280	21	25	525	14	20	280
Potatoes	7	55	385	—	—	—	7	60	420	—	—	—
Meat, poultry, or eggs	7	20	140	7	15	105	7	30	210	7	20	140

[a] FANTA 2014.

[b] Freg. = frequency

[c] "Serv, size (g)" refers to the average serving size of individual foods or the average serving size of foods within a recommended FSG.

Table 17. Food-Based Recommendations without Micronutrient Supplements for Children 12–23 Months (Breastfed and Non-Breastfed) Using the Primary (2012 FANTA Optifood Study) and Secondary (2011 Guatemala HCES) Datasets

	12–23 Months BF						**12–23 Months NBF**					
	Primary 2012 FANTA Optifood Study[a]			Secondary 2011 Guatemala HCES			Primary 2012 FANTA Optifood Study[a]			Secondary 2011 Guatemala HCES		
Recommended Food or FSG	Freq.[b]	Serv. Size (g)[c]	Total/ week (g)	Freq.	Serv. Size (g)	Total/ week (g)	Freq.	Serv. Size (g)	Total/ week (g)	Freq.	Serv. Size (g)	Total/ week (g)
Incaparina	14	15	210	7	19	133	14	15	210	14	20	280
Beans	7	30	210	7	45	315	7	60	420	7	49	343
GLV	—	—	—	7	38	266	—	—	—	7	37	259
Vegetables	28	35	980	—	—	—	28	40	1120	—	—	—
Dairy foods	—	—	—	—	—	—	—	—	—	7	30	210
Maize products	21	25	525	14	25	350	21	25	525	14	30	420
Potatoes	7	60	420	—	—	—	7	75	525	—	—	—
Meat, poultry, or eggs	7	35	245	7	25	175	7	40	280	7	25	175

[a] FANTA 2014.

[b] Freg. = frequency

[c] "Serv, size (g)" refers to the average serving size of individual foods or the average serving size of foods within a recommended FSG.

Table 18. Food-Based Recommendations without Micronutrient Supplements for Pregnant and Lactating Women Using the Primary (2012 FANTA Optifood Study) and Secondary (2011 Guatemala HCES) Datasets

Recommended Food Group or FSG	Lactating Women						Pregnant Women					
	Primary 2012 FANTA Optifood Study[a]			Secondary 2011 Guatemala HCES			Primary 2012 FANTA Optifood Study[a]			Secondary 2011 Guatemala HCES		
	Freq.[b]	Serv. Size (g)[c]	Total/ week (g)	Freq.	Serv. Size (g)	Total/ week (g)	Freq.	Serv. Size (g)	Total/ week (g)	Freq.	Serv. Size (g)	Total/ week (g)
Incaparina	14	30	420	14	25	350	14	25	350	14	25	350
Beans	7	90	630	7	96	672	7	90	630	7	98	686
GLV	—	—	—	7	79	553	—	—	—	7	77	539
Vegetables	28	80	2240	—	—	—	28	85	2380	—	—	—
Dairy foods	—	—	—	4	25	100	—	—	—	4	25	100
Maize products	*28*[d]	*150*	*4200*	21	87	1827	*21*[d]	*150*	*3150*	21	87	1827
Potatoes	7	170	1190	—	—	—	7	120	840	—	—	—
Liver	1	90	90	1	25	25	1	90	90	1	78	78
Any vitamin C fruit	—	—	—	4	75	300	—	—	—	4	75	300
Oranges only	3	205	615	—	—	—	3[e]	205	615	—	—	—

[a] FANTA 2014.

[b] Freg. = frequency

[c] "Serv, size (g)" refers to the average serving size of individual foods or the average serving size of foods within a recommended FSG.

[d] While maize products were not listed in the final set of FBRs for PLW in the 2012 FANTA Optifood study report, the models assumed a minimum daily intake of grain products of 28 servings per week for lactating women and 21 servings per week for pregnant women.

[e] The FBR of oranges for pregnant women was not required to meet nutrient acceptability but was included in the final set of FBRs for consistency with the recommendations for lactating women.

If the FBRs presented above were put into practice as recommended, they would ensure a nutritionally acceptable diet for almost all target groups. Even with the most optimal combinations of foods, it was not possible to meet iron requirements for breastfed children 6–8 months using either the primary or the secondary data. It was not possible to provide ≥ 65 percent of the RNI for iron in a minimized diet for pregnant women using FBRs as per the model constraints using the primary data; however, ≥ 65 percent of the RNI was achieved using the secondary data constraints, most likely because of the wider range of nutrient-dense foods and the number of servings available to model using the secondary data. Nutrients for which acceptability could not be achieved by FBRs are presented in Table 19.

Table 19. Nutrients for Which At Least 65 Percent of the RNI Could Not Be Met Using FBRs (without Micronutrient Supplements) and Highest Percentage of RNI Achievable in Minimized Diets

Target Group	Primary (2012 FANTA Optifood study) Data	Secondary (2011 Guatemala HCES) Data
6–8 months	Iron (62%), Zinc (61%)	Iron (42.6%)
9–11 months	—	—
12–23 months, BF	—	—
12–23 months, NBF	—	—
Pregnant women	Iron (62%)	—
Lactating women	—	—

The consumption of Incaparina (or other fortified blended flours [FBFs][28]) was recommended for all target groups across both datasets; however, less frequent consumption and a smaller overall quantity was recommended for breastfed children using the secondary data. Beans were also recommended for all target groups; however, the frequency and total quantity of beans were less for children 6–8 months using the secondary data, most likely a result of a lower estimated breast milk intake among children 6–8 months of age using the primary dataset, which allowed modeling of a greater amount of beans for the latter. For other breastfed child target groups, although the frequencies of consumption of beans were the same, the overall quantity of beans was greater for the secondary target groups, due to slightly larger serving sizes. For non-breastfed children 12–23 months of age, the overall quantity of Incaparina was more using the secondary data, and the quantity of beans less, when compared to the results using the primary data. In the latter, the frequency of consumption for Incaparina and beans was the same, but the serving sizes differed. This could reflect the adjustments to children's diets needed to optimize nutrient intake if breast milk is not available, as well as the variety and type of foods available in both food lists.

All sets of FBRs also recommended consuming vegetables in general or GLV specifically. Interestingly, subsequent testing that had been conducted with the primary data for children 6–23 months found that a specific FBR to consume GLV daily could replace the FBR of four servings per day of any vegetable and still meet nutrient needs (FANTA 2015). Recall that in a worst-case scenario diet, Optifood models the nutritionally worst options first, so the results would be based on consumption of the least nutrient-dense vegetables in the vegetables food group. Replacing "vegetables" with more a nutritionally dense "GLV" group meant that less would need to be eaten. The consumption of more uniform servings of GLV foods was modeled, as opposed to a collection of different foods within a food group that included GLV. These results suggest that a more specific FBR that includes a food or food subgroup that is nutritionally dense, could achieve similar results with less food, if the food item, for example, in this case, GLV, were locally accessible and its consumption acceptable.

All FBRs for children included meat or eggs and maize products, with less maize and slightly less meat or eggs for target groups using the secondary data. This reflects the overall greater range of foods available for modeling using the secondary data. Liver was recommended for all PLW. While an FBR for potatoes was included for all target groups when using the primary data, this recommendation was not included in any groups when using the secondary data, possibly because other more nutrient-rich foods were

[28] Incaparina was the only FBF available for modeling with the 2011 Guatemala HCES target groups. A comparison of FBRs including other FBFs common in Guatemala appears in Appendix 18.

available for modeling. Potato consumption was high during the data collection for the primary data, especially in Huehuetenango, so the primary data had a narrower food list compared to the secondary data and modeled higher potato consumption (FANTA 2014). Subsequent studies found that potato consumption is seasonal in Huehuetenango and less common in Quiché (FANTA 2015; Knight 2013). Given that the secondary data covers a larger area over a longer period, food lists are more diverse. Subsequent FBRs using the secondary data could potentially be easier to put into practice over different locations and seasons within Huehuetenango and Quiché, but this would need to be tested at the household level.

In both analyses, using the primary or the secondary data, the most critical FBR was that of consuming Incaparina once or twice per day, because of the nutrient density of this fortified product and its relatively low cost. However, even with the inclusion of Incaparina, additional FBRs were needed to achieve at least 65 percent of the RNI in the minimized diet for modeled nutrients, and this level of nutrient intake was not feasible for all modeled nutrients for every target group. Nutrient intakes that met at least 65 percent of RNI in the minimized diet were most difficult to achieve for those nutrients found predominantly in animal-source foods—namely, calcium, iron, zinc, niacin, and vitamin B12. Tables 20 and 21 show each nutrient modeled while developing FBRs for the target groups using the secondary data (Table 20) and the primary data (Table 21) and the foods that helped meet requirements for specific nutrients. For the secondary data, Incaparina was required to meet at least 65 percent of RNI in the minimized diet for niacin for all child target groups and zinc and calcium for most groups. However, the contribution of dietary tryptophan is not modeled in Optifood and hence the amount of niacin in the modeled diets is likely underestimated.[29] In many cases, the upper constraint for Incaparina consumption was increased to model the amount needed to meet 65 percent of RNI in the minimized diet. Using target group constraints derived from the primary data, FBF was required to meet 65 percent of the RNI in the minimized diet for iron, zinc, and niacin for most target groups; and B12 for non-breastfed children 12–23 months. In addition, liver was needed to meet B12 requirements for PLW using both datasets.

In summary, when considering the child FBRs without micronutrient supplementation, the FBRs were similar across the target groups for the two datasets, and both included Incaparina; beans; meat, poultry, and eggs; and maize. However, the frequency of consumption of some secondary-data FBRs appears somewhat high, considering results a prior FBR feasibility study in Guatemala (conducted after the primary data used in this study were collected), and would require special attention during household-level testing (e.g., consumption of eggs and beans daily) (FANTA 2015). The FBRs derived from the secondary data would require micronutrient supplementation for children 6–8 months of age to meet iron needs, while the FBRs from the primary data would require micronutrient supplementation to meet the needs for iron and zinc of this age group, and the nutrient needs of other child target groups would be met through the diet for both datasets.

For the FBRs for PLW without micronutrient supplementation, similarities were also found across the target groups for the two datasets, and both included Incaparina, beans, liver, and maize. However, feasibility of the recommended frequency of consumption of Incaparina and beans using the secondary data would require testing at the household level, given that the frequency appears relatively high (daily consumption). The FBRs developed using the secondary data would not require micronutrient supplementation for PLW to meet nutrient needs, while the FBRs from the primary data would require micronutrient supplementation for pregnant women to meet iron needs.

[29] The human body can convert 60 mg of tryptophan into approximately 1 mg of nicotinic acid (niacin) (WHO 2000).

Table 20. Possibility of Meeting Requirements for Modeled Nutrients Using Best Sets of FBRs without Supplementation for Women and Children Using the Secondary (2011 Guatemala HCES) Dataset

KEY	
×	Not possible to meet requirements
■	Possible to meet requirements with local foods (not including Incaparina)
Liver	Not possible to meet requirements without liver
▶	Not possible to meet requirements without Incaparina

	6–8 Months	9–11 Months	12–23 Months BF	12–23 Months NBF	Lactating Women	Pregnant Women
Calcium	■	▶	▶	▶	▶	▶
Vitamin C	■	■	■	■	■	■
Thiamin	■	■	■	■	■	■
Riboflavin	■	■	■	■	■	■
Niacin	▶	▶	▶	▶	■	■
Vitamin B6	■	■	■	■	■	■
Folate	■	■	■	■	■	■
Vitamin B12	▶	■	▶	■	Liver	Liver
Vitamin A	▶	■	■	■	▶	Liver
Iron	×	▶	▶	■	■	■
Zinc	▶	▶	▶	■	▶	▶

Table 21. Possibility of Meeting Requirements for Modeled Nutrients Using Best Sets of FBRs without Supplementation for Women and Children Using the Primary (2012 FANTA Optifood Study) Dataset[a]

	6–8 Months	9–11 Months	12–23 Months BF	12–23 Months NBF	Lactating Women	Pregnant Women
Niacin	▶	▶	▶	▶	■	■
Folate	■	■	■	■	▶	▶
Vitamin B12	■	■	■	▶	Liver	Liver
Iron	×	▶	▶	▶	■	×
Zinc	×	▶	▶	■	▶	▶

[a] Data available for problem nutrients only (partial or absolute).

5.2.3.2 Food-Based Recommendations with Micronutrient Supplements

Tables 22–24 show the best sets of FBRs that would meet at least 65 percent of the RNI in the minimized diets for all target groups if diets include micronutrient supplements as per the Government of Guatemala guidelines. The best sets of FBRs for children in diets with micronutrient supplements included five to six recommendations using the primary data and four to five using the secondary data, in addition to recommendations for continuing breastfeeding. Recommendations for women with micronutrient supplementation consisted of six individual FBRs using the primary data and seven FBRs when using the secondary data. When implemented with micronutrient supplements, it was possible to provide diets that would likely meet the requirements for the modeled nutrients using FBRs for all target groups.

Guatemala Ministry of Health guidelines advise that children 6–59 months should consume a multiple micronutrient powder (MNP)[30] every day for 60 days every 6 months and that PLW consume 5 mg of folic acid and 600 mg of iron per week. However, previous studies have indicated that supplements are not routinely distributed to or consumed by PLW and young children in some areas of the Western Highlands (FANTA 2014; FANTA 2015).

Developing FBRs in the context of diets that include micronutrient supplements meant that in most cases, the number of individual FBRs and the quantity of recommended foods could be reduced, making it less costly for families to adopt the FBRs. For the child target groups using the secondary data, the sets of FBRs with MNP cost up to 0.9 GTQ less than those without micronutrient supplements; the recommendation of consuming meat or eggs was not in the list of FBRs with micronutrient supplements; fewer GLV were recommended, and in most cases fewer beans were recommended. For the child target groups using the primary data, compared to FBRs without micronutrient supplementation, recommendations with micronutrient supplementation included less of all FBR foods for all child target groups, except maize for children 12–23 months (breastfed and non-breastfed); removed “other vegetables” completely from the FBRs; and added GLVs for all children 12–23 months of age.

The cost of the FBR diets for PLW using the secondary data with and without micronutrient supplementation were similar. However, for lactating women, fewer servings per week of beans were needed to meet at least 65 percent of the RNI for nutrients in the minimized diet if iron-folate supplements were consumed. The FBRs with micronutrient supplementation for PLW using the primary data recommended less Incaparina and maize and fewer beans than the primary data recommendations for PLW without micronutrient supplementation.

The FBR for vitamin C fruits for PLW developed using the secondary data is more flexible than the primary data FBR for oranges, because in addition to oranges, it provides the option of consuming pineapples, lemons, or mangoes if oranges are not available or if another fruit is preferred. The reason that the primary data FBR was for one food while the secondary data FBR was for a broader food group is that there was a greater variety of food items in the secondary (2011 Guatemala HCES) food lists due to the wider data collection area and longer time frame. This is the case for the PLW FBRs both with and without micronutrient supplementation.

[30] The MNP modeled in the Optifood analysis included vitamins A, C, B6, and B12; thiamin; riboflavin; niacin; iron; zinc; and folic acid. The composition is given in Appendix 19.

Table 22. Food-Based Recommendations with Micronutrient Supplements for Breastfed Children 6–11 Months Using the Primary (2012 FANTA Optifood Study) and Secondary (2011 Guatemala HCES) Datasets

FBR	6–8 Months BF						9–11 Months BF					
	Primary 2012 FANTA Optifood Study[a]			Secondary 2011 Guatemala HCES			Primary 2012 FANTA Optifood Study[a]			Secondry 2011 Guatemala HCES		
	Freq.[b]	Serv. Size (g)[c]	Total/ Week (g)	Freq.	Serv. Size (g)	Total/ Week (g)	Freq.	Serv. Size (g)	Total/ Week (g)	Freq.	Serv. Size (g)	Total/ Week (g)
Incaparina	3	20	60	4	10	40	3	20	60	7	15	105
Beans	3	25	75	4	17	68	3	25	75	4	26	104
GLV	—	—	—	7	9.6	67.2	—	—	—	4	18	72
Maize products	14	20	280	14	20	280	14	25	350	14	20	280
Potatoes	3	55	165	—	—	—	3	60	180	—	—	—
Eggs	3	25	75	—	—	—	3	20	60	—	—	—

[a] FANTA 2014.

[b] Freg. = frequency

[c] "Serv, size (g)" refers to the average serving size of individual foods or the average serving size of foods within a recommended FSG.

Table 23. Food-Based Recommendations with Micronutrient Supplements for Breastfed and Non-breastfed Children 12–23 Months Using the Primary (2012 FANTA Optifood Study) and Secondary (2011 Guatemala HCES) Datasets

FBR	12–23 Months BF						12–23 Months NBF					
	Primary 2012 FANTA Optifood Study[a]			Secondary 2011 Guatemala HCES			Primary 2012 FANTA Optifood Study[a]			Secondary 2011 Guatemala HCES		
	Freq.[b]	Serv. Size (g)[c]	Total/ Week (g)	Freq.	Serv. Size (g)	Total/ Week (g)	Freq.	Serv. Size (g)	Total/ Week (g)	Freq.	Serv. Size (g)	Total/ Week (g)
Incaparina	4	30	120	7	19	133	5	30	150	14	20	280
Beans	4	30	120	4	45	180	4	60	240	5	49	245
GLV	4	30	120	4	38	152	4	30	120	5	37	185
Dairy foods	—	—	—	—	—	—	—	—	—	7	30	210
Maize products	28	25	700	14	25	350	28	50	1400	14	30	420
Potatoes	4	60	240	—	—	—	4	75	300	—	—	—
Eggs	4	50	200	—	—	—	5	50	250	—	—	—

[a] FANTA 2014.

[b] Freg. = frequency

[c] "Serv, size (g)" refers to the average serving size of individual foods or the average serving size of foods within a recommended FSG.

Table 24. Food-Based Recommendations with Micronutrient Supplements for Pregnant and Lactating Women Using the Primary (FANTA Optifood Study) and Secondary (2011 Guatemala HCES) Datasets

	Lactating Women						Pregnant Women					
	Primary 2012 FANTA Optifood Study[a]			Secondary 2011 Guatemala HCES			Primary 2012 FANTA Optifood Study[a]			Secondary 2011 Guatemala HCES		
FBR	Freq.[b]	Serv. Size (g)[c]	Total/ Week (g)	Freq.	Serv. Size (g)	Total/ Week (g)	Freq.	Serv. Size (g)	Total/ Week (g)	Freq.	Serv. Size (g)	Total/ Week (g)
Incaparina	7	30	210	14	25	350	7	25	175	14	25	350
Beans	—	—	—	4	96	384	—	—	—	7	98	686
GLV	—	—	—	7	79	553	—	—	—	7	77	539
Liver	1	90	90	1	25	25	1	90	90	1	78	78
Vegetables	28	80	2240	—	—	—	28	85	2380	—	—	—
Dairy foods	—	—	—	4	25	100	—	—	—	4	25	100
Maize products	*21*[d]	*150*	*3150*	21	87	1827	*28*[d]	*150*	*4200*	21	87	1827
Potatoes	7	170	1190	—	—	—	7	120	840	—	—	—
Oranges	3	205	615	—	—	—	3[e]	205	615	—	—	—
Vitamin C fruit	—	—	—	4	75	300	—	—	—	4	75	300

[a] FANTA 2014.

[b] Freg. = frequency

[c] "Serv, size (g)" refers to the average serving size of individual foods or the average serving size of foods within a recommended FSG.

[d] While maize products were not listed in the final set of FBRs for PLW in the 2012 FANTA Optifood study report, the models assumed a minimum daily intake of grain products of 28 servings per week for lactating women and 21 servings per week for pregnant women.

[e] The FBR of oranges for pregnant women was not required to meet nutrient acceptability but was included in the final set of FBRs for consistency with the recommendations for lactating women.

Although the FBRs maximized nutrient intake, the quantity of food recommended is high for all target groups, and higher using the primary data compared to the secondary data, likely due to variations in food lists, serving sizes, availability of micronutrient-rich foods for modeling, and methods for estimating breast milk intake. This has implications for FBR adoption, including the cost of purchasing the recommended foods, the ability to produce sufficient quantities of the foods, and/or gastric capacity of young children, especially children 6–8 months who may only recently have been introduced to complementary foods. As shown in Table 25, if micronutrient supplements were provided and if the sets of FBRs that took micronutrient supplementation into account were adopted, at least 65 percent of RNI in the minimized diets of all modeled nutrients could be met using less food and/or fewer FBRs and, in many cases, for a lower cost.

Table 25. Number of FBRs, Quantity (g) of Food Recommended, and Cost of Adopting FBRs for Sets of FBRs with No Micronutrient Supplements (NMS) and with Micronutrient Supplements (MS) for Children 6–23 Months and PLW Using the Primary (2012 FANTA Optifood Study) and Secondary (2011 Guatemala HCES) Datasets

	Breastfed 6–8 Months				Breastfed 9–11 Months				Breastfed 12–23 Months			
	Primary 2012 FANTA Optifood Study		Secondary 2011 Guatemala HCES		Primary 2012 FANTA Optifood Study		Secondary 2011 Guatemala HCES		Primary 2012 FANTA Optifood Study		Secondary 2011 Guatemala HCES	
	NMS	MS[a]	NMS	MS[a]	NMS	MS[a]	NMS	MS[a]	NMS	MS[a]	NMS	MS[a]
No. FBRs	6	5	5	4	6	5	5	4	6	6	5	4
Total (g) per week	1820	655	560	455	2170	725	833	561	2590	1500	1239	815
Cost (GTQ/day)	2	1.2	0.8	0.8	2.4	1.5	2	1.1	3.5	2.5	3.3	2

	Non-Breastfed 12–23 Months				Lactating Women				Pregnant Women			
	2012 FANTA Optifood Study		2011 Guatemala HCES		2012 FANTA Optifood Study		2011 Guatemala HCES		2012 FANTA Optifood Study		2011 Guatemala HCES	
	NMS	MS[a]	NMS	MS[a]	NMS	MS[b]	NMS	MS[b]	NMS	MS[b]	NMS	MS[b]
No. FBRs	6	6	6	5	7	6	7	7	7	6	7	7
Total (g) per week	3080	2460	1687	1340	9385	7495	3827	3539	8055	8300	3880	3880
Cost (GTQ/day)	5.2	3.5	5.3	4.9	12.1	11.3	12.9	12.9	10.2	10	11.6	11.6

[a] Modeled micronutrient supplements for children 6–23 months were 1-g MNP sachets three times per week.

[b] Modeled micronutrient supplements for PLW were 5 mg of folic acid and 600 mg of iron per week.

In the final development of the primary data FBRs, larger portion sizes of Incaparina were modeled so that preparation of FBF as a thick porridge for children and thick *atole* for women could be tested. While these larger serving sizes were not modeled in the secondary data analysis, the secondary data FBR results included more frequent consumption so the final amount of Incaparina in both models was somewhat similar, although often larger in the secondary data results with micronutrient supplementation compared to the primary data results with supplementation. Also, instead of recommending a daily serving of GLV for PLW, the primary data included a recommendation of four servings per day of any vegetable. While the serving sizes of vegetables modeled in the worst-case scenario diets were probably small, the serving size listed in the FBR results tables (Tables 22–24) referred to the average of all foods from the vegetable food group, inflating the actual amount of food needed to meet requirements. This could also be the case for maize products. These differences meant that in many cases a greater total quantity of food was listed in the FBRs for the primary data target groups than the secondary data target groups.

The secondary data FBRs for PLW and non-breastfed children 12–23 months included consumption of dairy foods, while the primary data FBRs did not. Milk was identified as a key source of calcium, riboflavin, and vitamin B12 for target groups from both datasets. Cheese was a key calcium source for both datasets, but also a key source of riboflavin and vitamins A and B12 for the secondary data target groups. The dairy FBRs from the analysis using the secondary data could be due to a greater variety or amount of dairy foods in the secondary data food lists and hence more dairy available for modeling. The assumption that PLW and non-breastfed children 12–23 months have access to dairy foods and that consumption would be feasible and acceptable would require testing at the household level.

Given the different methods used to estimate breast milk intake,[31] the Optifood models for the secondary data target groups assumed a higher nutrient contribution from breast milk than the primary data models. For this reason, less complementary food was needed to meet nutrient requirements for breastfed secondary data target groups, also contributing to the difference in food quantities between the two groups of FBRs.

Finally, over one-half of the serving sizes in the FBRs are the same or similar between the two datasets, while most of the remainder are generally higher using the primary data compared to the secondary data. The primary data serving sizes were based on the reported consumption from 24-hour dietary recalls from a sub-sample of 5 percent or more of the study sample; for some foods, this meant the median portion sizes were based not on the entire sample but on a few individuals who had consumed the food. As described in the background section of this report, the secondary (HCES) data serving sizes for individual target groups were estimated using available secondary data from two 24-hour recall datasets from a Western Highlands department similar to the departments used for the primary data analysis. As mentioned earlier, it is possible that neither the primary nor the secondary data serving sizes adequately represent usual dietary practices of the target population. Further, it is extremely likely that serving sizes differ between households, based on preference and food access. For these reasons, achievable and acceptable serving sizes and food quantities would need to be determined through testing FBRs at the household level before the FBRs are promoted in the community.

In summary, the final FBRs with micronutrient supplementation for all target groups developed with the secondary and primary data were highly comparable and both datasets provided FBRs that met nutrient requirements if micronutrient supplements were provided. Both sets of FBRs recommended Incaparina, beans, and maize for all child target groups, and GLV for breastfed and non-breastfed children 12–23 months of age. In the case of the FBR for maize for breastfed children 12–23 months of age, the secondary data FBR may be more feasible than the primary data FBR (25 g 2x/day vs. 25 g 4x/day). However, the secondary data FBR for daily Incaparina intake for breastfed children 9–11 and 12–23 months of age and twice-daily intake for non-breastfed children 12–23 months, as well as daily dairy consumption for non-breastfed children 12–23 months of age, will require special attention during testing at the household level to ensure their feasibility, as prior feasibility trials found economic constraints limited family access to purchased FBF such as Incaparina and animal-source foods (FANTA 2015).

The FBRs for PLW from the secondary and the primary data both recommended Incaparina, liver, and maize. The secondary data FBRs include beans for PLW, which is reasonable, but the recommended frequency for pregnant women is daily, which will require household-level testing, as prior feasibility testing results demonstrated constraints to daily bean consumption, including cost, difficulties in production (drought), and dietary preferences (FANTA 2015). The secondary data FBR for GLV consumption may be very practical given that a prior FANTA study found families could easily produce or forage for GLV throughout the year (FANTA 2015). As with child FBRs, the secondary data dairy FBR and twice-daily Incaparina FBR for PLW will need testing during household trials to determine their

[31] Estimation of energy from breast milk for primary data equaled the median estimated energy requirements for the target group, minus the median observed energy intake from complementary foods (from 24-hour recall data). Estimated energy from breast milk for the secondary data was assumed to be 67 percent, 55 percent, and 39 percent of the median estimated energy requirements for children 6–8, 9–11, and 12–23 months, respectively (Brown, Dewey, and Allen 1998); energy content of breast milk used in these calculations is 0.66 kcal/g (Brown et al. 1998).

feasibility given potential cost constaints. Although costs may appear feasible, families in a previous FANTA study shared that food items must be purchased for the entire family, and family sizes are large, so feasibility of FBR implementation may be limited (FANTA 2015).

Field-level household testing is a critical next step to validate all FBRs, for children and PLW. If, after household-level FBR testing, the final quantities that are feasible and acceptable for the population differ from the quantities in the tested FBRs, the FBRs should be revised with the new quantities and should be tested in Optifood to determine any nutrient gaps that may remain and discuss options for filling the gaps. Final FBRs that would be promoted through social and behavior change communication campaigns would be those that required some behavior change, for example, Incaparina, beans, liver, or GLV consumption, and not maize, since it is a staple that is already readily consumed.

Cost of FBRs with and without supplements. The costs of the least expensive diets (GTQ/day) that include the final sets of FBRs for each target group using the secondary data and the primary data are shown in Table 26. The final sets of FBRs developed for children without micronutrient supplementation cost 2.0–5.2 GTQ/day using the primary data and 0.8–5.3 GTQ/day using the secondary data, while the sets of FBRs for women cost 10.2–12.1 GTQ/day with the primary data and 11.6–12.9 GTQ/day with the secondary data. The final sets of FBRs developed for children with micronutrient supplementation cost 1.2–3.5 GTQ/day using the primary data and 0.8-4.9 GTQ/day using the secondary data, while the sets of FBRs for women cost 10.0–11.3 GTQ/day with the primary data and 11.6–12.9 GTQ/day with the secondary data. The estimated costs of adopting each FBR or set of FBRs reflect a "base diet" modeled to meet energy requirements based on the minimum consumption pattern for food groups. It is important to note that the cost presented for sets of FBRs does not equal the sum of the costs for each individual FBR in the set but rather the cost of providing these foods in addition to other foods modeled to comply with minimum food patterns and meet energy requirements.

Table 26. Cost (GTQ/Day) of Putting the Best Sets of FBRs without Micronutrient Supplements and the Best Sets of FBRs with Micronutrient Supplements into Practice as Part of a Minimized Diet that Meets Energy Requirements for Each Target Group Using Both the Primary (2012 FANTA Optifood Study) Data and the Secondary (2011 Guatemala HCES) Data

	FBRs Only		FBRs with Micronutrient Supplements	
Target Group	Primary 2012 FANTA Optifood Study	Secondary 2011 Guatemala HCES	Primary 2012 FANTA Optifood Study	Secondary 2011 Guatemala HCES
6–8 months	2	0.8	1.2	0.8
9–11 months	2.4	2	1.5	1.1
12–23 months BF	3.5	3.3	2.5	2
12–23 months NBF	5.2	5.3	3.5	4.9
Pregnant women	12.1	12.9	11.3	12.9
Lactating women	10.2	11.6	10	11.6

5.2.4 Module 4: Cost of Diet

Module 4. Cost Analysis

Purpose: To generate the lowest-cost, nutritionally best diet.

Provides information on the lowest-cost, nutritionally best diet for the target population, which foods in this diet are the most expensive, and which nutrient requirements are the most expensive to meet.

Optifood Module 4 was used to model the lowest-cost, nutritionally best diet for each target group. These diets represent the most optimal combination of local foods, given model constraints, that would meet or come as close as possible to meeting nutrient requirements for the lowest cost.

As shown in Table 27, it was not possible to select lowest-cost diets that met the RNI for all modeled nutrients within average food patterns for children 6–8 months of age using either the secondary or the primary data. However, adequacy was attainable for all remaining secondary data target groups and most of the primary data target groups. Requirements for nutrients derived from animal-source foods such as calcium, iron, zinc, and vitamin B12 were the most expensive to meet across all target groups. Vitamin B12 may have been identified as a costlier nutrient in the primary dataset and not in the secondary dataset because of higher breast milk intake among breastfed children using the secondary data, and higher intake of Incaparina and eggs in the primary data FBRs. For pregnant women, the nutrient could be costlier in the primary data because of higher intake of liver compared to the secondary data FBRs. Calcium may be a costlier nutrient for PLW in the secondary data because of the FBRs for dairy foods. The primary data FBRs do not have an FBR for dairy foods, but do have an FBR with a high intake of maize, including corn tortillas that would be made with calcium hydroxide.

The analysis results show that the most affordable and nutritionally best diets from the primary data cost 1.7–5.7 GTQ/day for child target groups and 15.6–19.1 GTQ/day for women. The modeled costs for diets using the secondary apparent consumption data were generally lower, ranging from 1.5–4.2 GTQ/day for children and 11.5–14.4 GTQ/day for women.

Table 27. Cost per Day of the Lowest-Cost, Nutritionally Best Diets for Each Target Group Using the Secondary (2011 Guatemala HCES) Data and the Primary (2012 FANTA Optifood) Data, Most Expensive Nutrient Requirements to Meet, and Nutrients with Requirements That Could Not Be Met

	6–8 Months BF		9–11 Months BF		12–23 Months BF		12–23 Months NBF		Lactating Women		Pregnant Women	
	Primary 2012 FANTA Optifood Study	Secondary 2011 Guatemala HCES	Primary 2012 FANTA Optifood Study	Secondary 2011 Guatemala HCES	Primary 2012 FANTA Optifood Study	Secondary 2011 Guatemala HCES	Primary 2012 FANTA Optifood Study	Secondary 2011 Guatemala HCES	Primary 2012 FANTA Optifood Study	Secondary 2011 Guatemala HCES	Primary 2012 FANTA Optifood Study	Secondary 2011 Guatemala HCES
Cost/day (GTQ)[a]	1.7	1.5	2.6	2.2	4.3	2	5.7	4.2	19.1	14.4	15.6	11.5
Cost/day (US$)	0.22	0.19	0.34	0.29	0.56	0.26	0.74	0.55	2.48	1.87	2.03	1.50
Most expensive nutrient/s (most expensive listed first)	Zinc Calcium Iron B12	Calcium Iron Zinc	Zinc Calcium Iron B12	Iron Zinc Calcium	B12 Iron Calcium	Calcium Iron	B12 Calcium Iron	Calcium	Folate Zinc Riboflavin	Zinc Calcium Riboflavin	Vitamin B12 Folate	Calcium
No. requirements not met[b]	3	3	1	0	1	0	0	0	0	0	2	0
Nutrient/s for which requirement was not met (highest % RNI achieved)	Zinc (80%) Iron (95.5%) Calcium (97.7%)	Zinc (79%) Iron (49%) Calcium (86%)	Zinc (76.2%)	—	Iron (97.1%)	—	—	—	—	—	Zinc (90%) Folate (96%)	—

[a] 1 GTQ = approx. US$ 0.13

[b] Nutrients for which adequacy (100% of RNI) was not met in the modeled diet.

5.2.5 Summary of Optifood Food-Based Recommendations Using the Primary (2012 FANTA Optifood Study) Data and the Secondary (2011 Guatemala HCES) Data

Table 28 shows the final pilot FBRs developed using the primary data (2012 FANTA Optifood study) and the secondary data (2011 Guatemala HCES) with micronutrient supplementation, and cost in Guatemala quetzales (GTQ) per target group member per day for families to comply with the FBRs. Differences between the FBRs are highlighted in bold and outlined in Table 29. Both sets of FBRs with micronutrient supplementation meet nutrient needs. A critical next step would be testing their feasibility and acceptability at the household level, including the recommended foods, serving sizes, and frequency of consumption.

Table 28. Final Pilot FBRs with Micronutrient Supplementation (Entries in bold represent differences between the FBRs from the two datasets)

Target Group	FBRs: Primary Data—2012 FANTA Optifood Study	Cost (GTQ/Day)	FBRs: Secondary Data—2011 Guatemala HCES	Cost (GTQ/Day)
Infants 6–8 months, breastfed	1. Breastfeed on demand 2. Eat Incaparina 3 times per week, serving size 20 g 3. Eat beans 3 times per week, serving size 25 g 4. Eat maize products 2 times per day, serving size 20 g **5. Eat potatoes 3 times per week, serving size 55 g** **6. Eat eggs 3 times per week, serving size 25 g**	1.2	1. Breastfeed on demand 2. Eat Incaparina 4 times per week, serving size 10 g 3. Eat beans 4 times per week, serving size 17 g 4. Eat maize products 2 times per day, serving size 20 g **5. Eat green leafy vegetables every day, serving size 9.6 g**	0.8
Infants 9–11 months, breastfed	1. Breastfeed on demand **2. Eat Incaparina 3 times per week, serving size 20 g** 3. Eat beans 3 times per week, serving size 25 g 4. Eat maize products 2 times per day, serving size 25 g **5. Eat potatoes 3 times per week, serving size 60 g** **6. Eat eggs 3 times per week, serving size 20 g**	1.5	1. Breastfeed on demand **2. Eat Incaparina every day, serving size 15 g** 3. Eat beans 4 times per week, serving size 26 g 4. Eat maize products 2 times per day, serving size 20 g **5. Eat green leafy vegetables 4 times a week, serving size 18 g**	1.1
Infants 12–23 months, breastfed	1. Breastfeed on demand **2. Eat Incaparina 4 times per week, serving size 30 g** 3. Eat beans 4 times per week, serving size 30 g **4. Eat maize products 4 times per day, serving size 25 g** **5. Eat potatoes 4 times per week, serving size 60 g** **6. Eat eggs 4 times per week, serving size 50 g** 7. Eat green leafy vegetables 4 times per week, serving size 30 g	2.5	1. Breastfeed on demand **2. Eat Incaparina every day, serving size 19 g** 3. Eat beans 4 times per week, serving size 45 g **4. Eat maize products 2 times per day, serving size 25 g** 5. Eat green leafy vegetables 4 times per week, serving size 38 g	2.0
Infants 12–23 months, non-breastfed	**1. Eat Incaparina 5 times per week, serving size 30 g** 2. Eat beans 4 times per week, serving size 60 g **3. Eat maize products 4 times per day, serving size 50 g** **4. Eat potatoes 4 times per week, serving size 75 g** **5. Eat eggs 5 times per week, serving size 50 g** 6. Eat green leafy vegetables 4 times per week, serving size 30 g	3.5	**1. Eat Incaparina 2 times per day, serving size 20 g** 2. Eat beans 5 times per week, serving size 49 g **3. Eat maize products 2 times per day, serving size 30 g** 4. Eat green leafy vegetables 5 times per week, serving size 37 g **5. Eat dairy foods every day, serving size 30 g**	4.9
Lactating women	**1. Eat Incaparina every day, serving size 30 g** 2. Eat maize products 3 times per day, serving size 150 g 3. Eat liver once per week, serving size 90 g **4. Eat vegetables 4 times per day, serving size 85 g** **5. Eat potatoes every day, serving size 170 g** 6. Eat oranges 3 times per week, serving size 205 g	10	**1. Eat Incaparina 2 times per day, serving size 25 g** 2. Eat maize products 3 times per day, serving size 87 g 3. Eat liver once per week, serving size 25 g **4. Eat green leafy vegetables every day, serving sie 79 g** **5. Eat beans 4 times per week, serving size 96 g** **6. Eat dairy foods 4 times per week, serving size 25 g** 7. Eat vitamin C rich fruit 4 times per week, serving size 75 g	11.6
Pregnant women	**1. Eat Incaparina every day, serving size 25 g** **2. Eat maize products 4 times per day, serving size 150 g** 3. Eat liver once per week, serving size 90 g **4. Eat vegetables 4 times per day, serving size 85 g** **5. Eat potatoes every day, serving size 120 g** 6. Eat oranges 3 times per week, serving size 205 g	11.3	**1. Eat Incaparina 2 times per day, serving size 25 g** **2. Eat maize products 3 times per day, serving size 87 g** 3. Eat liver once per week, serving size 78 g **4. Eat green leafy vegetables every day, serving size 77 g** **5. Eat beans every day, serving size 98 g** **6. Eat dairy foods 4 times per week, serving size 25 g** 7. Eat vitamin C–rich fruit 4 times per week, serving size 75 g	12.9

Table 29. Key Differences between FBRs with Micronutrient Supplementation for Each Target Group for the Primary and Secondary Datasets

Target Group	Differences in FBRs	
	FBRs: Primary Data—2012 FANTA Optifood Study	FBRs: Secondary Data—2011 Guatemala HCES
Infants 6–8 months, breastfed	Potatoes and eggs 3 times per week	Green leafy vegetables once per day
Infants 9–11 months, breastfed	Incaparina 3 times per week Potatoes and eggs 3 times per week	Incaparina once per day Green leafy vegetables 4 times per week
Infants 12–23 months, breastfed	Incaparina 4 times per week Maize 4 times per day Potatoes and eggs 4 times per week	Incaparina once per day Maize 2 times per day
Infants 12–23 months, non-breastfed	Incaparina 5 times per week Maize 4 times per day Potatoes and eggs 4–5 times per week	Incaparina 2 times per day Maize 2 times per day Dairy foods once per day
Lactating women	Incaparina once per day Vegetables 4 times per day Potatoes once per day	Incaparina 2 times per day Green leafy vegetables once per day Beans and dairy foods 4 times per week
Pregnant women	Incaparina once per day Maize 4 times per day Vegetables 4 times per day Potatoes once per day	Incaparina 2 times per day Maize 3 times per day Green leafy vegetables once per day Beans once per day Dairy foods 4 times per week

6 Discussion

Sustainable and feasible dietary improvement to ensure adequate nutrient intake among children 6–23 months and PLW is essential to improve the nutritional status, and therefore contribute to the reduction of the prevalence of stunting in developing countries like Guatemala (WHO 2008). Efficient and cost-effective tools to develop pilot FBRs contribute to the process for dietary improvement among these vulnerable groups. However, the collection of primary dietary data through 24-hour dietary recalls and ideally, food frequency questionnaires, to develop the inputs for Optifood analysis to develop pilot FBRs can take time and resources (financial and human), can be invasive for participants, and is subject to measurement error (Fiedler 2009). This study served to validate whether existing, periodically collected HCES data could serve as a proxy for 24-hour dietary recall and food frequency data to develop Optifood inputs and outputs, including pilot FBRs. The findings, summarized in Box 2, generally indicate that the pilot target group FBRs were largely comparable between the two datasets, except, in some cases, a relatively higher frequency of consumption of some FBRs derived from the secondary data, and inclusion of one or two different foods or food groups in the FBRs developed using the secondary data. The next step in the process of final FBR development would be to test pilot FBRs at the household level.

Given that pilot food-based recommendations developed with Optifood need to be validated through household-level testing, the results presented here suggest that existing household-level apparent consumption data derived from HCES can be used to generate data inputs for Optifood, model realistic diets, and develop context-specific pilot FBRs for household-level testing without costly primary dietary data collection. The findings are promising, suggesting that similar analyses could be conducted of appropriate apparent consumption data derived from (HCES) in other settings both within Guatemala and in other countries to identify potential approaches for optimizing local diets. However, the assumptions when HCES data are used in Optifood analysis require further consideration. These assumptions and considerations are discussed below, as well as a summary of the strengths and limitations of use of HCES data in Optifood, implications of the findings, and recommendations regarding use of HCES as a source for secondary for analysis in Optifood.

6.1 Use of HCES Data for Optifood Inputs: Considerations Regarding Assumptions

Assumption: Food distribution in households is directly proportional to the energy requirements of each person in the household. This is a critical assumption because the feasibility and acceptability of the FBRs for all target groups hinges on food availability and access of each target group and current intrahousehold food distribution and food intake practices. While some bias has been identified, two international reviews concluded that intrahousehold distribution of energy generally is relatively equitable (Berti 2012; Haddad et al. 1996). However, in general, distribution of protein and micronutrients may be less equitable; for example, males may be favored, household heads may receive larger portions, and firstborn children could be treated differently than their siblings when animal-source or other costly food is allocated (Haddad et al. 1996). There may also be local taboos or beliefs that influence whether certain foods or food types are fed to different target groups. For example, it has been suggested that children in remote areas of Chiantla, Huehuetenango, are not commonly given eggs until they are at least 1 year of age (Knight 2013), and some local food taboos for pregnant women have also been identified (FANTA 2014). Although it represented nutrient intake of 1 day, an INCAP analysis of the primary (2012 FANTA

Box 2. Main Findings: Comparison of Optifood Inputs and Outputs Using Secondary (2011 Guatemala HCES) Apparent Consumption Data and Primary (2012 FANTA Optifood Study) 24-Hour Recall and Food Frequency Data

Optifood inputs

- Food lists generated using the secondary data were more diverse than the food lists from the primary data, reflecting secondary data collection that covered more seasons and geographic areas, and may allow for more flexibility in modeling diets, but feasibility and acceptability of the modeled diets would need to be tested at the household level.
- Proxy portion sizes appeared to provide relatively good estimates for less expensive and more commonly consumed foods, but may overestimate serving sizes for more expensive and less commonly consumed foods and foods purchased/acquired less frequently, particularly for young children, and in some cases for pregnant women and lactating women. Preliminary portion sizes must be tested at the household level as a part of testing FBRs.
- Model constraints including low, average, and high servings per week for food groups and low and high servings per week for FSGs were mostly comparable for target groups using the two datasets. In many cases, the secondary data allowed for equal or greater flexibility in modeling, given higher upper constraints, but lower constraints that included at a minimum daily or twice-daily consumption of some foods or food groups would require testing to determine feasibility and acceptability.

Optifood outputs

- The Optifood Module 2 best diets were similar using the two datasets. Across both sets of analyses, diets were often optimized with similar foods or food groups and with somewhat similar servings per week.
- Problem nutrients were identical for three out of the six target groups using both data sources (children 6–8 months, non-breastfed children 12–23 months, and lactating women). For the remaining three groups, one to three nutrients were identified as problem nutrients using the primary data but not the secondary data, possibly because of the greater variety of foods available for modeling in the secondary data, or for pregnant women, that household apparent consumption was distributed based on heightened energy requirements during pregnancy, which might not reflect household practices.
- For each nutrient, Optifood identified over half of the same best food sources using the two datasets, and for iron and folate the foods selected were all, or nearly all, the same. The pilot FBRs developed using the two datasets, were generally comparable among target groups regarding foods/food groups and serving sizes, but frequency of consumption for some foods/food groups for some target groups appeared high using the secondary data (e.g., daily Incaparina consumption for children 9-23 months in FBRs with micronutrient supplementation), and all FBRs require testing at the household-level to ensure feasibility and acceptability.
- The more varied secondary (2011 Guatemala HCES) food lists enhanced the ability to test recommendations at the FSG level, which may provide more options for families across diverse geographical areas and seasons when adopting the FBRs.

Optifood study) 24-hour dietary recall data used in this study suggested that PLW had relatively low caloric adequacy (77–94 percent) (FANTA 2014).[32] Optimization of diets for PLW was generally less achievable using the primary (2012 FANTA Optifood study) data compared to the secondary (2011 Guatemala HCES) data, perhaps because the redistribution of household apparent consumption for the HCES analysis was based on increased energy requirements during pregnancy and lactation, when in reality PLW's energy needs might not be met. Frequency of food consumption in some secondary data FBRs appeared relatively high, given results of household-level FBR testing that was conducted after the primary data used in this study was collected (FANTA 2015)—for example, Incaparina for children 12–23 months; Incaparina and dairy foods for non-breastfed children 12–23 months; and Incaparina, beans, and dairy foods for pregnant women.

Because of the risk of over- or underestimation of food intake using HCES data, an important question is "Is there a way that AMEs can be adjusted to better reflect local reality?" One approach may be to determine if secondary data on food consumption and intrahousehold food allocation exist and could be used to inform adjustments to Optifood inputs developed using HCES data. If secondary data are not available, primary data may need to be collected on a small scale using qualitative methods with relevant age- and sex-specific target groups, or mixed groups, depending on the context. AME adjusments using the latter data could, for example, result in excluding an AME for a food or a food group for a target group, or adjusting the AME by an identified factor considering intrahousehold distribution. The adjustments would be context-specific. Testing of adjustments to AMEs based on local reality could possibly result in the development of adjustment factors based on specified criteria. Adjusted FBRs would need to be tested in Optifood to determine nutrient gaps that may remain, and any nutrient gaps would require consideration in policy or program design. In addition, secondary data on child nutritional status, IYCF practices, anemia, and/or other indicators of nutritional status could be reviewed to consider the types of nutrient gaps that could be found in the target groups, and to determine if the estimates of apparent consumption appear realistic, given the available data.

Assumption: All food acquired in the recall period is consumed by the household in the defined period and not stored, sold, bartered, given as a gift, fed to animals, or thrown out. The AME approach assumes that all foods purchased or produced by a household in the two-week recall period are eaten within the specified recall period and that only these foods were consumed. This method would consider foods as consumed even if they were acquired in the period but stored for later consumption, wasted, used for animal feed, sold, or given as a gift; and would not include foods that were consumed after being bought or produced and stored in the period prior to the recall in the survey (Imhoff-Kunsch et al. 2012). Regarding storage of food, studies have shown that randomly selected households in a population are equally likely to be drawing down on food stocks as they are to be accumulating them, so target group consumption estimates at the population level should not be greatly affected by stored food (Smith and Subandoro 2007).

The 2011 Guatemala HCES did not capture data on whether a household's obtained food during the recall period was sold, bartered, given as a gift, fed to animals, or thrown out. Most households in the 2011 Guatemala HCES owned an animal, so it is possible that some produced or purchased food was used for livestock feed and consequently, the apparent household consumption could have been overestimated (INE 2011; Smith and Subandoro 2007). Although it is possible that wasted food results in some overestimation of consumption (Fiedler et al. 2012b), it has also been reported that food waste at the consumer level is low in developing countries compared to developed countries (FAO 2011). Secondary

[32] Caloric adequacy for pregnant women was 81 percent in Huehuetenango and 77 percent in Quiché, and for lactating women 84 percent in Huehuetenango and 94 percent in Quiché (FANTA 2014).

data on practices such as bartering and gifting, using food for animals, or throwing out food would be useful to determine if adjustments to quantities of food may be needed. If secondary data are not available, primary data collection using qualitative methods with relevant target groups, as a part of the qualitative studies mentioned above, could help clarify what the practices are, if they impact food consumption, and how food quantities could be adjusted.

Assumption: Estimated breast milk intake is similar using the secondary (2011 Guatemala HCES) and primary (2012 FANTA Optifood study) data. Estimated quantities of daily breast milk intake for children 9–11 and 12–23 months were very similar for the secondary (2011 Guatemala HCES) and primary dataset (2012 FANTA Optifood study) target groups, but the estimated amount of breast milk for children 6–8 months in the secondary dataset was notably higher than the amount modeled using the primary data. As noted above, for the secondary data, breast milk intake was estimated as 67 percent of the median estimated energy requirements for children 6–8 months (Brown et al. 1998), while for the primary data, estimated energy from breast milk equaled the median estimated energy requirements for the target group, minus the median observed energy intake from complementary foods from the 24-hour recall data. Estimated breast milk intake among infants 6–8 months of age in the primary data is lower than that from the secondary data likely because infants in the primary dataset represented children at the older end of the 6–8 month age range, and these children may be accustomed to consuming more solids This meant that the higher breast milk quantity in the diets for children 6–8 months in the secondary dataset could provide more nutrients; however, less energy was left over to model complementary foods, and therefore, the requirements of some nutrients could be met using fewer servings per week of FBR foods compared to the FBRs developed with the primary data. In addition, it was not possible to test greater quantities of some foods with the secondary dataset, as their inclusion would have exceeded 100 percent of energy requirements, thus exceeding energy constraints.

It may be that the approach used to estimate breast milk intake in the primary dataset was not ideal. Generally, energy needs from complementary foods for young children are estimated by subtracting average breast milk energy intake from total energy requirements (PAHO and WHO 2004). Given the latter, and the limited availability of country-specific data on the volume of breast milk intake by age, the use of average breast milk intake derived from international studies may be a better approach for estimating breast milk intake than the approach used for the primary data. If an infant is consuming an amount of breast milk that differs from the average, the amount needed from complementary foods will vary accordingly. Because it is not feasible for caregivers to know precisely the amount of breast milk consumed by an infant, it is important that the amount of food offered be based on responsive feeding, actively encouraging and assisting an infant with feeding and responding to a child's hunger cues, while ensuring appropriate energy density and meal frequency (PAHO and WHO 2004). The results further highlight the need to always promote age-appropriate breastfeeding in addition to FBRs developed for children 6–23 months.

Despite the difference in estimated breast milk intake for infants 6–8 months of age using the two datasets—given that modeled diets for children 6–8 months, as well as the modeded diets for other child target groups, were considered reasonable by the Guatemalan expert working group; that energy constraints were adhered to in the Module 2 best diets; and that Optifood outputs were comparable to those generated using the primary data—it may be concluded that estimating breast milk consumption using international studies to complement the HCES apparent consumption data for use with Optifood was viable in this situation.

6.2 Strengths and Limitations of HCES Data for Optifood Inputs

Table 30 provides a summary of strengths and limitations of using HCES data for Optifood inputs compared to primary 24-hour recall and food frequency questionnaire data. Using secondary data to prepare inputs for an Optifood analysis can save time and money, but as HCES data are not collected specifically for Optifood use, some key variables used to define target groups may not be collected, such as age in months, breastfeeding status of infants, or women's lactation status.[33]

In HCES surveys, closed lists of foods or food types are generally used when asking about production or purchase, but it can be difficult to determine nutrient composition for some foods because data are usually not collected on specific food brands, varieties, and cooking methods, and information on rare foods may not be included. In addition, the proposed method of using HCES data for Optifood analysis relies on the availability of secondary dietary reference data for estimating portion sizes. Depending on the location, portion size data specific to the target population may not exist and assumptions based on similar populations will be needed or primary data may need to be collected to determine portion sizes.

As mentioned, HCES data are nationally representative random samples of all households within a population as opposed to households with predefined target group members. For the analysis in this report, data from households with a member of a key target group (e.g., infants 6–8 months of age, pregnant women) were selected from the overall Guatemala HCES dataset. If the Optifood target group makes up a small proportion of the overall population, such as children 6–8 months of age, few households in the HCES dataset may be included in the sample for the Optifood analysis. The sample size depends on the size of the geographic area selected, the original scale of HCES data collection, and the target group. If sample sizes for the Optifood analysis are very small, this may mean that for some target groups, it may be preferable to focus on multiple rather than individual geographic areas (districts or departments) to obtain a larger sample size for the Optifood analysis from the HCES dataset.

Undoubtedly, the chief concern with using HCES data is that dietary intake is derived from apparent consumption and assumes foods are consumed by household members per the energy requirements of each member of the household. As noted, there is a risk of over- or underestimation of the quantity of food consumed, that the availability and/or consumption of certain foods for specific target groups could be inflated and/or that food lists are not as varied as they appear. A further assumption is that foods consumed by 5 percent or more of households are available to all families in the population, which is an assumption also made when using 24-hour dietary recall data in Optifood, and is a key reason for using qualitative household-level testing to determine the feasibility and acceptability of FBRs. Further, given that HCES data are collected from a large geographical area compared to only a few communities when using the primary 24-hour dietary recall, foods from FBRs derived from HCES data may generally be more commonly available and used by households in the geographic area represented in the HCES, but may or may not be readily accessible to specific communities—for example, due to physical isolation or the high cost of foods. Nevertheless, the use of HCES data that is representative of a large geographic area where the population has similar dietary patterns is attractive for programs intended for these areas.

Use of HCES datasets would allow analyses for other vulnerable target groups such as adolescent girls, aging adults, or school-age children. In addition to developing pilot FBRs, HCES data could be used in Optifood to test the need for and potential benefit and cost of different food fortification programs and micronutrient supplements and fortified products in the context of local diets, providing invaluable information for product development and intervention design.

[33] However, the World Bank LSMS, a form of HCES, does include birthdate variables, individual and household identification codes, or pregnancy status (Grosh and Munoz 1996; Tanzania National Bureau of Statistics 2014).

Table 30. Strengths and Limitations of Using HCES Data versus 24-Hour Recall and Food Frequency Data to Generate Inputs for Optifood Dietary Analysis

Data Source	Strengths	Limitations
HCES Apparent Consumption	Regularly collected, existing secondary dataset that is nationally representative. Available for multiple areas. No costs or resources involved in data collection or data entry for use in Optifood. Data refer to > 1 day of consumption. Can model recommendations at FSG level, allowing adaptation to local production/seasonality.	Data available in the sample for specific target groups may be small. Food consumption data refer to apparent consumption only, not actual consumption. Serving size references are needed either from a secondary data source or by collecting primary data. Assumes that all foods reported in the 14-day recall (apart from those not consumed by some target groups—for example, taboo foods that may not be consumed by pregnant women) are consumed proportionally by all members of the household per capita energy requirements. May include generic food types, not specific foods, brands, and varieties. Possible recall bias in the reporting of household consumption given long (1–2 week) recall period.
24-Hour Recall Survey and Food Frequency Questionnaire	Gold standard of dietary data collection and for developing Optifood inputs. Ability to tailor data collection for intended use. Data collected refer to direct, individual consumption. Data include portion sizes consumed for each food. Data include frequency of consumption if food frequency questionnaire used. Data provide a much better picture of the local diet particularly for children under the age of 2 years.	Consumption data are collected for 1 day only and if food frequency data not collected, assumptions are made to estimate consumption frequency. Data collection and processing take a lot of time and resources/high cost, and data collection needs to be repeated for each geographic area and target group for which FBRs are needed to develop tailored FBRs. Skilled staff need to be trained to collect and process 24-hour recall data. Invasive and time-consuming for participants. Collected during one point in time or season only, limiting the diversity of foods available for modeling. Data collection is limited to a narrow geographical area.

6.3 Implications and Key Considerations Based on Study Results

This study has demonstrated that HCES data may serve as an adequate proxy data source for use in Optifood for the development of pilot FBRs. However, there are several implications and key considerations from these study results.

- Assumptions applied when using HCES data must be clearly defined—for example, regarding intra-household food distribution, household use of food during the recall period and other food previously acquired or stored, and estimates of breast milk intake for young children. If feasible, it is important to validate key assumptions by triangulation with relevant secondary data or, if secondary data is not available, with primary data collected on a small scale using qualitative methods. Validation of assumptions may help determine if adjustments to input data for Optifood may be needed to better reflect local realities.

- Estimates of breast milk intake from international data available in the literature, based on average percentage of recommended energy intake derived from breast milk, may be the preferred approach for estimating breast milk intake for use in Optifood given limited country-specific data on volume of breast milk intake by age (Brown et al. 1998, PAHO and WHO 2004).
- The Optifood tool was designed to be used to develop FBRs at a subnational level, given that there are generally different food intake patterns and varied food supply in different regions of a country (Daelmans et al. 2013). One inherent advantage of HCES data is that the data are representative at the subnational level. The Optifood analysis with HCES data should also be conducted separately per region, given differences in food intake patterns and food supply. It would not be appropriate to develop one set of pilot FBRs for a country as a whole using HCES data on a national level.
- All pilot FBRs developed with Optifood through the use of primary or secondary data must be validated through qualitative household-level testing working directly with and within target communities to determine their feasibility and acceptability.

7 Recommendations

Several recommendations on selecting data sources for Optifood analysis, finalizing and promoting FBRs, and designing HCES surveys emerged from this analysis.

7.1 Recommendations Regarding Sources of Data for Optifood Analysis

While this study showed that the 2011 Guatemala HCES served as an adequate proxy data source for use in Optifood for development of pilot FBRs, and that the HCES data may have some advantages over primary 24-hour recall data because the HCES has a longer recall period and data are collected over a longer time period, the limitations to using HCES mean that in certain cases it may be necessary or more appropriate to use the standard 24-hour recall method, especially for ensuring adequate intake of key nutrients, such as iron and zinc for young children and iron for pregnant women.

Consider using HCES data to develop Optifood inputs if:

- Representative relevant HCES data are available for the study area.
- Available HCES data are sufficiently recent to reflect current food availability and dietary patterns.
- The HCES dataset includes the variables needed to define key target groups and estimate apparent consumption, as well as an adequate sample for each target group (e.g., children 6–8, 9–11, 12–23 months, pregnant women, lactating women).
- Secondary dietary data relevant to the study population are available for estimating portion sizes.
- Time, capacity, and/or costs are constraints to collecting and processing 24-hour recall data.

Consider collecting or use existing 24-hour recall data if:

- Time and cost are not constraints.
- Representative relevant HCES data are not available for the study area.
- Analysis covers specialized or small populations not adequately included or identified in the HCES.
- 24-hour recall datasets already exist for the study population or will be collected—for example, as a part of a baseline evaluation or for monitoring purposes.
- If existing 24-hour recall data will be used, they are sufficiently recent to reflect current dietary patterns—for example, at least within the last 3–5 years and the target group/s and geographical region/s of interest.
- Secondary data for estimating serving sizes of foods from HCES datasets are not available.
- Seasonality or seasonal variation in food access or consumption is negligible.

7.2 Recommendations on Finalizing and Promoting FBRs

By themselves, FBRs are not that useful if they are not feasible and acceptable for families to practice and adopt to improve the diets of children and women (and other family members as relevant). As such, development of pilot FBRs with Optifood is part of broader process for FBR validation and finalization. The finalization of FBRs through validation in the field is critical to ensure FBRs are acceptable and feasible. The following are recommendations in the process for finalizing and promoting FBRs.

- Given the assumptions regarding portion sizes, food availability, and acceptability of consumption of household food by key target group members, FBRs derived from both HCES and 24-hour recall data should be validated for use in the population through testing at the household level (e.g., using methods such as Trials of Improved Practices [TIPs]).[34]
- Based on the results of household-level testing, FBRs should be adjusted to include foods, quantities, and preparations deemed feasible and acceptable for target populations.
- Promoting final FBRs should be part of a comprehensive behavior change strategy and informed by the results of the household-level testing, as well as any other necessary formative research to incorporate motivations for adopting the FBRs, methods for sustaining FBR use, and key influences on feeding behaviors, including the influence of other family and community members.
- The ability of the FBRs to meet nutrient requirements for breastfed children depends on adequate breast milk intake, so age-appropriate breastfeeding should always be promoted along with FBRs for children 6–8, 9–11, and 12–23 months of age.

7.3 Recommendations for HCES Survey Design

Additions to the design of HCES data collection and preparation for implementing standard methods such as the LSMS could facilitate the identification of target groups and the indirect measurement of food consumption to develop Optifood inputs. A "wish list" of recommended adjustments to current methods are in Table 31 (Fiedler 2009).

Table 31. Possible Additions[a] to Future Guatemala HCES or Other HCES Data Collection or Changes to Dataset Presentation to Facilitate the Indirect Estimation of Food Consumption and Generation of Inputs for Optifood Analysis

Recommended Modification	Survey	Dataset	Justification
Record date of birth for each household member on household roster	X		Allows calculation of age in months
Include date of birth for each household member in public dataset		X	Allows calculation of age in months and analysis of < 1-year target groups
Include de-identified individual household member and household identification codes in dataset		X	Used to redistribute household apparent consumption using AMEs
Record whether on household roster any women of childbearing age in the household are pregnant or lactating	X		Would allow more precise estimation of apparent consumption of women target groups
Record the breastfeeding status of children < 2 years in household roster	X		Would allow more precise estimation of apparent consumption

[34] The TIPs methodology can be used to evaluate whether Optifood-generated FBRs are feasible and acceptable by exploring intention to use and use of FBRs as well as identifying barriers to putting them into practice and motivations for their use (Daelmans et al. 2013; Dickin et al. 1997; Lutter et al. 2013; PAHO 2013).

For each food produced, acquired, or purchased, include questions on: Whether some/part of a food was stored, sold, bartered, or received/given as a gift Whether all/some household members consumed this food Whether some/part of a food was fed to animals Whether any food was wasted or thrown out	X		Eliminates need to make assumptions about foods available to household
Provide options for differentiating between similar food types for which nutrient content may differ considerably (e.g., fortified and nonfortified sugars and flours)	X		Use of more specific FCT for modeling diets

[a] Some of the recommended additions are already part of HCES design for some countries or standard methods but not necessarily all.

8 Conclusions

The analysis presented here suggests that it is possible to use HCES data as a proxy or alternative to primary data, when the data allow for estimation of individual-level apparent consumption, to generate inputs for Optifood analysis and develop pilot food-based recommendations for optimizing diets of key target groups using locally available foods. These results are promising, indicating that primary data collection may not always be necessary for use of Optifood. Optifood may be used to develop pilot FBRs with existing HCES datasets at a lower cost and within a comparatively shorter time frame than when its use involves primary data collection. This activity found additional and unexpected advantages of using HCES data, including greater food list variety and the enhanced ability to model FBRs at the food subgroup level. Still, confidence in pilot FBRs developed with HCES data may be limited by the assumption that intrahousehold food distribution is equitable and by the need to access other secondary data to estimate and/or validate typical serving sizes. Further analyses are needed to: validate these findings in other contexts; explore possible methods to adjust AMEs to better reflect local realities; and test the application of HCES data in Optifood for other target groups, such as adolescent girls. The results have implications for improving nutrition program planning and evaluation through the development of pilot food-based recommendations based on HCES data for validation through household-level testing, and incorporation into nutrition program design and implementation for vulnerable target populations. Results could also potentially influence the design of future HCES data collection to facilitate data use in Optifood.

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Appendix 1. Overview of the Optifood Analysis Modules

Table A1. Four Optifood Analysis Modules, Purpose, Outputs, and Questions Answered

Module	Purpose	Outputs	Questions Answered
1. Check diets	To check that the model parameters entered will lead to the generation of realistic diets	18–21 diets,[a] including two diets to define the possible energy range, that would be possible within the set parameters	1. Are the diets generated realistic?[b] 2. Do changes need to be made to model parameters to make sure generated diets are realistic?
2. Identify draft recommendations	To identify the best diet possible given local foods and dietary patterns, identify problem nutrients and best food sources, and formulate FBRs	Generates the best two diets possible within model constraints. Both diets come as close as possible to meeting recommended nutrient intakes: Diet A is within the model constraints and follows average food group patterns Diet B does not have to follow food group patterns but must come within the model constraints	1. Is it possible to meet nutrient requirements for the target group using a) local foods according to dietary patterns of the population or b) any combination of local foods? 2. Which nutrients are problem nutrients? 3. Which local foods are the best sources of necessary nutrients? 4. What are the nutrition and cost implications of promoting foods that deviate from the average dietary patterns? 5. Which foods should be tested as part of FBRs?
3. Test food-based recommendations	To test and compare alternative sets of FBRs and classify problem nutrients as partial or absolute	Comparison of the nutrient content and cost of diets using different FBRs	1. Which set of FBRs is best for the target population, taking at least 65% of RNI in the minimized diet and cost into consideration? 2. Are FBRs likely to ensure that nutrient requirements are met?
4. Cost analysis	To generate the lowest-cost, nutritionally best diet	Cost, content, and nutrition value of the lowest-cost, nutritionally best diet Estimates of each nutrient's contribution (in %) to the diet's cost?	1. What is the lowest-cost nutritionally best diet for this target population? 2. Which foods are most expensive in the lowest-cost nutritionally best diet? 3. Which nutrient requirements are the most expensive to meet?

Source: Daelmans et al. 2013.

[a] The diets generated in Module 1 are not nutritionally adequate and are not intended to be promoted. These diets are generated only to show the range possible using the set parameters and should be reviewed by the user to check if the outcomes are realistic and if any parameters need adjustment

[b] Would the diet in question be eaten by at least one person in the target population?

Module 1 – Checking Diets

Module 1 is used to check that the parameters will model realistic diets and that there is sufficient flexibility in energy range. Within the set model constraints, this module generates 18–21 different diets, using diverse objective functions for each, to demonstrate the range of possible diets that could result from the data inputs.

The resulting Module 1 diets for each target group were reviewed by a group of Guatemalan nutrition experts. The reviewers looked for any examples of diets or foods that would not be consumed by at least some members of the target group, such as diets with an unfeasible amount of animal-source foods or too few staples. Once satisfied that the models were generating realistic diets, the model parameters were locked for further analysis.

Module 2 – Identifying Draft Recommendations

Identifying Best Diets

The second Optifood module is used to answer a series of questions regarding the possibility of optimizing diets for each target group. To begin, two different diets are generated:

> **Best Diet A:** *The best diet possible if local foods are used according to average dietary patterns.* This diet is modeled to meet or come as close as possible to meeting 100 percent of the RNIs for selected nutrients[35] (objective function) while remaining within average food group constraints (50th percentile of consumption), which are set to represent average dietary patterns. If the diet cannot meet 100 percent for each nutrient, the software tries to get as close as possible to 100 percent of the RNI without affecting the balance of other nutrients This diet represents the absolute best diet possible if adhering to the target group's average food patterns. Note this analysis is not used to determine adequacy of actual dietary intake. It is designed to determine the possibility of optimizing diets for each target group using local foods within reaslistic consumption patterns.

> **Best Diet B:** *The best diet possible using local foods, not taking average dietary patterns into account*. This diet is modeled to meet or come as close as possible to meeting the RNIs for selected nutrients (see footnote) (objective function) using local foods within the upper and lower model constraints for the target group only. Diet B represents the nutritionally best diet possible for this target group given available foods and median portion sizes. This diet deviates from the population's average observed dietary patterns to optimize nutrient intake. As such, putting this diet into practice could require significant behavior change and have cost implications.

For each diet, results are provided on the percentage of RNI achieved for each nutrient and content in terms of servings per week from foods, food groups, and FSGs. The results were then examined to determine whether it is possible to meet or come close to meeting requirements for the eleven modeled nutrients using local foods and, if so, how much would existing dietary practices have to change to achieve this.

The Module 2 analysis was run for each 2011 Guatemala HCES target group. Outputs were compared to those from the 24-hour recall analysis.

[35] Calcium, vitamin C, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin A, vitamin B12, iron, and zinc.

Identifying Best Food Sources and Drafting FBRs

The results from Module 2 Diets A and B are used to identify the best food sources and FSG sources of problem nutrients. For each diet, the top five FSG sources that provided more than 5 percent of each nutrient's RNI were identified. This process was used to list the foods or FSGs that were the most nutrient-dense—meaning they were key sources of one or more nutrients—for each target group.

Module 2 results were examined again to compare the number of servings per week of the best food/FSG sources in Diet A to those in Diet B. If the number of servings per week of a food, food group, or FSG increased from Diet A to Diet B, then it indicated that Optifood chose this food or group as it was a significant source of nutrients. Key foods/FSGs, as well as the number of servings/week included in Best Diet B, were listed as draft FBRs for testing in Module 3.

Module 3 – Testing FBRs

In Optifood Module 3, different food- or FSG-specific FBRs are tested and compared. For each FBR tested, a new analysis is created. In each analysis, the user specifies the recommendation (for example, three servings per week of milk), which is tested in the context of both the best-case scenario, or maximized diet, and the worst-case scenario, or minimized diet, for the target group.

Once all FBRs have been entered and analyzed separately, results are combined to determine if at least 65 percent of the RNI can be achieved for nutrients in a minimized diet using different combinations of FBRs. Using this combine function, all possible combinations of FBRs are analyzed (see example in Table A2). This process enables the user to see which FBR additions could increase nutrient intake and which combinations would not result in any additional benefit to the target group.

Table A2. Example of Testing FBRs Using Module 3

Number of FBRs Tested in One Analysis	FBR/Set of FBRs Tested and Number of Servings per Week Modeled for Each Food or FSG
1	Milk 7 Egg 2 Tortilla 4 Tomato 2
2	Milk 7 + Egg 2 Milk 7 + Tortilla 4 Milk 7 + Tomato 2 Egg 2 + Tortilla 4 Egg 2 + Tomato 2 Tortilla 4 + Tomato 2
3	Milk 7 + Egg 2 + Tomato 2 Milk 7 + Egg 2 + Tortilla 4 Milk 7 + Tomato 2 + Tortilla 4 Tomato 2 + Tortilla 4 + Egg 2
4	Milk 7 + Tomato 2 + Tortilla 4 + Egg 2

For each FBR or combination of FBRs analyzed, Module 3 generates two sets of diets:

A. **Maximized nutrient intake:** In the first set of diets, energy and nutrient intakes are individually maximized to show the percentage of RNI achievable if this FBR was put into practice in the context of the best-case scenario, where the highest possible amount of a nutrient was provided.

B. **Minimized nutrient intake:** In the second set of diets, energy and nutrient intakes are individually minimized to show the percentage of RNI achievable if this FBR was put into practice in the context of the worst-case scenario, where the lowest possible amount of a nutrient was provided. As minimized nutrient intake is used to determine if FBRs can cover nutrient requirements, the worst-case scenarios in terms of food sources and serving sizes are modeled in Optifood during Module 3. This means that foods and serving sizes that would provide the lowest amount of a nutrient would be modeled first when testing a recommendation, instead of modeling an average amount. The results would then suggest that more servings of these foods are needed to meet the RNI for key nutrients.

The main goal of the FBR testing process is achieving minimized diets with at least 65 percent or higher of the RNI for nutrients. Additionally, important factors in the testing process included achieving at least 65 percent of the RNI in the minimized diet at the lowest cost with the fewest individual recommendations possible, harmonizing FBRs with those of other target groups, and using foods in quantities the target population was likely to accept. The criterion for meeting acceptable nutrient needs in Module 3 is the achievement of 65 percent or more of RNI for a nutrient in the minimized, worst-case scenario diet. The minimized diets represent the lower tail (approximately 5th percentile) of a nutrient intake distribution for the population. As such, a cut-off of 65 percent or more of RNI in the minimized diets would mean that the level of nutrient inadequacy would probably be below 2–3 percent for the population. If less than 65 percent of RNI is achieved for a modeled nutrient, the number of individuals in the target population at risk of nutrient inadequacy would likely be higher, meaning that nutrient adequacy was not being met.

For the analysis of the 2011 Guatemala HCES data in Optifood, FBRs were tested in three stages for each target group:

- The draft FBRs for foods and FSGs (developed using Module 2 results) were entered individually and tested in different combinations. The aim was to achieve at least 65 percent of the RNI in the minimized diet for the most nutrients possible using the fewest FBRs considered acceptable and feasible by researchers, at a reasonable cost.
- FBRs were modified to try to increase the number of nutrients for which requirements were met and to maximize the FBRs' feasibility, acceptability, and affordability. Modifications included increasing the frequency of servings per week of individual foods or from FSGs, within the model constraints. If the requirements for remaining nutrients were met at this stage, no further modifications were made.
- If difficulties in meeting nutrient requirements persisted or if the FBRs were considered impractical,[36] modifications that lay outside the model constraints but were considered acceptable by the local analysis team were made to the FBRs. This could include slight increases to serving sizes or frequencies, for example:

[36] FBRs are viewed as impractical if they are too expensive, difficult to recommend, or unacceptable in terms of gastric capacity or cultural preferences.

- Increasing the upper constraint (servings/week) of Incaparina from four to seven to meet calcium requirements
- Adjusting the upper constraints for green leafy vegetables (GLV) from five to seven servings per week to allow the recommendation of giving GLV every day, if this was considered acceptable by local experts

This process resulted in a final set of FBRs that, if adopted, would likely meet the required acceptability for the highest number of nutrients achievable, using the fewest individual recommendations at the lowest cost possible. A final set of FBRs and a list of remaining nutrient gaps were defined for each target group. Individual FBRs were defined by a specific food or FSG that was being recommended and the number of servings per week of this food or of foods from this FSG to include in the diet.

The final recommended serving size for each FBR was the estimated portion size for an individual food listed in Optifood or, if FSG-specific, the median of all estimated portion sizes of individual foods within the subgroup. Extreme outliers were not taken into account. Portion sizes were rounded to the closest whole digit.

Identifying Problem Nutrients

Problem nutrients were classified as being either partial or absolute problem nutrients, as per the criteria in Table A3.[37] Problem nutrients were identified for each 2011 Guatemala HCES target group to determine which nutrient gaps to prioritize in FBR development and which foods to promote. The findings were compared to the problem nutrients identified using 2012 FANTA Optifood study using 24-hour recall data.

Table A3. Criteria for the Classification of Problem Nutrients Using Optifood Modules 2 and 3 Results

Nutrient Classification	Criteria	Description
Problem nutrient	100% of RNI is not met in either Diet A or Diet B in Module 2.	100% of RNI cannot be met even in a diet (Best Diet B) that uses local foods in larger or smaller quantities than would be observed in the average food patterns.
Partial problem nutrient	100% of RNI is not met in Module 2 but can be met in a maximized diet when Module 3 is run without FBRs.	It is possible to meet 100% of RNI for this nutrient but only with significant behavior change and probably to the detriment of other nutrient intakes.
Absolute problem nutrient	100% of RNI is not met in Module 2 and cannot be met in a maximized diet when Module 3 is run without FBRs.	It is not possible to meet the requirements for this nutrient using local foods.

[37] Optifood's Module 2 is used to identify 1) nutrients for which RNIs could not be met in the best diet modeled outside of average dietary patterns (Diet B) and 2) the highest percentage of RNI achievable for each nutrient. Module 3 is first run without FBRs—that is, based on observed (low or average consumption) dietary practices—to determine the nutrient intake possible in the best- and worst-case scenario diets (maximized and minimized diets) and provide a benchmark diet for comparing different FBRs. If less than 100 percent of a nutrient's RNI is achieved in the Module 2 diet but 100 percent or more of the RNI can be met in the Module 3 maximized diet, then the nutrient is classified as a partial problem nutrient. If less than 100 percent of a nutrient's RNI is achieved in the Module 2 diet and 100 percent of RNI cannot be met in the Module 3 maximized diet, then the nutrient is classified as an absolute problem nutrient. Thus, Module 3 is used to distinguish between partial and absolute problem nutrients, while the presented percentage of nutrient adequacy achievable in optimized diets comes from Module 2.

It is worth noting that the cut-off of 100 percent of RNI used to identify problem nutrients in Module 2 is different from the cut-off of 65 percent of RNI used to assess the potential nutrient acceptability of FBRs in Module 3. This is because Module 2 generates the best diet possible using local foods and the model constraints. In contrast, the Module 3 results used in FBR testing show the percentage of RNI achievable for each nutrient in the "worst-case scenario" where nutrient intake is minimized (lower tail of intake distribution). In this circumstance, the majority of diets consumed by target group members would have a nutrient composition higher than that of the minimized diet, meaning that a cut-off at a lower percentage of RNI could be used as an indicator of nutrient acceptability.

Module 4 – Cost of Diet

Optifood's Module 4 runs a dietary cost analysis using the input data and model constraints. This analysis generates the lowest-cost, nutritionally best diet and shows the diet's cost and content. This module was applied to the 2011Guatemala HCES dataset and the results were used to help understand the cost implications of providing a diet that met or came as close as possible to meeting nutrient requirements for the target group in question.

Appendix 2. General HCES versus 2011 Guatemalan HCES Data

Table A4. Data Relevant to Optifood Analysis Generally Included in HCES Surveys and Comparison with Data in the 2011 Guatemalan HCES

Type of Data	Data Generally Included in HCES Surveys[a]	2011 Guatemala HCES
Sample size	Between 7,000 and 20,000 households	13,531 households
Collection of consumption data	Diary approach (73%) and recall (27%)	Recall approach
Date of birth for each household (HH) member	Mostly available	Data collected but not publicly available
Individual ID	Mostly available	Data not publicly available
HH ID	Mostly available	Available
Pregnancy status of women	Collected by some HCES only	Available
Breastfeeding status of children	Mostly available	Available
Lactation status of mothers	Not generally collected	Not collected
Whether any of the food produced or purchased was sold, bartered, wasted, or fed to animals	Collected by some HCES only	Not collected
Open or closed food list	Mainly closed list of foods; significant variation in length	Closed list of foods
Foods “produced” and “purchased” grouped as apparent consumption	Generally grouped	Not grouped; separate datasets must be merged
Length of apparent consumption	Week or fortnight	Fortnight
Public accessibility	Generally publicly accessible	Yes
Anthropometry	Some include	Does not include
Cost	Yes, separate market surveys	Only estimated by family, not a good reference

[a] Source: Fiedler et al. 2012a.

Appendix 3. Estimation of Daily Energy Intake from Breast Milk and Calculation of AMEs for Guatemalan Children and Adults

Table A5. Target Groups Identified in the 2011 Guatemala HCES Dataset and Estimation of AMEs, Taking into Account Recommended Energy from Breast Milk for Breastfed Children 6–23 Months

Target Group	Energy Requirement	Calculation of Daily Energy Requirement That Takes Breastfeeding into Account			AME = Target Group Energy Requirement (for Breastfed Children, the Adjusted Energy Requirement)/Energy Requirement for Adult Male 30-50 years
	A. Energy Requirement for Target Group[a]	B. Recommended % of Energy from Breast Milk (% of Requirement)	C. Recommended Energy from Breast Milk (A*B)	D. Adjusted Energy Requirement (A–C)	
6–8 mo BF male	650	67%	435.5	214.5	0.083
6–8 mo BF female	600	67%	402	198	0.076
6–8 mo NBF male	650	0%	0	650	0.250
6–8 mo NBF female	600	0%	0	600	0.231
9–11 mo BF male	650	55%	357.5	292.5	0.113
9–11 mo BF female	600	55%	330	270	0.104
9–11 mo NBF male	650	0%	0	650	0.250
9–11 mo NBF female	600	0%	0	600	0.231
12–23 mo BF male	950	39%	370.5	579.5	0.223
12–23 mo BF female	865	39%	337.35	527.65	0.203
12–23 mo NBF male	950				0.365
12–23 mo NBF female	865				0.333
2–3-year-old male	1,125				0.433
2–3- yr female	1,047				0.403
3–4 yr male	1,250				0.481

Target Group	Energy Requirement	Calculation of Daily Energy Requirement That Takes Breastfeeding into Account			AME = Target Group Energy Requirement (for Breastfed Children, the Adjusted Energy Requirement)/Energy Requirement for Adult Male 30-50 years
	A. Energy Requirement for Target Group[a]	B. Recommended % of Energy from Breast Milk (% of Requirement)	C. Recommended Energy from Breast Milk (A*B)	D. Adjusted Energy Requirement (A–C)	
3–4 yr female	1,156				0.445
4–5 yr male	1,350				0.519
4–5 yr female	1,241				0.477
5–6 yr male	1,475				0.567
5–6 yr female	1,330				0.512
6–7 yr male	1,575				0.606
6–7 yr female	1,225				0.471
7–8 yr male	1,692				0.651
7–8 yr female	1,325				0.510
8–9 yr male	1,830				0.704
8–9 yr female	1,450				0.558
9–10 yr female	1,978				0.761
9–10 yr female	1,575				0.606
10–11 yr male	2,150				0.827
10–11 yr female	1,700				0.654
11–12 yr male	2,341				0.900
11–12 yr female	1,825				0.702
12–13 yr male	2,548				0.980
12–13 yr female	1,925				0.740

Target Group	Energy Requirement	Calculation of Daily Energy Requirement That Takes Breastfeeding into Account			AME = Target Group Energy Requirement (for Breastfed Children, the Adjusted Energy Requirement)/Energy Requirement for Adult Male 30-50 years
	A. Energy Requirement for Target Group[a]	B. Recommended % of Energy from Breast Milk (% of Requirement)	C. Recommended Energy from Breast Milk (A*B)	D. Adjusted Energy Requirement (A–C)	
13–14 yr male	2,770				1.065
13–14 yr female	2,025				0.779
14–15 yr male	2,990				1.150
14–15 yr female	2,075				0.798
15–16 yr male	3,178				1.222
15–16 yr female	2,125				0.817
16–17 yr male	3,322				1.278
16–17 yr female	2,125				0.817
17–18 yr male	3,410				1.312
17–18 yr female	2,125				0.817
18–29 yr male	2,650				1.019
30–59 yr male	2,600				1.000
60 + yr male	2,150				0.827
18–29 yr female	2,350				0.904
30–59 yr female	2,500				0.962
60 + yr female	2,200				0.846
14–18 yr pregnant adolescent	2394.5				0.921
18–29 yr pregnant women	2,632				1.012
30–59 yr pregnant women	2,782				1.070

Target Group	Energy Requirement	Calculation of Daily Energy Requirement That Takes Breastfeeding into Account			AME = Target Group Energy Requirement (for Breastfed Children, the Adjusted Energy Requirement)/Energy Requirement for Adult Male 30-50 years
	A. Energy Requirement for Target Group[a]	B. Recommended % of Energy from Breast Milk (% of Requirement)	C. Recommended Energy from Breast Milk (A*B)	D. Adjusted Energy Requirement (A–C)	
14–18 yr lactating adolescent	2,617.5				1.007
18–29 yr lactating women	2,855				1.098
30–59 yr lactating women	3,005				1.156

[a]To calculate AMEs that were specific to a rural Guatemalan community and as specific as possible to local energy needs by age and sex, separate energy requirements for boys and girls, and narrow age ranges were used. These age- and sex-specific requirements were estimated using the INCAP energy requirements (INCAP 2012a), adjusted using methods for developing the Guatemalan Canasta Basica reported in Monroy Valle et al. (2012). The requirements for males and females 0–18 years were determined using suggested age-specific weights from the WHO growth standards (WHO Multicentre Growth Reference Study Group 2006) and the tables in the joint WHO/FAO/UNU protein and energy requirement reports (FAO et al. 2004; WHO et al. 2002; WHO 2004; WHO 2002) (Monroy Valle et al. 2012). Given the paucity of national anthropometric data for men 18 years and older, average weight was estimated from men of shortest stature using FAO/WHO standards, which was 65 kg. Average heights and body mass index for Guatemalan women 15–49 were presented in the 2008–2009 Encuesta Nacional de Salud Materno Infantil (ENSMI; National Maternal and Child Health Survey) (MSPAS 2010b). These were used to estimate an average weight of 45 kg for calculating energy requirements for specific targeted groups of women. Suggestions made by the Economic Commission for Latin America and the Caribbean were used to apply a “vigorous” physical activity level to females and males in rural areas of Guatemala (Monroy Valle et al. 2012).

Box A1. Example of the Methods Used to Redistribute Household Apparent Consumption Using AMEs to Estimate the Quantity Available to Individuals in the Dataset

Household A consists of a man, age 34; a lactating woman, age 30; a girl, age 15 years; a boy, age 3 years; a breastfed girl, age 12 months. The total household AME would be 3.657 (1+1.156 +0.817+0.481+0.203).

- An AME quotient (individual AME divided by total household AME) was calculated for each household member:
  - Male, age 34: 1/3.657 = 0.27
  - Lactating woman, age 30: 1.156/3.657 = 0.32
  - Female, 15 years: 0.817/3.657 = 0.22
  - Male, 3 years: 0.481/3.657 = 0.13
  - Breastfed female, 12 months: 0.203/3.657 = 0.06
- Household A reported that in a 2-week period, they harvested 2.5 kg of beans from their land and purchased another 1 kg of beans. It was assumed that all the beans were consumed by the household members within the 2 weeks.
  - The household-level apparent consumption of beans for the 2 weeks was 3.5 kg (3,500 g)

The total amount of beans apparently consumed was multiplied by the AME quotient for each household member to give the estimated apparent consumption of beans per individual. The estimated bean consumption over 2 weeks would be 1.12 kg for the lactating woman and 210 g for the breastfed infant.

Appendix 4. Estimation of Daily Breast Milk Consumption for Infants in the 2011 Guatemalan HCES Dataset

Table A6. Estimated Daily Breast Milk Consumption Used for Modeling in Optifood for Breastfed Children 6–23 Months

Target Group	Energy Requirement	Calculation of Energy Requirement That Takes Breastfeeding into Account			Estimated Daily Breast Milk Consumption (g) (Assuming 66 kcal/100 g)[b] ([C/66]*100)
	A. Energy Requirement for Target Group (kcal)[a]	B. Recommended % of Energy from Breast Milk (% of Requirements)[b]	C. Recommended Energy from Breast Milk (A*B)	D. Recommended Energy from Complementary Food (A–C)	
6–8 mo. BF children	600	67%	442.2	217.8	670
9–11 mo. BF children	650	55%	363	297	550
12–23 mo. BF children	950	39%	331.5	518.5	502

[a] INCAP 2012a

[b] Brown et al. 1998

Appendix 5. Final Optifood Food Lists Developed for All Target Groups Using 2011 Guatemala HCES Data

Tables A7–A12 present the food lists developed for each target group using the 2011 Guatemala HCES data. A separate, specific food list was developed for each unique target group. As per Methods section 4.2.3, these food lists detail the foods chosen for inclusion in the Optifood analysis (foods consumed by > 5 percent of the study population) and, for each food, the serving size used for that specific target group, the minimum and maximum number of servings that can be modeled per week in the Optifood diets, the cost per 100 g of each food (edible portion) and whether each particular food was classified as either a snack, a starchy staple or neither (designated as "TRUE" if the food item was a snack or starchy staple and "FALSE if it was not).

Table A7. Final Optifood Food List for Breastfed Children 6–8 Months, Using the 2011 Guatemala HCES Data

Food Item (Spanish/English)	Serving Size (g)	Min. # Servings/ Week	Max. # Servings/ Week	Cost (GTQ) /100g	Snack	Starchy Staple
Aceites comestibles/edible oils	3	0	6	2.1	FALSE	FALSE
Aguacates/avocados	14.5	0	3	1.5	FALSE	FALSE
Aguas gaseosas/carbonated beverages	89.4	0	1	1.2	FALSE	FALSE
Ajo/garlic	2.9	0	2	0.64	FALSE	FALSE
Apio/celery	18.6	0	1	0.4	FALSE	FALSE
Arroz/rice	14.4	0	5	0.9	FALSE	FALSE
Arveja/peas	19.6	0	2	0.56	FALSE	FALSE
Atol de maiz/corn drink	10	0	5	1.1	FALSE	TRUE
Avenas de toda clase (e.g., mosh)/oats of all types (e.g., oatmeal)	9.7	0	3	1.07	FALSE	FALSE
Azucar/sugar	7	0	7	0.7	FALSE	FALSE
Bananos/bananas	19.9	0	5	0.6	FALSE	FALSE
Brocolli/broccoli	20	0	3	0.56	FALSE	FALSE
Carne de pollo o gallina/chicken or hen meat	14.9	0	3	3.2	FALSE	FALSE
Cebolla/onion	3	0	7	0.5	FALSE	FALSE
Chiles/chiles	2.9	0	3	1.54	FALSE	FALSE
Chocolate/chocolate	5	0	2	11.2	FALSE	FALSE
Coliflor/cauliflower	19.2	0	3	0.5	FALSE	FALSE
Dulces y confites de toda clase/sweets or confectionary of all types	3.8	0	1	3	FALSE	FALSE
Duraznos/peaches	14.1	0	2	1	FALSE	FALSE

Food Item (Spanish/English)	Serving Size (g)	Min. # Servings/ Week	Max. # Servings/ Week	Cost (GTQ) /100g	Snack	Starchy Staple
Ejotes/green beans	19.1	0	3	0.9	FALSE	FALSE
Embutidos (jamon, salchichas, chorizos, longanizas, etc.)/sausages (various types listed)	14.4	0	3	2.9	FALSE	FALSE
Fideos, tallarines, coditos, pastas de toda clase/noodles, macaroni, pasta of all types	18.4	0	3	2.1	FALSE	FALSE
Fresas/strawberries	14.5	0	1	1	FALSE	FALSE
Frijol (negro, blanco, colorado etc.)/beans (black, white, red, etc.)	19.5	0	5	1.3	FALSE	FALSE
Frijoles enlatados/canned beans	15.4	0	2	2.2	FALSE	FALSE
Galletas/biscuits	17.9	0	2	3.5	FALSE	FALSE
Guisquil/chayote	5	0	4	0.4	FALSE	FALSE
Harina de maiz/corn flour	19.8	0	3	0.8	FALSE	TRUE
Helados, granizadas, etc./ice cream, slushie, etc.	13.4	0	1	3.3	FALSE	FALSE
Hierbas (berro, perejil, macuy, chipilín, culantro, yerbabuena, etc.)/herbs (watercress, parsley, macuy, chipilín, cilantro, peppermint)	9.6	0	7	2.65	FALSE	FALSE
Huevos de gallina/chicken eggs	19.9	0	4	2.4	FALSE	FALSE
Incaparina/Incaparina	9.9	0	4	1.9	FALSE	FALSE
Jugos empacados o enlatados/juices—packaged or canned	96	0	3	1.2	FALSE	FALSE
Leche en polvo[38]/powdered milk	9.4	0	3	8.7	FALSE	FALSE
Lechuga/lettuce	9.8	0	2	3.7	FALSE	FALSE
Limones/lemons	14.1	0	4	1.2	FALSE	FALSE
Maiz (blanco, amarillo, etc.)/corn (white, yellow, etc.)	19.9	0	7	0.3	FALSE	TRUE
Mandarinas/tangerines	14.1	0	2	0.39	TRUE	FALSE
Mangos/mangoes	14.8	0	3	0.6	TRUE	FALSE
Manteca de cerdo/lard	3	0	3	2.33	FALSE	FALSE

[38] Powdered and/or liquid milk appeared in the food lists for breastfed children 6–23 months and was available for modeling. However, these items were not used in the final FBR testing, given national guidelines that these foods not be recommended to breastfeeding infants.

Food Item (Spanish/English)	Serving Size (g)	Min. # Servings/ Week	Max. # Servings/ Week	Cost (GTQ) /100g	Snack	Starchy Staple
Manzanas/apples	13.6	0	2	2.2	TRUE	FALSE
Leche, humana, madura, fluida/milk, human, mature, fluid	670	6.9	7.1	0	FALSE	FALSE
Naranjas/oranges	14.9	0	4	0.9	FALSE	FALSE
Otros atoles (arroz en leche, atol de platano, atolillo, shuco, etc.)/other “atole” drinks (rice in milk, plantain, etc.)	20	0	4	1.07	FALSE	FALSE
Pan dulce/sweet bread	18.6	0	5	1.9	FALSE	FALSE
Pan frances/french bread	17.7	0	3	2.6	FALSE	FALSE
Papas/potatoes	19.9	0	5	0.6	FALSE	FALSE
Pepino/cucumber	19.8	0	2	0.6	FALSE	FALSE
Pescado fresco/fresh fish	14.6	0	3	2.9	FALSE	FALSE
Piñas/pineapples	14.8	0	3	0.4	TRUE	FALSE
Platanos/plantains	15	0	3	0.5	FALSE	FALSE
Queso fresco o duro/cheese—fresh or hard	13.6	0	1	5.4	FALSE	FALSE
Remolacha/beet	19.1	0	3	0.5	FALSE	FALSE
Repollo/cabbage	19.8	0	3	0.2	FALSE	FALSE
Salsas y pastas de tomate/tomato sauce or paste	9.3	0	3	3.2	FALSE	FALSE
Sandias/watermelon	19.8	0	3	0.3	TRUE	FALSE
Semillas tostadas (mania, marañón, etc./toasted seeds (peanuts, cashew, etc.)	14.7	0	3	5.4	FALSE	FALSE
Tamales colorados, negros, de elote etc., chuchitos, etc./tamales (colorados, with tomato and chicken or pork; negros, with a dark sauce; de elote, with sweet corn; etc.)	19.6	0	2	0.7	FALSE	FALSE
Tomate/tomato	19.5	0	5	0.7	FALSE	FALSE
Tortillas de maiz (gramos)/corn tortillas (grams)	20	0	7	0.6	FALSE	TRUE
Visceras de pollo o gallina (menudos)/ chicken or hen viscera (giblets)	14.8	0	2	3.4	FALSE	FALSE
Zanahoria/carrot	19.2	0	4	0.5	FALSE	FALSE

Table A8. Final Optifood Food List for Breastfed Children 9–11 Months, Using the 2011 Guatemala HCES Data

Food Item Spanish/English	Serving Size (g)	Min. # Servings /Week	Max. # Servings /Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Aceites comestibles/edible oils	5	0	7	2.1	FALSE	FALSE
Aguacates/avocados	24.4	0	5	1.5	FALSE	FALSE
Aguas gaseosas/carbonated beverages	142.1	0	2	1.2	FALSE	FALSE
Apio/celery	29.6	0	2	0.4	FALSE	FALSE
Arroz/rice	19.2	0	7	0.9	FALSE	TRUE
Atol de maiz/corn drink	15	0	14	1.1	FALSE	TRUE
Avenas de toda clase (e.g., mosh)/oats of all types (e.g., oatmeal)	14.4	0	7	1.07	FALSE	FALSE
Azucar/sugar	10	0	7	0.7	FALSE	FALSE
Bananos/bananas	24.9	0	7	0.6	TRUE	FALSE
Brocolli/broccoli	29.6	0	3	0.56	FALSE	FALSE
Carne de pollo o gallina/chicken or hen meat	19.3	0	4	3.2	FALSE	FALSE
Cebolla/onion	5	0	7	0.5	FALSE	FALSE
Chiles/chiles	4.8	0	6	1.54	FALSE	FALSE
Chocolate/chocolate	9.6	0	1	11.2	FALSE	FALSE
Coliflor/cauliflower	29.2	0	4	0.5	FALSE	FALSE
Crema fresca/fresh cream	24.9	0	1	3.3	FALSE	FALSE
Dulces y confites de toda clase/sweets and confectionery of all types	8.4	0	1	3	FALSE	FALSE
Duraznos/peaches	24.6	0	5	1	TRUE	FALSE
Ejotes/green beans	28.8	0	5	0.9	FALSE	FALSE
Embutidos (jamon, salchichas, chorizos, longanizas, etc.)/sausages (various types listed)	19.3	0	3	2.9	FALSE	FALSE
Fideos, tallarines, coditos, pastas de toda clase/noodles, macaroni, pasta of all types	19.3	0	7	2.1	FALSE	TRUE
Fresas/strawberries	22.9	0	3	1	FALSE	FALSE
Frijol (negro, blanco, colorado, etc.)/beans (black, white, red, etc.)	29.6	0	7	1.3	FALSE	FALSE
Frijoles enlatados/canned beans	26.3	0	1	2.2	FALSE	FALSE
Galletas/biscuits	14.4	0	4	3.5	FALSE	FALSE
Guicoy/squash	19.9	0	4	0.8	FALSE	FALSE

Food Item Spanish/English	Serving Size (g)	Min. # Servings /Week	Max. # Servings /Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Guisquil/chayote	29	0	7	0.4	FALSE	FALSE
Harina de maiz/corn flour	19.8	0	4	0.8	FALSE	TRUE
Helados, granizadas, etc./ice cream, slushie, etc.	19.8	0	1	3.3	FALSE	FALSE
Hierbas (berro, perejil, macuy, chipilín, culantro, yerbabuena, etc.)/herbs (watercress, parsley, macuy, chipilín, cilantro, peppermint)	18.6	0	5	2.65	FALSE	FALSE
Huevos de gallina/chicken eggs	29.7	0	4	2.4	FALSE	FALSE
Incaparina/Incaparina	14.6	0	6	1.9	FALSE	FALSE
Jugos empacados o enlatados/juices—packaged or canned	136.2	0	1	1.2	FALSE	FALSE
Leche en polvo/powdered milk	14.9	0	5	8.7	FALSE	FALSE
Leche liquida/milk, fluid	85.4	0	1	1.2	FALSE	FALSE
Lechuga/lettuce	19.2	0	3	3.7	FALSE	FALSE
Limones/lemons	11.5	0	7	1.2	FALSE	FALSE
Maiz (blanco, amarillo, etc.)/corn (white, yellow, etc.)	20	0	14	0.3	FALSE	TRUE
Mangos/mangoes	24.5	0	7	0.6	TRUE	FALSE
Manteca de cerdo/lard	4.9	0	3	2.33	FALSE	FALSE
Manzanas/apples	22.9	0	3	2.2	TRUE	FALSE
Margarina/margarine	4.6	0	2	2	FALSE	FALSE
Melones/melons	24.8	0	1	0.6	TRUE	FALSE
Leche, humana, madura, fluida/milk, human, mature, fluid	550	6.9	7.1	0	FALSE	FALSE
Naranjas/oranges	24.2	0	5	0.9	TRUE	FALSE
Otros atoles (arroz en leche, atol de platano, atolillo, shuco, etc.)/other “atol” drinks (rice in milk, plantain, etc.)	14.9	0	4	1.07	FALSE	FALSE
Pan dulce/sweet bread	19.3	0	7	1.9	FALSE	FALSE
Pan frances/french bread	19.8	0	4	2.6	FALSE	FALSE
Papas/potatoes	19.8	0	7	0.6	FALSE	FALSE
Pepino/cucumber	29	0	3	0.6	FALSE	FALSE
Pescado fresco/fresh fish	19.7	0	2	2.9	FALSE	FALSE
Piñas/pineapples	24.7	0	4	0.4	TRUE	FALSE

Food Item Spanish/English	Serving Size (g)	Min. # Servings /Week	Max. # Servings /Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Platanos/plantains	24.5	0	4	0.5	FALSE	FALSE
Queso fresco o duro/cheese, fresh white or hard	21.6	0	1	5.4	FALSE	FALSE
Remolacha/beet	28.3	0	2	0.5	FALSE	FALSE
Repollo/cabbage	28.9	0	6	0.2	FALSE	FALSE
Sandias/watermelon	24.6	0	6	0.3	TRUE	FALSE
Semillas tostadas (mania, marañón, etc./toasted nuts (peanuts, cashew, etc.)	19.6	0	2	5.4	FALSE	FALSE
Tamales colorados, negros, de elote etc., chuchitos, etc./tamales (colorados, with tomato and chicken or pork; negros, with a dark sauce; de elote, with sweet corn; etc.)	28.9	0	1	0.7	FALSE	FALSE
Tomate/tomato	29.6	0	7	0.7	FALSE	FALSE
Tortillas de maiz (gramos)/corn tortillas (grams)	20	0	14	0.6	FALSE	FALSE
Visceras de pollo o gallina (menudos)/chicken or hen viscera (giblets)	19	0	4	3.4	FALSE	FALSE
Zanahoria/carrot	28.5	0	6	0.5	FALSE	FALSE

Table A9. Final Optifood Food List for Breastfed Children 12–23 Months, Using the 2011 Guatemala HCES Data

Food Item Spanish/English	Serving Size (g)	Min. # Servings /Week	Max. # Servings /Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Aceites comestibles/edible oils	9.8	0	6	2.1	FALSE	FALSE
Aguacates/avocados	48.3	0	5	1.5	FALSE	FALSE
Aguas gaseosas/carbonated beverages	96.6	0	2	1.2	FALSE	FALSE
Arroz/rice	24.7	0	7	0.9	FALSE	TRUE
Atol de maiz/corn drink	19.9	0	7	1.1	FALSE	TRUE
Avenas de toda clase (e.g., mosh)/oats of all types (e.g., oatmeal)	19.5	0	7	1.07	FALSE	FALSE
Azucar/sugar	11.9	0	7	0.7	FALSE	FALSE
Bananos/bananas	49.9	0	7	0.6	TRUE	FALSE
Brocolli/broccoli	49.6	0	2	0.56	FALSE	FALSE
Carne de pollo o gallina/chicken or hen meat	24.3	0	4	3.2	FALSE	FALSE
Cebolla/onion	6.9	0	7	0.5	FALSE	FALSE
Chiles/chiles	6.9	0	6	1.54	FALSE	FALSE
Chocolate/chocolate	9.8	0	1	11.2	FALSE	FALSE
Coliflor/cauliflower	49.8	0	4	0.5	FALSE	FALSE
Dulces y confites de toda clase/sweets and confectionery of all types	8.5	0	2	3	FALSE	FALSE
Duraznos/peaches	49	0	4	1	TRUE	FALSE
Ejotes/green beans	49.8	0	4	0.9	FALSE	FALSE
Embutidos (jamon, salchichas, chorizos, longanizas, etc.)/sausages (various types listed)	24	0	3	2.9	FALSE	FALSE
Fideos, tallarines, coditos, pastas de toda clase/noodles, macaroni, pasta of all types	24.8	0	7	2.1	FALSE	TRUE
Frijol (negro, blanco, colorado etc.)/beans (black, white, red, etc.)	49.8	0	4	1.3	FALSE	FALSE
Frijoles enlatados/canned beans	40.3	0	2	2.2	FALSE	FALSE
Galletas/biscuits	22.1	0	1	3.5	FALSE	FALSE
Guicoy/squash	29.9	0	7	0.8	FALSE	FALSE
Harina de maiz/corn flour	24.9	0	3	0.8	FALSE	TRUE
Helados, granizadas, etc./ice cream, slushie, etc.	34	0	2	3.3	FALSE	FALSE

Food Item Spanish/English	Serving Size (g)	Min. # Servings /Week	Max. # Servings /Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Hierbas (berro, perejil, macuy, chipilín, culantro, yerbabuena, etc.)/herbs (watercress, parsley, macuy, chipilín, cilantro, peppermint)	38.3	0	7	2.65	FALSE	FALSE
Huevos de gallina/chicken eggs	47	0	4	2.4	FALSE	FALSE
Incaparina/Incaparina	19.6	0	5	1.9	FALSE	FALSE
Jugos empacados o enlatados/juices—packaged or canned	159.4	0	1	1.2	FALSE	FALSE
Leche en polvo/powdered milk	19	0	3	8.7	FALSE	FALSE
Leche liquida/milk, fluid	146	0	2	1.2	FALSE	FALSE
Limones/lemons	14.7	0	6	1.2	FALSE	FALSE
Maiz (blanco, amarillo, etc.)/corn (white, yellow, etc.)	25	0	7	0.3	FALSE	TRUE
Mangos/mangoes	49.9	0	6	0.6	TRUE	FALSE
Manteca de cerdo/lard	9.8	0	3	2.33	FALSE	FALSE
Manzanas/apples	46.6	0	2	2.2	TRUE	FALSE
Leche, humana, madura, fluida/milk, human, mature, fluid	502	6.9	7.1	0	FALSE	FALSE
Naranjas/oranges	49.3	0	3	0.9	TRUE	FALSE
Otros atoles (arroz en leche, atol de platano, atolillo, shuco, etc.)/other “atole” drinks (rice in milk, plantain, etc.)	19.9	0	4	1.07	FALSE	FALSE
Pan dulce/sweet bread	24.1	0	7	1.9	FALSE	FALSE
Pan frances/french bread	24	0	2	2.6	FALSE	FALSE
Papas/potatoes	24.8	0	7	0.6	FALSE	FALSE
Pepino/cucumber	49.1	0	3	0.6	FALSE	FALSE
Pescado fresco/fresh fish	23.4	0	2	2.9	FALSE	FALSE
Piñas/pineapples	49.7	0	3	0.4	TRUE	FALSE
Platanos/plantains	49.49	0	4	0.5	FALSE	FALSE
Queso fresco o duro/cheese, soft white or hard	35.8	0	3	5.4	FALSE	FALSE
Repollo/cabbage	48.9	0	5	0.2	FALSE	FALSE
Sandias/watermelon	49.3	0	5	0.3	TRUE	FALSE
Semillas tostadas (mania, marañón, etc./toasted nuts (peanuts, cashew, etc.)	23.5	0	3	5.4	FALSE	FALSE

Food Item Spanish/English	Serving Size (g)	Min. # Servings /Week	Max. # Servings /Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Tamales colorados, negros, de elote etc., chuchitos, etc./tamales (colorados, with tomato and chicken or pork; negros, with a dark sauce; de elote, with sweet corn; etc.)	39.5	0	3	0.7	FALSE	FALSE
Tomate/tomato	48.3	0	7	0.7	FALSE	FALSE
Tortillas de maiz (gramos)/corn tortillas (grams)	24.9	0	14	0.6	FALSE	FALSE
Visceras de pollo o gallina (menudos)/ chicken or hen viscera (giblets)	24.9	0	4	3.4	FALSE	FALSE
Zanahoria/carrot	48.2	0	6	0.5	FALSE	FALSE

Table A10. Final Optifood Food List for Non-Breastfed Children 12–23 Months, Using the 2011 Guatemala HCES Data

Food Item Spanish/English	Serving Size (g)	Min. # Servings / Week	Max. # Servings / Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Aceites comestibles/edible oils	9.9	0	7	2.1	FALSE	FALSE
Aguacates/avocados	49.4	0	6	1.5	FALSE	FALSE
Aguas gaseosas/carbonated beverages/	98.3	0	2	1.2	FALSE	FALSE
Apio/celery	43.9	0	2	0.4	FALSE	FALSE
Arroz/rice	24.6	0	7	0.9	FALSE	TRUE
Arveja/peas	39.9	0	2	0.56	FALSE	FALSE
Atol de maiz/corn drink	20	0	7	1.1	FALSE	TRUE
Avenas de toda clase (e.g. mosh)/oats of all types (e.g., oatmeal)	19.7	0	6	1.07	FALSE	FALSE
Azucar/sugar	12	0	7	0.7	FALSE	FALSE
Bananos/bananas	50	0	5	0.6	TRUE	FALSE
Carne de pollo o gallina/chicken or hen meat	24.9	0	4	3.2	FALSE	FALSE
Cebolla/onion	7	0	7	0.5	FALSE	FALSE
Chiles/chiles	6.9	0	5	1.54	FALSE	FALSE
Chocolate/chocolate	10	0	2	11.2	FALSE	FALSE
Coliflor/cauliflower	49.9	0	4	0.5	FALSE	FALSE
Crema fresca/fresh cream	38.1	0	3	3.3	FALSE	FALSE
Dulces y confites de toda clase/ sweets and confectionery of all types	9.9	0	3	3	FALSE	FALSE
Duraznos/peaches	48.6	0	4	1	TRUE	FALSE
Ejotes/green beans	48.8	0	4	0.9	FALSE	FALSE
Embutidos (jamon, salchichas, chorizos, longanizas, etc.)/ sausages (various types listed)	24.9	0	4	2.9	FALSE	FALSE
Fideos, tallarines, coditos, pastas de toda clase/noodles, macaroni, pasta of all types	24.6	0	7	2.1	FALSE	TRUE
Fresas/strawberries	45.9	0	3	1	FALSE	FALSE
Frijol (negro, blanco, colorado etc.)/beans (black, white, red, etc.)	49.9	0	7	1.3	FALSE	FALSE
Frijoles enlatados/canned beans	45.3	0	4	2.2	FALSE	FALSE
Galletas/biscuits	24.5	0	4	3.5	FALSE	FALSE

Food Item Spanish/English	Serving Size (g)	Min. # Servings / Week	Max. # Servings / Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Guicoy/squash	48.7	0	7	0.8	FALSE	FALSE
Guisquil/chayote	48.5	0	2	0.4	FALSE	FALSE
Harina de maiz/corn flour	24.9	0	2	0.8	FALSE	TRUE
Hierbas (berro, perejil, macuy, chipilín, culantro, yerbabuena, etc.)/ herbs (watercress, parsley, macuy, chipilín, cilantro, peppermint)	37.4	0	7	2.65	FALSE	FALSE
Huevos de gallina/chicken eggs	49.6	0	4	2.4	FALSE	FALSE
Incaparina/Incaparina	19.9	0	6	1.9	FALSE	FALSE
Jugos empacados o enlatados/juices—packaged or canned	178.4	0	2	1.2	FALSE	FALSE
Leche en polvo/powdered milk	19.9	0	4	8.7	FALSE	FALSE
Leche liquida/milk, fluid	146	0	2	1.2	FALSE	FALSE
Lechuga/lettuce	33	0	2	3.7	FALSE	FALSE
Limones/lemons	14.9	0	6	1.2	FALSE	FALSE
Maiz (blanco, amarillo, etc.)/corn (white, yellow, etc.)	25	0	7	0.3	FALSE	TRUE
Mangos/mangoes	49.8	0	5	0.6	TRUE	FALSE
Manteca de cerdo/lard	9.9	0	3	2.33	FALSE	FALSE
Manzanas/apples	49.7	0	3	2.2	TRUE	FALSE
Margarina/margarine	9.7	0	3	2	FALSE	FALSE
Naranjas/oranges	49.8	0	4	0.9	TRUE	FALSE
Otros atoles (arroz en leche, atol de platano, atolillo, shuco, etc.)/ other “atole” drinks (rice in milk, plantain, etc.)	20	0	4	1.07	FALSE	FALSE
Pan dulce/sweet bread	24.8	0	7	1.9	FALSE	FALSE
Pan frances/french bread	24.9	0	4	2.6	FALSE	FALSE
Papas/potatoes	24.8	0	7	0.6	FALSE	FALSE
Papayas/papayas	5	0	2	0.6	FALSE	FALSE
Pepino/cucumbers	46.2	0	2	0.6	FALSE	FALSE
Piñas/pineapples	49.4	0	3	0.4	TRUE	FALSE
Platanos/plantains	49	0	4	0.5	FALSE	FALSE
Queso fresco o duro/cheese, soft white or hard	38.6	0	4	5.4	FALSE	FALSE

Food Item Spanish/English	Serving Size (g)	Min. # Servings / Week	Max. # Servings / Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Repollo/cabbage	49.7	0	6	0.2	FALSE	FALSE
Sandias/watermelon	49.9	0	5	0.3	FALSE	FALSE
Semillas tostadas (mania, marañón, etc.)/toasted nuts (peanuts, cashews, etc.)	24.7	0	4	5.4	FALSE	FALSE
Tamales colorados, negros, de elote etc., chuchitos, etc./tamales (colorados, with tomato and chicken or pork; negros, with a dark sauce; de elote, with sweet corn; etc.)	39.9	0	3	0.7	FALSE	FALSE
Tomate/tomato	49.5	0	7	0.7	FALSE	FALSE
Tortillas de maiz (gramos)/corn tortillas (grams)	25	0	14	0.6	FALSE	FALSE
Visceras de pollo o gallina (menudos)/chicken or hen viscea (giblets)	24.9	0	3	3.4	FALSE	FALSE
Yogures/yogurt	39.2	0	2	2.5	FALSE	FALSE
Zanahoria/carrot	48.5	0	6	0.5	FALSE	FALSE

Table A11. Final Optifood Food List for Lactating Women, Using the 2011 Guatemala HCES Data

Food Item Spanish/English	Serving Size (g)	Min. # Servings/ Week	Max. # Servings/ Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Aceites comestibles/edible oils	15	0	6	2.1	FALSE	FALSE
Aguacates/avocados	116.7	0	5	1.5	FALSE	FALSE
Aguas gaseosas/carbonated beverages	246	0	2	1.2	FALSE	FALSE
Arroz/rice	147.1	0	7	0.9	FALSE	TRUE
Atol de maiz/corn drink	25	0	7	1.1	FALSE	TRUE
Avenas de toda clase (e.g., mosh)/oats of all types (e.g., oatmeal)	24.8	0	6	1.07	FALSE	FALSE
Azucar/sugar	20	0	7	0.7	FALSE	FALSE
Bananos/bananas	120	0	7	0.6	TRUE	FALSE
Brocolli/broccoli	146.6	0	2	0.56	FALSE	FALSE
Carne de pollo o gallina/chicken or hen meat	79.1	0	3	3.2	FALSE	FALSE
Cebolla/onion	15	0	7	0.5	FALSE	FALSE
Chiles/chiles	14.8	0	6	1.54	FALSE	FALSE
Chocolate/chocolate	10	0	1	11.2	FALSE	FALSE
Coliflor/cauliflower	149	0	4	0.5	FALSE	FALSE
Crema fresca/fresh cream	98.4	0	1	3.3	FALSE	FALSE
Dulces y confites de toda clase/sweets and confectionery of all types	9.8	0	4	3	FALSE	FALSE
Duraznos/peaches	118.7	0	4	1	TRUE	FALSE
Ejotes/green beans	146.3	0	4	0.9	FALSE	FALSE
Embutidos (jamon, salchichas, chorizos, longanizas, etc.)/sausages (various types listed)	78.9	0	3	2.9	FALSE	FALSE
Fideos, tallarines, coditos, pastas de toda clase/noodles, macaroni, pasta of all types	143.4	0	7	2.1	FALSE	TRUE
Frijol (negro, blanco, colorado, etc.)/beans (black, white, red, etc.)	99	0	7	1.3	FALSE	FALSE
Frijoles enlatados/canned beans	93.4	0	3	2.2	FALSE	FALSE
Galletas/biscuits	39.4	0	4	3.5	FALSE	FALSE
Guicoy/squash	150	0	7	0.8	FALSE	FALSE
Harina de maiz/corn flour	148.7	0	3	0.8	FALSE	TRUE
Helados, granizadas, etc./ice cream, slushie, etc.	48.9	0	2	3.3	FALSE	FALSE

Food Item Spanish/English	Serving Size (g)	Min. # Servings/ Week	Max. # Servings/ Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Hierbas (berro, perejil, macuy, chipilín, culantro, yerbabuena, etc.)/herbs (watercress, parsley, macuy, chipilín, cilantro, peppermint)	79.3	0	7	2.65	FALSE	FALSE
Huevos de gallina/chicken eggs	59.5	0	4	2.4	FALSE	FALSE
Incaparina/Incaparina	24.8	0	5	1.9	FALSE	FALSE
Jugos empacados o enlatados/juices—packaged or canned	238	0	2	1.2	FALSE	FALSE
Leche en polvo/powdered milk	24.7	0	3	8.7	FALSE	FALSE
Leche liquida/milk, fluid	247.8	0	1	1.2	FALSE	FALSE
Limones/lemons	29.8	0	6	1.2	FALSE	FALSE
Maiz (blanco, amarillo, etc.)/corn (white, yellow, etc.)	149.9	0	7	0.3	FALSE	TRUE
Mangos/mangoes	118.7	0	6	0.6	TRUE	FALSE
Manteca de cerdo/lard	14.9	0	2	2.33	FALSE	FALSE
Manzanas/apples	119.9	0	3	2.2	TRUE	FALSE
Naranjas/oranges	119.5	0	4	0.9	TRUE	FALSE
Otros atoles (arroz en leche, atol de platano, atolillo, shuco, etc.)/other “atole” drinks (rice in milk, plantain, etc.)	25	0	5	1.07	FALSE	FALSE
Pan dulce/sweet bread	148.8	0	3	1.9	FALSE	FALSE
Pan frances/french bread	147	0	3	2.6	FALSE	FALSE
Papas/potatoes	149.4	0	7	0.6	FALSE	FALSE
Pepino/cucumber	149.5	0	2	0.6	FALSE	FALSE
Pescado fresco/fresh fish	79	0	2	2.9	FALSE	FALSE
Piñas/pineapples	118.8	0	3	0.4	TRUE	FALSE
Platanos/plantains	118.3	0	3	0.5	FALSE	FALSE
Queso fresco o duro/cheese, soft white or hard	95.1	0	4	5.4	FALSE	FALSE
Repollo/cabbage	147.8	0	5	0.2	FALSE	FALSE
Sandias/watermelon	119.1	0	5	0.3	FALSE	FALSE
Sardinas, atun, etc. (enlatados)/sardines, tuna, etc. (canned)	79.8	0	2	4.4	FALSE	FALSE
Semillas tostadas (mania, marañón, etc./toasted nuts (peanuts, cashew, etc.)	79.9	0	3	5.4	FALSE	FALSE

Food Item Spanish/English	Serving Size (g)	Min. # Servings/ Week	Max. # Servings/ Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Tamales colorados, negros, de elote etc., chuchitos, etc./tamales (colorados, with tomato and chicken or pork; negros, with a dark sauce; de elote, with sweet corn; etc.)	148.9	0	3	0.7	FALSE	FALSE
Tomate/tomato	146.5	0	7	0.7	FALSE	FALSE
Tortillas de maiz (gramos)/corn tortillas (grams)	149.9	0	14	0.6	FALSE	FALSE
Visceras de pollo o gallina (menudos)/chicken or hen viscera (giblets)	79.3	0	4	3.4	FALSE	FALSE
Zanahoria/carrot	149.2	0	5	0.5	FALSE	FALSE

Table A12. Final Optifood Food List for Pregnant Women, Using the 2011 Guatemala HCES Data

Food Item Spanish/English	Serving Size (g)	Min. # Servings/ Week	Max. # Servings/ Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Aceites comestibles/edible oils	15	0	6	2.1	FALSE	FALSE
Aguacates/avocados	116.5	0	6	1.5	FALSE	FALSE
Aguas gaseosas/carbonated beverages	245.1	0	3	1.2	FALSE	FALSE
Arroz/rice	146.9	0	7	0.9	FALSE	TRUE
Atol de maiz/corn drink	25	0	6	1.1	FALSE	TRUE
Avenas de toda clase (e.g., mosh)/oats of all types (e.g., oatmeal)	24.8	0	7	1.07	FALSE	FALSE
Azucar/sugar	20	0	7	0.7	FALSE	FALSE
Bananos/bananas	119.9	0	7	0.6	TRUE	FALSE
Brocolli/broccoli	146.4	0	2	0.56	FALSE	FALSE
Carne de pollo o gallina/chicken or hen meat	78.8	0	4	3.2	FALSE	FALSE
Cebolla/onion	15	0	7	0.5	FALSE	FALSE
Chiles/chiles	14.9	0	6	1.54	FALSE	FALSE
Coliflor/cauliflower	148.2	0	3	0.5	FALSE	FALSE
Crema fresca/fresh cream	95.8	0	1	3.3	FALSE	FALSE
Dulces y confites de toda clase/sweets and all types of confectionery	9.9	0	3	3	FALSE	FALSE
Duraznos/peaches	116	0	4	1	TRUE	FALSE
Ejotes/green beans	142	0	4	0.9	FALSE	FALSE
Embutidos (jamon, salchichas, chorizos, longanizas, etc.)/sausages (various types listed)	78.7	0	3	2.9	FALSE	FALSE
Fideos, tallarines, coditos, pastas de toda clase/noodles, macaroni, pasta of all types	144.4	0	7	2.1	FALSE	TRUE
Fresas/strawberries	49.9	0	1	1	TRUE	FALSE
Frijol (negro, blanco, colorado, etc.)/beans (black, white, red, etc.)	98.7	0	7	1.3	FALSE	FALSE
Frijoles enlatados/canned beans	96.9	0	3	2.2	FALSE	FALSE
Galletas/biscuits	39.7	0	4	3.5	FALSE	FALSE
Guicoy/squash	149.4	0	2	0.8	FALSE	FALSE
Guisquil/chayote	145.5	0	7	0.4	FALSE	FALSE
Harina de maiz/corn flour	149.4	0	2	0.8	FALSE	TRUE

Food Item Spanish/English	Serving Size (g)	Min. # Servings/ Week	Max. # Servings/ Week	Cost (GTQ) /100 g	Snack	Starchy Staple
Helados, granizadas, etc./ice cream, slushie, etc.	48.6	0	2	3.3	FALSE	FALSE
Hierbas (berro, perejil, macuy, chipilín, culantro, yerbabuena, etc.)/herbs (watercress, parsley, macuy, chipilín, cilantro, peppermint)	76.7	0	7	2.65	FALSE	FALSE
Huevos de gallina/chicken eggs	59.6	0	4	2.4	FALSE	FALSE
Incaparina/Incaparina	24.9	0	5	1.9	FALSE	FALSE
Jugos empacados o enlatados/juices—packaged or canned	239.3	0	2	1.2	FALSE	FALSE
Leche en polvo/powdered milk	24.8	0	3	8.7	FALSE	FALSE
Limones/lemons	29.7	0	6	1.2	FALSE	FALSE
Maiz (blanco, amarillo, etc.)/corn (white, yellow, etc.)	149.8	0	7	0.3	FALSE	TRUE
Mangos/mangoes	119.7	0	6	0.6	TRUE	FALSE
Manteca de cerdo/lard	15	0	2	2.33	FALSE	FALSE
Manzanas/apples	118.9	0	3	2.2	TRUE	FALSE
Margarina/margarine	14.9	0	2	2	FALSE	FALSE
Melones/melons	119.4	0	1	0.6	FALSE	FALSE
Naranjas/oranges	119.8	0	3	0.9	TRUE	FALSE
Otros atoles (arroz en leche, atol de platano, atolillo, shuco, etc.)/other “atole” drinks (rice in milk, plantain, etc.)	25	0	4	1.07	FALSE	FALSE
Pan dulce/sweet bread	145	0	4	1.9	FALSE	FALSE
Pan frances/french bread	142	0	4	2.6	FALSE	FALSE
Papas/potatoes	146.3	0	7	0.6	FALSE	FALSE
Pepino/cucumber	146.4	0	3	0.6	FALSE	FALSE
Pescado fresco/fresh fish	79.3	0	2	2.9	FALSE	FALSE
Piñas/pineapple	119.4	0	3	0.4	TRUE	FALSE
Platanos/Plantains	119.3	0	3	0.5	FALSE	FALSE
Queso fresco o duro/cheese, soft white or hard	98.3	0	4	5.4	FALSE	FALSE
Repollo/cabbage	146.8	0	6	0.2	FALSE	FALSE
Sandias/watermelon	119.5	0	6	0.3	FALSE	FALSE
Sardinas, atun, etc. (enlatados)/sardines,	79.8	0	2	4.4	FALSE	FALSE

Food Item Spanish/English	Serving Size (g)	Min. # Servings/ Week	Max. # Servings/ Week	Cost (GTQ) /100 g	Snack	Starchy Staple
tuna, etc. (canned)						
Semillas tostadas (mania, marañón, etc./toasted nuts (peanuts, cashews, etc.)	77.3	0	4	5.4	FALSE	FALSE
Tamales colorados, negros, de elote etc., chuchitos, etc./tamales (colorados, with tomato and chicken or pork; negros, with a dark sauce; de elote, with sweet corn; etc.)	147.9	0	3	0.7	FALSE	FALSE
Tomate/tomato	149.6	0	7	0.7	FALSE	FALSE
Tortillas de maiz (gramos)/corn tortillas (grams)	150	0	14	0.6	FALSE	FALSE
Visceras de pollo o gallina (menudos)/chicken or hen viscera (giblets)	78.5	0	4	3.4	FALSE	FALSE
Zanahoria/carrot	143.5	0	6	0.5	FALSE	FALSE

Appendix 6. Reference Portion Sizes for Food Types Used to Estimate Consumption Frequency and Serving Sizes for Optifood Analysis with 2011 Guatemala HCES Data

The reference portions used in the Optifood analysis with 2011 Guatemala HCES data were determined by referring to two 24-hour-recall datasets from the Western Highlands department of Quetzaltenango, which is similar to the two departments used for the 2012 FANTA Optifood analysis, Huehuetenango and Quiché (Vossenaar 2014). A group of local experts then carefully scrutinized the resulting lists of serving sizes and determined them to be realistic given their knowledge of diets in the study area.

Table A13. Reference Portion Sizes (Grams per Serving) by Target Group

Food Type	6–8 Months	9–11 Months	12–23 Months BF	12–23 Months NBF	Lactating Women	Pregnant Women
Carbohydrate staples	15	25	50	50	150	150
Beans	20	30	50	50	100	100
Hard vegetables	20	30	45	45	100	100
GLV	10	20	40	40	80	80
Condiment vegetables	3	5	7	7	15	15
Atole flour and powdered milk	10	15	20	20	25	25
Meat	15	20	25	25	80	80
Nuts or seeds	15	20	25	25	80	80
Egg	20	30	50	50	60	60
Oils	3	5	10	10	15	15
Fruit	15	25	50	50	120	120
Lemons	7	12	15	15	30	30
Dairy ice cream	15	25	40	40	100	100
Sweets	5	10	10	10	10	10
Salt, sugar, honey	7	10	12	12	20	20
Liquids	100	150	180	180	250	250
Biscuits, cake	15	15	25	25	50	50

Appendix 7. INCAP Energy and Nutrient Requirements

Table A14. Energy and Nutrient Requirements for Children and Adults (INCAP 2012a)

Age (Years)	Energy	Protein	Calcium	Iron (bioavail.)[a]			Zinc (bioavail.)		Vit. A	Vit. C	Thiamin	Riboflavin	Niacin	B6	Folate	B12
				High	Med	Low	High	Med.								
	kcal/d[b]	g	mg/d	mg/d	mg/d	mg/d	mg/d	mg/d	µg/d	mg/d	mg/d	mg/d	mg/d	mg/d	µg/d	µg /d
Children (boys and girls)																
0.5–0.9	660	15	350	—	—	—	2.6	5.2	450	50	0.3	0.4	4	0.3	75	0.5
1–1.9	850	16	500	3.6	5.4	10.8	1.9	3.8	210	13	0.4	0.4	4	0.4	120	0.7
2–3.9	1,138	18	500	3.6	5.4	10.8	1.9	3.8	210	13	0.4	0.4	4	0.4	120	0.7
4–6.9	1,355	22	600	5.8	8.7	17.4	2.4	4.8	250	20	0.4	0.4	5	0.5	140	0.9
Males																
7–9.9	1,725	31	700	6.8	10.2	20.3	3.3	6.6	300	27	0.5	0.5	6	0.6	170	1.1
10–13.9	2,250	45	1,200	7.7	11.6	23.2	5.6	11.3	450	36	0.7	0.8	8	0.8	225	1.4
14–17.9	2,975	67	1,200	8.4	12.6	25.2	7.4	14.9	513	55	1	1.1	11	1.1	295	1.9
18–29.9	3,100	71	1,000	5.7	8.6	17.2	8.8	17.7	525	63	1	1.1	12	1.1	320	2
30–59.9	2,950	71	1,000	5.7	8.6	17.2	8.8	17.7	525	63	1	1.1	12	1.1	320	2
60 +	2,350	71	1,200	5.7	8.6	17.2	8.8	17.7	525	63	1	1.1	12	1.1	320	2
Females																
7–9.9	1,575	30	700	6.8	10.2	20.3	3.3	6.6	300	27	0.5	0.5	6	0.6	170	1.1
10–13.9	2,025	46	1,200	6.2	9.3	18.6	5.1	10.2	375	36	0.8	0.8	9	0.9	253	1.5
14–17.9	2,263	58	1,200	8.3	12.5	25	6	11.9	450	50	0.9	0.9	11	1.1	318	2
18–29.9	2,300	61	1000	8	12	24	6.1	12.2	450	55	0.9	0.9	11	1.1	320	2
30–59.9	2,300	61	1000	8	12	24	6.1	12.2	450	55	0.9	0.9	11	1.1	320	2
60 +	2,000	61	1200	4.5	6.7	13.4	6.1	12.2	450	55	0.9	0.9	11	1.3	320	2

Age (Years)	Energy	Protein	Calcium	Iron (bioavail.)[a]			Zinc (bioavail.)		Vit. A	Vit. C	Thiamin	Riboflavin	Niacin	B6	Folate	B12
				High	Med	Low	High	Med.								
	kcal/d[b]	g	mg/d	mg/d	mg/d	mg/d	mg/d	mg/d	µg/d	mg/d	mg/d	mg/d	mg/d	mg/d	µg/d	µg /d
Pregnant	2,713	88	1000	—	—	—	8.4	16.8	500	65	1.2	1.2	14	1.6	520	2.2
Lactating	2,888	82	1000	—	—	—	9.4	18.8	825	90	1.1	1.3	13	1.7	450	2.4

[a] bioavail. = bioavailability.

[b] d = day.

Appendix 8. Food Items, Food Group and FSG Categories, INCAP FCT Codes, and FCT Values for Foods Used in Optifood Analysis of the 2011 Guatemala HCES Data

Table A15. Food Items and Corresponding Food Groups, Food Subgroups, and INCAP FCT Codes Used in the Final Optifood FCT for the 2011 Guatemala HCES Target Groups

Food Item Name Spanish (English)	Food Group	Food Subgroup	INCAP FCT Code
Mantequilla (butter)	Added fats	Butter, ghee, margarine (unfortified)	16016
Margarina (margarine)	Added fats	Butter, ghee, margarine (unfortified)	16018
Manteca de cerdo (lard)	Added fats	Other added fats	16012
Manteca vegetal (vegetable shortening)	Added fats	Other added fats	16013
Aceites comestibles (edible oils)	Added fats	Vegetable oil (unfortified)	16010
Mieles, melazas y jarabes (honey, molasses, syrups)	Added sugars	Honey, syrup, nectar	15024
Azucar (sugar)	Added sugars	Sugar (non-fortified)	15002
Panela (rapadura) (unrefined whole cane sugar)	Added sugars	Sugar (non-fortified)	15027
Pan de rodaja (sliced bread)	Bakery and breakfast cereals	Refined grain bread, unenriched/unfortified	14021
Pan dulce (sweet bread)	Bakery and breakfast cereals	Refined grain bread, unenriched/unfortified	14025
Pan frances (french bread)	Bakery and breakfast cereals	Refined grain bread, unenriched/unfortified	14034
Pastel (cake)	Bakery and breakfast cereals	Sweetened bakery products, unenriched/unfortified	18020
Aguas gaseosas (carbonated beverages)	Beverages (non-dairy or blended dairy)	Sugar-sweetened beverages	17016
Paches (potato tamales)	Composites (mixed food groups)	Grain products w/fillings (sandwiches, burgers, samosas, enchiladas)	21138
Tacos de toda clase (tacos of all types)	Composites (mixed food groups)	Grain products w/fillings	21079
Tamales colorados, negros, de elote etc., chuchitos, etc.	Composites (mixed food	Grain products w/fillings (sandwiches, burgers,	21136

Food Item Name Spanish (English)	Food Group	Food Subgroup	INCAP FCT Code
(tamales [colorados, with tomato and chicken or pork; negros, with a dark sauce; de elote, with sweet corn; etc.])	groups)	samosas, enchiladas)	
Tostadas con guacamol, frijol, salsa, etc. (fried corn tortilla with guacamole, beans, salsa, etc.)	Composites (mixed food groups)	Grain products w/fillings (sandwiches, burgers, samosas, enchiladas)	21088
Queso fresco o duro (cheese, soft white or hard)	Dairy foods	Cheese	1030
Requezon (ricotta cheese)	Dairy foods	Cheese	1027
Crema fresca (fresh cream)	Dairy foods	Cream, sour cream	1001
Leche en polvo (powdered milk)	Dairy foods	Fluid or powdered milk (non-fortified)	1016
Leche en polvo para bebe (powdered milk for infants)	Dairy foods	Fluid or powdered milk (non-fortified)	19082
Leche evaporada o condensada (evaporated or condensed milk)	Dairy foods	Fluid or powdered milk (non-fortified)	1014
Leche liquida (milk, fluid)	Dairy foods	Fluid or powdered milk (non-fortified)	1015
Yogures (yogurt)	Dairy foods	Yogurt, solid and drinkable	1041
Bananos (bananas)	Fruits	Other fruit	12010
Duraznos (peaches)	Fruits	Other fruit	12034
Manzanas (apples)	Fruits	Other fruit	12084
Sandias (watermelon)	Fruits	Other fruit	12134
Melones (melons)	Fruits	Vitamin A–source fruit	12096
Papayas (papayas)	Fruits	Vitamin A–source fruit	12115
Fresas (strawberries)	Fruits	Vitamin C–rich fruit	12042
Limones (lemons)	Fruits	Vitamin C–rich fruit	12070
Mandarinas (tangarines)	Fruits	Vitamin C–rich fruit	12077
Mangos (mangoes)	Fruits	Vitamin C–rich fruit	12080

Food Item Name Spanish (English)	Food Group	Food Subgroup	INCAP FCT Code
Naranjas (oranges)	Fruits	Vitamin C–rich fruit	12103
Piñas (pineapples)	Fruits	Vitamin C–rich fruit	12125
Incaparina (Incaparina)	Grains and grain products	Enriched/fortified grains and products, whole/refined	17022
Arroz (rice)	Grains and grain products	Refined grains and products, unenriched/unfortified	13004
Cereales preparados (corn flakes, etc.) (Ready-to-eat cereals [corn flakes, etc.])	Grains and grain products	Refined grains and products, unenriched/unfortified	13016
Fideos, tallarines, coditos, pastas de toda clase (noodles, macaroni, pasta of all types)	Grains and grain products	Refined grains and products, unenriched/unfortified	13068
Harina de maiz (corn flour)	Grains and grain products	Refined grains and products, unenriched/unfortified	13033
Harina de trigo (wheat flour)	Grains and grain products	Refined grains and products, unenriched/unfortified	13039
Atol de maiz (corn drink)	Grains and grain products	Whole grains and products, unenriched/unfortified	17068
Avenas de toda clase (e.g., mosh) (oats of all types [e.g., oatmeal])	Grains and grain products	Whole grains and products, unenriched/unfortified	13008
Maiz (blanco, amarillo, etc.) (corn [white, yellow, etc.])	Grains and grain products	Whole grains and products, unenriched/unfortified	13047
Otros atoles (arroz en leche, atol de platano, atolillo, shuco, etc.) (other “atole” drinks [rice in milk, plantain, etc.])	Grains and grain products	Whole grains and products, unenriched/unfortified	17064
Tortillas de harina (gramos) (flour tortillas [grams])	Grains and grain products	Whole grains and products, unenriched/unfortified	14058
Tortillas de maiz (gramos) (corn tortillas [grams])	Grains and grain products	Whole grains and products, unenriched/unfortified	14052
Frijol (negro, colorado etc.) (beans [black, red, etc.])	Legumes, nuts, and seeds	Cooked beans, lentils, peas	9009
Frijoles enlatados (canned beans)	Legumes, nuts, and seeds	Cooked beans, lentils, peas	9018
Semillas tostadas (mania, marañón, etc. (toasted nuts [peanuts, cashews, etc.])	Legumes, nuts, and seeds	Nuts, seeds, and unsweetened products	10007
Huevos de gallina (chicken eggs)	Meat, fish, and eggs	Eggs	2002

Food Item Name Spanish (English)	Food Group	Food Subgroup	INCAP FCT Code
Otras clases de huevo (other types of eggs)	Meat, fish, and eggs	Eggs	2002
Pescado fresco (fresh fish)	Meat, fish, and eggs	Fish without bones	8018
Sardinas, atun, etc. (enlatados) (sardines, tuna, etc. [canned])	Meat, fish, and eggs	Fish without bones	8039
Visceras de pollo o gallina (chicken or hen viscera [giblets])	Meat, fish, and eggs	Organ meat	3028
Visceras de res (menudos) (beef viscera)	Meat, fish, and eggs	Organ meat	5032
Carne de cerdo con hueso (pork with bone)	Meat, fish, and eggs	Pork	4004
Carne de cerdo sin hueso (pork without bone)	Meat, fish, and eggs	Pork	4004
Carne de pollo o gallina (chicken or hen meat)	Meat, fish, and eggs	Poultry, rabbit	3024
Embutidos (jamon, salchichas, chorizos, longanizas, etc.) (sausages [various types listed])	Meat, fish, and eggs	Processed meat	7026
Carne de res con hueso (beef with bone)	Meat, fish, and eggs	Red meat	5025
Carne de res sin hueso (beef without bone)	Meat, fish, and eggs	Red meat	5025
Carne molida (ground beef)	Meat, fish, and eggs	Red meat	5021
Mariscos, (camarones, cangrejos) (shellfish [shrimp, crab])	Meat, fish, and eggs	Seafood	8053
Consomes (consommé)	Miscellaneous	Condiments, herbs, spices	22023
Sopas en sobre (Malher, Maggi) (soup in a packet [Malher, Maggi])	Miscellaneous	Condiments, herbs, spices	22023
Sopas instantaneas en vaso (instant soup in a cup)	Miscellaneous	Condiments, herbs, spices	22023
Mayonesa y aderezo (mayonnaise or dressing)	Miscellaneous	Savory spreads, sauces, pastes, salad dressing, pickles	16021
Chicharones o carnitas de cerdo (pork belly or rinds)	Savory snacks	Savory snacks, salted, spiced, fried	4012
Papas (potatoes)	Starchy roots and other plant	Other starchy plant foods	11128

Food Item Name Spanish (English)	Food Group	Food Subgroup	INCAP FCT Code
	foods		
Platanos (plantains)	Starchy roots and other plant foods	Other starchy plant foods	12130
Yuca (cassava)	Starchy roots and other plant foods	Other starchy plant foods	11167
Chocolate (chocolate)	Sweetened snacks & desserts	Sweet snack foods (candy and chocolate)	15009
Dulces y confites de toda clase (sweets and confectionery of all types)	Sweetened snacks and desserts	Sweet snack foods (candy and chocolate)	15006
Ajo (garlic)	Vegetables	Condiment vegetables	22001
Chiles (chiles)	Vegetables	Condiment vegetables	11057
Cebolla (onion)	Vegetables	Condiment vegetables	11036
Aguacates (avocados)	Vegetables	Other Vegetables	11005
Apio (celery)	Vegetables	Other vegetables	11010
Arveja (peas)	Vegetables	Other vegetables	11012
Brocolli (broccoli)	Vegetables	Other vegetables	11028
Coliflor (cauliflower)	Vegetables	Other vegetables	11044
Ejotes (green beans)	Vegetables	Other vegetables	11072
Guicoy (squash)	Vegetables	Other vegetables	11020
Guisquil (chayote)	Vegetables	Other vegetables	11048
Lechuga (lettuce)	Vegetables	Other vegetables	11105
Pepino (cucumber)	Vegetables	Other vegetables	11138
Remolacha (beet)	Vegetables	Other vegetables	11148
Repollo (cabbage)	Vegetables	Other vegetables	11176

Food Item Name Spanish (English)	Food Group	Food Subgroup	INCAP FCT Code
Hierbas (berro, perejil, macuy, chipilín, culantro, yerbabuena) (herbs [watercress, parsley, macuy, chipilín, cilantro, peppermint])	Vegetables	Vitamin A–source dark green leafy vegetables	11093
Zanahoria (carrot)	Vegetables	Vitamin A–source other vegetables	11171
Tomate (tomato)	Vegetables	Vitamin C–rich vegetables	11157

Table A16. Food Composition per Every 100 g Edible Portion, Used for Optifood Analysis Based on the 2011 Guatemala HCES Dataset

Food Item Name Spanish (English)	Energy	Protein	Water	Fat	Carbohydrates	Calcium	Iron	Zinc	Vitamin C	Thiamin	Riboflavin	Niacin	Vitamin B6	Folate	Vitamin B12	Vit. A retinol activity equivalents (RAE)
	kcal	g	g	g	g	mg	mg	mg	mg	mg	mg	mg	mg	mg	µg	µg
Mantequilla (butter)	717	0.9	15.9	81.1	0.1	24	0.02	0.09	0.0	0.01	0.03	0.04	0.00	3	0.17	684
Margarina (margarine)	719	0.9	15.7	80.5	0.9	30	0.06	0	0	0.01	0.04	0.02	0.01	0	0.1	819
Manteca de cerdo (lard)	879	0	0.6	99.4	0	0	0	0.11	0	0	0	0	0	0	0	0
Manteca vegetal (vegetable shortening)	884	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0
Aceites comestibles (edible oils)	884	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0
Mieles, melazas y jarabes (honey, molasses, syrups)	304	0.3	17.1	0.0	82.4	6	0.42	0.22	0.5	0.00	0.04	0.12	0.02	2	0.00	0
Azucar (sugar)	387	0.0	0.0	0.0	100.0	1	0.05	0.01	0.0	0.00	0.02	0.00	0.00	0	0.00	1,000
Panela (rapadura) (unrefined whole cane sugar)	356	0.4	7.4	0.5	90.6	51	4.2	0.18	2	0.02	0.11	0.3	0.03	1	0	0
Pan de rodaja (sliced bread)	289	11.8	27.8	1.8	56.4	44	3.63	0.93	0.2	0.43	0.29	4.76	0.10	230	0.00	0
Pan dulce (sweet bread)	293	9.0	30.4	4.0	54.4	119	3.33	0.68	0.0	0.42	0.34	3.93	0.06	159	0.02	0
Pan frances (french bread)	289	11.8	27.8	1.8	56.4	44	3.63	0.93	0.2	0.43	0.29	4.76	0.10	230	0.00	0
Pastel (cake)	388	5.5	24.6	19.9	48.8	35	1.38	0.46	0.0	0.14	0.23	1.31	0.04	62	0.25	149

Food Item Name Spanish (English)	Energy	Protein	Water	Fat	Carbohydrates	Calcium	Iron	Zinc	Vitamin C	Thiamin	Riboflavin	Niacin	Vitamin B6	Folate	Vitamin B12	Vit. A retinol activity equivalents (RAE)
	kcal	g	g	g	g	mg	mg	mg	mg	mg	mg	mg	mg	mg	µg	µg
Aguas gaseosas (carbonated beverages)	48	0.1	90.3	0.0	12.3	2	0.11	0.02	0.0	0.00	0.00	0.00	0.00	0	0.00	0
Paches (potato tamales)	94	2.86	0	4.88	10.7	22	0.79	0.42	14	0.08	0.04	1.51	0.19	11	0.02	16
Tacos de toda clase (all types of tacos)	216	12.08	58.4	12.02	15.63	129	1.41	469	1	0.09	0.26	1.88	0.14	26	0.61	63
Tamales colorados, negros, de elote etc., chuchitos, etc. (tamales [colorados, with tomato and chicken or pork; negros, with a dark sauce; de elote, with sweet corn; etc.])	166	5.3	0	9.9	13.1	33	1	0.55	9	0.11	0.07	1.3	0.25	7	0.1	1
Tostadas con guacamol, frijol, salsa, etc. (fried corn tortilla with guacamole, beans, salsa, etc.)	138	4.78	72.51	8.91	12.27	162	0.62	1.56	1	0.05	0.22	0.76	0.1	2	0.38	80
Queso fresco o duro (cheese, soft white or hard)	310	20.4	48.7	24.3	2.5	690	0.18	3.06	0.0	0.05	0.23	0.04	0.09	0	1.75	157
Requezon (ricotta cheese)	236	18.7	55.2	15.4	5.4	718	3.5	2.88	0	0.04	0.73	0.07	0.42	32	1.69	153
Crema fresca (fresh	193	2.1	74.5	19.7	2.9	110	0.17	0.38	0.9	0.04	0.17	0.11	0.06	7	0.28	176

Food Item Name Spanish (English)	Energy	Protein	Water	Fat	Carbohydrates	Calcium	Iron	Zinc	Vitamin C	Thiamin	Riboflavin	Niacin	Vitamin B6	Folate	Vitamin B12	Vit. A retinol activity equivalents (RAE)
	kcal	g	g	g	g	mg	mg	mg	mg	mg	mg	mg	mg	mg	µg	µg
cream)																
Leche en polvo (powdered milk)	496	26.32	2.47	26.71	38.42	912	0.47	3.34	9	0.28	1.21	0.65	0.3	37	3.25	257
Leche en polvo para bebe (powdered milk for infants)	509	9.5	3	27.7	57.9	320	6.2	3.9	51	0.36	0.78	5.2	0.38	47	1.5	540
Leche evaporada o condensada (evaporated or condensed milk)	134	6.81	74.04	7.56	10.04	261	0.19	0.77	2	0.05	0.32	0.19	0.05	8	0.16	112
Leche liquida (milk, fluid)	60	3.22	88.32	3.25	4.52	113	0.03	0.4	0	0.04	0.18	0.11	0.04	5	0.44	28
Yogures (yogurt)	61	3.5	87.9	3.3	4.7	121	0.05	0.59	0.5	0.03	0.14	0.08	0.03	7	0.37	27
Bananos (bananas)	89	1.1	74.9	0.3	22.8	5	0.26	0.15	8.7	0.03	0.07	0.67	0.37	20	0.00	3
Duraznos (peaches)	39	0.9	88.9	0.3	9.5	6	0.25	0.17	6.6	0.02	0.03	0.81	0.03	4	0.00	16
Manzanas (apples)	48	0.3	86.7	0.1	12.8	5	0.07	0.05	4.0	0.02	0.03	0.09	0.04	0	0.00	2
Sandias (watermelon)	30	0.6	91.5	0.2	7.6	7	0.24	0.10	8.1	0.03	0.02	0.18	0.05	3	0.00	28
Melones (melons)	34	0.8	90.2	0.2	8.2	9	0.21	0.18	36.7	0.04	0.02	0.73	0.07	21	0.00	169
Papayas (papayas)	43	0.5	88.1	0.3	10.8	20	0.25	0.08	60.9	0.02	0.03	0.36	0.04	37	0.00	47
Fresas (strawberries)	32	0.7	91.0	0.3	7.7	16	0.41	0.14	58.8	0.02	0.02	0.39	0.05	24	0.00	1
Limones (lemons)	22	0.4	92.3	0.2	6.9	6	0.08	0.05	38.7	0.02	0.02	0.09	0.05	20	0.00	0
Mandarinas (tangarines)	53	0.8	85.2	0.3	13.3	37	0.15	0.07	26.7	0.06	0.04	0.38	0.08	16	0.00	34

Food Item Name Spanish (English)	Energy	Protein	Water	Fat	Carbohydrates	Calcium	Iron	Zinc	Vitamin C	Thiamin	Riboflavin	Niacin	Vitamin B6	Folate	Vitamin B12	Vit. A retinol activity equivalents (RAE)
	kcal	g	g	g	g	mg	mg	mg	mg	mg	mg	mg	mg	mg	µg	µg
Mangos (mangoes)	60	0.8	83.5	0.4	15.0	11	0.16	0.09	36.4	0.03	0.04	0.67	0.12	43	0.00	54
Naranjas (oranges)	47	0.9	86.8	0.1	11.8	40	0.10	0.07	53.2	0.09	0.04	0.28	0.06	30	0.00	11
Piñas (pineapples)	50	0.5	86.0	0.1	13.1	13	0.29	0.12	47.8	0.08	0.03	0.50	0.11	18	0.00	3
Incaparina (Incaparina)	368	20.7	7.24	2	68	305	20	15	0.0	1.2	1.3	16	0	187	1.01	1350
Arroz (rice)	130	2.7	68.4	0.3	28.2	10	1.20	0.49	0.0	0.16	0.01	1.48	0.09	97	0.00	0
Cereales preparados, corn flakes, etc. (ready-to-eat cereals, corn flakes, etc.)	365	6.6	3.8	0.6	87.1	7	29.00	0.18	22.0	2.13	2.64	24.40	3.44	792	9.47	455
Fideos, tallarines, coditos, pastas de toda clase (noodles, macaroni, pasta of all types)	384	14.16	9.01	4.44	71.27	35	4.01	1.92	0	1.13	0.43	8.39	0.22	370	0.29	17
Harina de maiz (corn flour)	365	9.34	9.02	3.78	76.27	141	7.21	1.78	0	1.43	0.75	9.84	0.37	380	0	0
Harina de trigo (wheat flour)	364	10.33	11.92	0.98	76.31	15	4.64	0.7	0	0.79	0.49	5.9	0.04	291	0	0
Atol de maiz (corn drink)	376	3.35	0	0.7	89.2	230	5	0.31	0	0.22	0.01	0.26	0	0	0	0
Avenas de toda clase (e.g., mosh) (oats of all types [e.g., oatmeal])	389	16.89	8.22	6.9	66.27	54	4.72	3.97	0.1	0.76	0.14	0.96	0.12	0	0.00	0
Maiz (blanco, amarillo, etc.) (corn [white,	365	9.42	10.37	4.74	74.26	7	2.71	2.21	0	0.38	0.2	3.63	0.62	19	0	11

Food Item Name Spanish (English)	Energy kcal	Protein g	Water g	Fat g	Carbohydrates g	Calcium mg	Iron mg	Zinc mg	Vitamin C mg	Thiamin mg	Riboflavin mg	Niacin mg	Vitamin B6 mg	Folate mg	Vitamin B12 µg	Vit. A retinol activity equivalents (RAE) µg
yellow, etc.])																
Otros atoles (arroz en leche, atol de platano, atolillo, shuco, etc.) (other "atole" drinks [rice in milk, plantain, etc.])	108	1.72	89.7	0.58	24.08	34	0.58	0.11	0	0.22	0.01	0.26	0	0	0	0
Tortillas de harina (gramos) (flour tortillas [grams])	312	8.29	30.22	7.75	51.35	129	3.34	0.54	0	0.54	0.27	3.57	0.05	1.68	0	0
Tortillas de maiz (gramos) (corn tortillas [grams])	222	5.7	44.1	2.5	46.6	175	1.40	0.94	0.0	0.11	0.07	1.50	0.22	114	0.00	29
Frijol (negro, blanco, colorado etc.) (beans [black, white, red, etc.])	343	22.7	10.4	1.6	61.6	134	7.1	2.55	1	0.47	0.15	2.09	0.53	463	0	0
Frijoles enlatados (canned beans)	192	6.6	60.9	9.1	21.7	43	2.07	0.89	2.7	0.14	0.07	0.33	0.15	127.722	0.00	0
Semillas tostadas (mania, marañón, etc.) (toasted nuts [peanut, cashew, etc.])	446	18.6	4.5	19.4	53.8	55	3.31	10.30	0.3	0.03	0.05	0.29	0.04	9	0.00	3
Huevos de gallina (chicken eggs)	147	12.58	75.84	9.94	0.77	53	1.83	1.11	0	0.07	0.48	0.07	0.14	47	1.29	140
Otras clases de huevo	147	12.58	75.84	9.94	0.77	53	1.83	1.11	0	0.07	0.48	0.07	0.14	47	1.29	140

Food Item Name Spanish (English)	Energy	Protein	Water	Fat	Carbohydrates	Calcium	Iron	Zinc	Vitamin C	Thiamin	Riboflavin	Niacin	Vitamin B6	Folate	Vitamin B12	Vit. A retinol activity equivalents (RAE)
	kcal	g	g	g	g	mg	mg	mg	mg	mg	mg	mg	mg	mg	µg	µg
(other types of egg)																
Pescado fresco (fresh fish)	128	26.2	71.6	2.7	0.0	14	0.69	0.41	0.0	0.09	0.07	4.75	0.12	6	1.86	0
Sardinas, atun, etc. (enlatados) (sardines, tuna, etc. [canned])	208	24.62	59.61	11.45	0	382	2.92	1.31	0	0.08	0.22	5.24	0.17	12	8.94	32
Visceras de pollo o gallina (menudos) (Chicken or hen viscera [giblets])	116	16.92	76.46	4.83	0	8	8.99	2.67	18	0.31	1.78	9.73	0.85	588	16.58	3296
Visceras de res (menudos) (beef viscera)	135	20.36	70.81	3.63	3.89	5	4.9	4	1	0.19	2.76	13.18	1.08	290	59.3	9442
Carne de cerdo con hueso (pork with bone)	285	15.82	59.2	24.12	0	29	0.83	2.35	1	0.65	0.23	3.65	0.37	3	0.09	2
Carne de cerdo sin hueso (pork without bone)	285	15.82	59.2	24.12	0	29	0.83	2.35	1	0.65	0.23	3.65	0.37	3	0.09	2
Carne de pollo o gallina (chicken or hen meat)	234	26.8	60.1	13.3	0.1	15	1.66	2.16	0.5	0.06	0.22	7.91	0.38	29	0.94	191
Embutidos (jamon, salchichas, chorizos, longanizas, etc.) (sausages [various types listed])	455	24.1	31.9	38.3	1.9	8	1.59	3.41	0.0	0.63	0.30	5.13	0.53	2	2.00	0
Carne de res con hueso	288	18.28	57.83	23.3	0	7	1.79	3.38	0	0.09	0.15	3.32	0.38	6	2.78	0

Food Item Name Spanish (English)	Energy kcal	Protein g	Water g	Fat g	Carbohydrates g	Calcium mg	Iron mg	Zinc mg	Vitamin C mg	Thiamin mg	Riboflavin mg	Niacin mg	Vitamin B6 mg	Folate mg	Vitamin B12 µg	Vit. A retinol activity equivalents (RAE) µg
(beef with bone)																
Carne de res sin hueso (beef without bone)	288	18.28	57.83	23.3	0	7	1.79	3.38	0	0.09	0.15	3.32	0.38	6	2.78	0
Carne molida (ground beef)	193	29.2	62.6	7.6	0.0	9	3.23	7.06	0.0	0.04	0.20	7.29	0.43	7	2.64	0
Mariscos, (camarones, cangrejos, etc.) (shellfish [shrimp, crab, etc.])	99	20.91	77.28	1.08	0	39	3.09	1.56	2	0.03	0.03	2.59	0.13	4	1.49	68
Consomes (consommé)	307	9.53	9.31	7.63	65.69	996	35.3	3.14	12	0.26	0.19	2.97	1.32	138	0	132
Sopas en sobre (Malher, Maggi, etc.) (soup in a packet, Malher, Maggi, etc.)	307	9.53	9.31	7.63	65.69	996	35.3	3.14	12	0.26	0.19	2.97	1.32	138	0	132
Sopas instantaneas en vaso (instant soups in a cup)	307	9.53	9.31	7.63	65.69	996	35.3	3.14	12	0.26	0.19	2.97	1.32	138	0	132
Mayonesa y aderezo (mayonnaise and dressing)	390	0.9	39.9	33.4	23.9	14	0.2	0.18	0	0.01	0.02	0	0.02	0	0.21	21
Chicharones o carnitas de cerdo (fried pork belly or rind)	660	20.8	2.9	56.1	16.8	61	2.8	0	0	0.03	0.02	3.8	0	0	0	0
Papas (potatoes)	86	1.7	77.5	0.1	20.0	8	0.31	0.27	7.4	0.10	0.02	1.31	0.27	9	0.00	0
Platanos (plantains)	236	1.4	49.0	7.5	40.8	6	0.62	0.24	0.0	0.07	0.02	0.84	0.29	0	0.00	66

Food Item Name Spanish (English)	Energy	Protein	Water	Fat	Carbohydrates	Calcium	Iron	Zinc	Vitamin C	Thiamin	Riboflavin	Niacin	Vitamin B6	Folate	Vitamin B12	Vit. A retinol activity equivalents (RAE)
	kcal	g	g	g	g	mg	mg	mg	mg	mg	mg	mg	mg	mg	µg	µg
Yuca (cassava)	160	1.36	59.68	0.28	38.06	16	0.27	0.34	21	0.09	0.05	0.85	0.09	27	0	1
Chocolate (chocolate)	535	7.65	1.5	26.99	59.4	189	2.35	2.01	0	0.11	0.3	0.39	0.04	11	0.62	49
Dulces y confites de toda clase (sweets and all class of confectionery)	394	0	1.3	0.2	98	0	0	0	0	0	0	0	0	0	0	0
Ajo (garlic)	149	6.4	58.6	0.5	33.1	181	1.70	1.16	31.2	0.20	0.11	0.70	1.24	3	0.00	0
Chiles (chiles)	40	1.9	88.0	0.4	8.8	14	1.03	0.26	143.7	0.07	0.09	1.24	0.51	23	0.00	48
Cebolla (onion)	45	1.4	88.1	0.2	9.7	30	1	0.1	8.5	0.04	0.03	0.29	0.14	17	0	0
Aguacates (avocados)	160	2.0	73.2	14.7	8.5	12	0.55	0.64	10.0	0.07	0.13	1.74	0.26	81	0.00	7
Apio (celery)	18	0.8	94.1	0.2	4.0	42	0.42	0.14	6.1	0.04	0.05	0.32	0.09	22	0.00	26
Arveja (pea)	84	5.4	77.9	0.2	15.6	27	1.54	1.19	14.2	0.26	0.15	2.02	0.22	63	0.00	40
Brocolli (broccoli)	35	2.4	89.3	0.4	7.2	40	0.67	0.45	64.9	0.06	0.12	0.55	0.20	108	0.00	77
Coliflor (cauliflower)	23	1.8	93.0	0.5	4.1	16	0.32	0.17	44.3	0.04	0.05	0.41	0.17	44	0.00	1
Ejotes (green beans)	35	1.9	89.2	0.3	7.9	44	0.65	0.25	9.7	0.07	0.10	0.61	0.06	33	0.00	35
Guicoy (squash)	30	0.6	91	0.2	7.6	19	0.5	0.32	15	0.04	0.04	0.5	0.06	16	0	143
Guisquil (chayote)	24	0.6	93.4	0.5	5.1	13	0.22	0.31	8.0	0.03	0.04	0.42	0.12	18	0.00	2
Lechuga (lettuce)	24	0.6	93.4	0.5	5.1	13	0.22	0.31	8	0.03	0.04	0.42	0.12	18	0	2
Pepino (cucumber)	12	0.6	96.7	0.2	2.2	14	0.22	0.17	3.2	0.03	0.03	0.04	0.05	14	0.00	4
Remolacha (beet)	44	1.7	87.1	0.2	10.0	16	0.79	0.35	3.6	0.03	0.04	0.33	0.07	80	0.00	2
Repollo (cabbage)	23	1.3	92.6	0.1	5.5	48	0.17	0.20	37.5	0.06	0.04	0.25	0.11	30	0.00	4

Food Item Name Spanish (English)	Energy	Protein	Water	Fat	Carbohydrates	Calcium	Iron	Zinc	Vitamin C	Thiamin	Riboflavin	Niacin	Vitamin B6	Folate	Vitamin B12	Vit. A retinol activity equivalents (RAE)
	kcal	g	g	g	g	mg	mg	mg	mg	mg	mg	mg	mg	mg	µg	µg
Hierbas (berro, perejil, macuy, chipilín, culantro, yerbabuena, etc.) (herbs [watercress, parsley, macuy, chipilín, cilantro, peppermint])	45	5.1	85	0.8	7.3	226	12.6	1.09	92	0.2	0.35	0.97	0.16	105	0	34
Zanahoria (carrot)	35	0.8	90.2	0.2	8.2	30	0.34	0.20	3.6	0.07	0.04	0.65	0.15	14	0.00	852
Tomate (tomato)	21	0.8	93.8	0.3	4.6	24	0.6	0.17	23	0.06	0.06	0.05	0.08	0	0	42

Appendix 9. Food Group Constraints (Low, Average, and High Number of Servings per Week) Developed for Target Groups for the 2012 FANTA Optifood Study and the 2011 Guatemala HCES Analysis in Optifood

Table A17. Food Group Constraints for Children 6–11 Months Developed Using 2012 FANTA Optifood Study 24-Hour-Recall and the 2011 Guatemala HCES Datasets

Food Group	BF Children 6–8 Months						BF Children 9–11 Months					
	2012 FANTA Optifood Study Using 24-Hour Recall			2011 Guatemala HCES			2012 FANTA Optifood Study Using 24-Hour Recall			2011 Guatemala HCES		
	Low	Av	High	Low	Av	High	Low	Av	High	Low	Av	High
	Servings/week			Servings/week			Servings/week			Servings/week		
Added fats	0	1	7	0	7	14	0	1	7	0	3	8
Added sugars	3	6	7	0	7	7	5	7	8	0	4	7
Bakery, breakfast cereal	0	1	7	0	3	14	0	1	7	0	4	7
Beverages	0	7	14	0	0.1	7	0	7	14	0	0.1	3
Composites	—	—	—	0	1	7	—	—	—	0	1	1
Dairy foods	0	1	7	0	1	7	0	1	7	0	4	8
Fruits	0	1	7	7	10	42	0	1	7	7	7	35
Grains	7	28	42	14	21	42	7	28	42	14	14	35
Human milk	6.9	7	7.1	6.9	7	7.1	6.9	7	7.1	6.9	7	7.1
Legumes	0	1	7	0	5	14	0	1	7	0	3	10
Meat, poultry, eggs	0	1	7	0	3	5	0	1	7	0	3	7
Miscellaneous	—	—	—	0	0.1	3	—	—	—	—	—	—
Mixed foods	0	7	14	—	—	—	0	7	14	—	—	—
Snacks	0	1	7	7	10	42	0	1	14	7	7	35
Staples	7	14	21	14	21	42	7	14	21	14	14	35
Starchy roots	0	6	7	0	7	14	0	1	7	0	4	11
Sweetened snacks and desserts	—	—	—	0	1	7	—	—	—	0	0.1	2
Vegetables	0	14	28	7	21	35	0	14	28	7	14	42

Table A18. Food Group Constraints for Children 12–23 Months Developed Using the 2012 FANTA Optifood Study 24-Hour Recall and the 2011 Guatemala HCES Datasets

Food Group	BF 12–23 Months						NBF 12–23 Months					
	2012 FANTA Optifood Study Using 24-Hour Recall			2011 Guatemala HCES			2012 FANTA Optifood Study Using 24-Hour recall			2011 Guatemala HCES		
	Low	Av	High	Low	Av	High	Low	Av	High	Low	Av	High
	Servings/week			Servings/week			Servings/week			Servings/week		
Added fats	0	1	7	0	3	9	0	6	7	2	3	12
Added sugars	5	7	8	0	3	7	5	7	8	2	3	7
Bakery, breakfast cereal	0	1	7	0	4	6	0	1	7	4	6	15
Beverages	0	7	14	0	0.1	3	6	7	14	0	0.1	3
Composites	—	—	—	0	0.1	3	—	—	—	0	0.1	1
Dairy foods	0	1	7	0	2	8	0	1	7	3	4	8
Fruits	0	4	14	7	8	30	0	1	7	7	9	40
Grains	14	28	49	14	14	35	21	35	56	21	28	49
Human milk	6.9	7	7.1	6.9	7	7.1	—	—	—	—	—	—
Legumes	0	1	7	0	2	9	0	1	7	2	3	9
Meat, poultry, eggs	0	1	7	0	3	7	0	7	8	2	3	7
Miscellaneous	—	—	—	—	—	—	—	—	—	—	—	—
Mixed foods	0	7	14	—	—	—	0	11	14	—	—	—
Snacks	0	7	14	7	8	30	0	1	14	7	9	40
Staples	7	21	28	14	14	35	7	21	28	21	28	49
Starchy roots	0	1	7	0	4	11	0	4	7	2	3	11
Sweetened snacks and desserts	—	—	—	0	0.1	5	—	—	—	0	0.1	5
Vegetables	7	14	28	7	14	36	7	21	35	14	18	49

Table A19. Food Group Constraints for PLW Target Groups Developed Using the 2012 FANTA Optifood Study 24-Hour Recall and the 2011 Guatemala HCES Datasets

Food Group	Lactating Women						Pregnant Women					
	2012 FANTA Optifood Study Using 24-Hour Recall			2011 Guatemala HCES			2012 FANTA Optifood Study Using 24-Hour Recall			2011 Guatemala HCES		
	Low	Av	High	Low	Av	High	Low	Av	High	Low	Av	High
	Servings/week			Servings/week			Servings/week			Servings/week		
Added fats	0	1	7	3	4	8	0	1	7	3	4	7
Added sugars	5	7	8	3	4	7	5	7	8	3	3	7
Bakery, breakfast cereal	0	1	7	4	4	10	0	1	7	2	3	7
Beverages	6	7	14	0	0.1	2	6	7	14	0	0.1	5
Composites	—	—	—	0	0.1	7	—	—	—	0	0.1	3
Dairy foods	0	1	7	0	3	9	0	1	7	0	2	6
Fruits	0	4	14	6	6	31	0	1	7	6	7	39
Grains	21	28	49	21	28	49	28	35	49	14	16	40
Human milk	—	—	—	—	—	—	—	—	—	—	—	—
Legumes	0	7	14	0	3	13	0	7	8	0	6	11
Meat, poultry, eggs	0	4	14	0	4	8	0	7	8	0	5	8
Miscellaneous	—	—	—	—	—	—	—	—	—	—	—	—
Mixed foods	0	7	14	—	—	—	0	7	14	—	—	—
Snacks	0	1	14	6	6	31	0	1	7	6	7	39
Staples	14	21	28	28	35	49	20	21	28	28	30	40
Starchy roots	0	7	14	4	6	10	0	1	7	4	4	7
Sweetened snacks and desserts	—	—	—	0	0.1	2	—	—	—	0	0.1	3
Vegetables	7	21	28	14	16	40	14	21	28	11	14	51

Appendix 10. Comparison of Food Subgroup-Level Constraints (Minimum/Maximum Number of Servings per Week) Developed for the 2012 FANTA Optifood Study and the 2011 Guatemala HCES Target Groups

Table A20. Food Subgroup Constraints for Woman and Child Target Groups Developed Using 2012 FANTA Optifood Study Using 24-Hour Recall and 2011 Guatemala HCES Datasets

Food Subgroups	6–8 Months BF				9–11 Months BF				12–23 Months BF				12–23 Months NBF				Pregnant Women				Lactating Women			
	2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
	Servings per week																							
Breast milk	6.9	7.1	6.9	7.1	6.9	7.1	6.9	7.1	6.9	7.1	6.9	7.1	6.9	7.1	—	—	6.9	7.1	—	—	6.9	7.1	—	—
Broths	0	7	—	—	0	7	—	—	0	7	—	—	0	14	—	—	0	7	—	—	0	7	—	—
Butter, margarine (unfortified)	—	—	—	—	—	—	0	2	—	—	—	—	—	—	0	3	—	—	—	—	—	—	0	7
Cheese	0	1	0	1	0	7	0	1	0	1	0	3	0	1	0	4	0	1	0	4	0	7	0	4
Condiment vegetables	0	7	0	12	0	7	0	13	0	7	0	13	0	7	0	12	0	7	0	21	0	7	0	13
Cooked beans	0	7	0	7	0	7	0	8	0	7	0	6	0	7	0	7	0	14	0	10	0	7	0	10
Cream, sour cream	—	—	—	—	—	—	0	1	—	—	—	—	—	—	0	2	—	—	0	1	—	—	0	1
Eggs	0	7	0	4	0	7	0	4	0	7	0	4	0	7	0	4	0	7	0	4	0	7	0	4
Enriched/fortified bread	0	7	—	—	0	7	—	—	0	7	—	—	0	7	—	—	0	7	—	—	0	7	—	—
Enriched/fortified grains (Incaparina, etc.)	0	15	0	4	0	14	0	6	0	14	0	5	0	14	0	6	0	14	0	7	0	14	0	6

Food Subgroups	6–8 Months BF				9–11 Months BF				12–23 Months BF				12–23 Months NBF				Pregnant Women				Lactating Women			
	2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
	Servings per week																							
Fish without bones	—	—	0	3	—	—	0	2	—	—	0	2	—	—	—	—	—	—	0	3	—	—	0	2
Fluid or powdered milk (non-fortified)	0	7	0	3	0	7	0	6	0	7	0	5	0	7	0	4	0	7	0	4	0	7	0	3
Grain products with fillings (sandwiches, burgers, samosas, enchiladas)	—	—	0	2	—	—	0	1	—	—	0	3	—	—	0	1	—	—	0	3	—	—	0	3
Juices	—	—	0	3	—	—	0	1	—	—	0	1	—	—	0	2	—	—	0	2	0	7	0	2
Nuts, seeds, and unsweetened products	—	—	0	3	—	—	0	2	—	—	0	3	—	—	0	4	—	—	0	2	—	—	0	4
Organ meat	—	—	0	2	—	—	0	4	—	—	0	2	—	—	0	3	—	—	0	3	0	1	0	4
Other added fats	—	—	0	3	—	—	0	3	—	—	0	3	—	—	0	3	—	—	0	2	—	—	0	7
Other fruit	0	7	0	12	0	7	0	21	0	7	0	18	0	7	0	17	0	7	0	12	0	7	0	20
Other starchy plant foods	0	7	0	8	0	7	0	11	0	7	0	11	0	7	0	9	0	14	0	6	0	7	0	7
Other sweetened desserts (gelatin, non-dairy ice)	—	—	0	1	—	—	0	1	—	—	0	2	—	—	—	—	—	—	0	2	—	—	0	2
Other vegetables	0	4	0	35	0	4	0	42	0	4	0	30	0	7	0	37	0	7	0	27	0	7	0	31

Food Subgroups	6–8 Months BF				9–11 Months BF				12–23 Months BF				12–23 Months NBF				Pregnant Women				Lactating Women			
	2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
	Servings per week																							
Poultry, rabbit	0	1	0	3	0	1	0	4	—	—	0	2	0	7	0	4	0	7	0	4	0	7	0	4
Processed meat	—	—	0	3	0	1	0	3	0	1	0	2			0	4	0	1	0	3	0	1	0	3
Red meat	—	—	—	—	—	—	—	—	—	—	—	—	0	1	—	—	0	1	—	—	—	—	—	—
Refined grain bread, unenriched/ unfortified	—	—	0	8	—	—	0	7	—	—	0	6	—	—	0	11	—	—	0	6	—	—	0	7
Refined grains and products, unenriched/ unfortified	0	7	0	13	0	3	0	18	0	4	0	17	0	3	0	16	0	7	0	17	0	3	0	16
Soups	0	7	—	—	0	1	—	—	0	2	—	—	0	7	—	—	—	—	—	—	—	—	—	—
Soy products	0	1	—	—	—	—	—	—	0	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sugar (fortified)	5	7	0	7	5	7	0	7	0	4	0	7	5	8	0	7	—	—	0	7	—	—	0	7
Sugar-sweetened beverages (soda, processed or artificial juices)	0	1	0	1	0	7	0	2	—	—	0	2	—	—	0	2	0	7	0	2	—	—	0	3
Sweet snack foods (candy and chocolate)	—	—	0	3	—	—	0	2	—	—	0	3	—	—	0	5	—	—	0	2	—	—	0	3
Sweetened bakery products, unenriched/	—	—	0	2	—	—	0	4	—	—	0	1	—	—	0	4	—	—-	0	4	—	—	0	4

Food Subgroups	6–8 Months BF				9–11 Months BF				12–23 Months BF				12–23 Months NBF				Pregnant Women				Lactating Women			
	2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES		2012 FANTA Optifood 24-Hour Recall		2011 Guatemala HCES	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
	Servings per week																							
unfortified																								
Vegetable oil (unfortified)	0	7	0	6	0	7	0	7	0	7	0	6	0	7	0	7	0	7	0	6	0	7	0	7
Vitamin A-source dark GLV	0	7	0	35	0	7	0	11	0	7	0	13	0	7	0	11	0	7	0	4	0	7	0	20
Vitamin A-source fruit	—	—	—	—	—	—	0	1	—	—	—	—	—	—	0	2	—	—	—	—	—	—	0	1
Vitamin A–source other vegetables	0	7	0	35	0	1	0	11	0	1	0	13	0	7	0	13	0	7	0	4	0	7	0	20
Vitamin C–rich fruit	0	1	0	17	0	7	0	26	0	7	0	18	0	7	0	21	0	7	0	2	0	7	0	19
Vitamin C–rich vegetables	0	14	0	35	0	14	0	7	0	14	0	7	0	14	0	7	0	14	0	5	0	14	0	20
Whole grains and products, unenriched/ unfortified	7	35	0	26	7	35	0	35	7	42	0	35	14	42	0	38	21	35	0	39	21	42	0	38

Appendix 11. Main Food Sources of Nutrients at the Subgroup Level in Diet B (Best Modeled Diet That Did Not Take Average Intake into Account) Using 2011 Guatemala HCES Data

Table A21. Main Food Sources of Nutrients at the Subgroup Level in Diet B (Best Modeled Diet That Did Not Take Average Intake into Account) Using 2011 Guatemala HCES Data

Number of Nutrients (Out of a Possible 11) for Which Food Subgroup Was a Main Source[a]						
FSG	**6–8 Months BF**	**9–11 Months BF**	**12–23 Months BF**	**12–23 Months NBF**	**Lactating Women**	**Pregnant Women**
Whole grains and products, unenriched/unfortified[b]	7	5	7	8	8	8
Organ meat	7	7	6	6	8	7
Enriched/fortified grains and products, whole or refined[c]	9	9	9	9	7	7
Refined grains and products, unenriched/unfortified	5	5	5	4	7	7
Beans, lentils, and peas	6	6	6	2	5	5
Vitamin A–source dark GLV	3	4	5	4	3	4
Fish without bones	0	0	0	0	2	2
Other starchy plant foods	0	0	0	0	2	2
Processed meat	0	0	0	0	2	0
Other vegetables	6	0	0	5	1	0
Cheese	0	1	0	5	1	1
Nuts and seeds	1	0	0	1	1	1
Vitamin C–rich fruit	1	1	4	1	1	1
Grain products with fillings	0	0	0	0	1	0
Sweetened bakery products, unenriched/unfortified	0	0	0	3	0	0
Breast milk	10	10	10	—	—	—
Refined grain bread, unenriched/unfortified	5	0	0	0	0	0
Fluid or powdered milk (non-fortified)	3	3	0	0	0	0
Fortified sugar	1	1	1	1	1	1
Eggs	1	0	0	0	0	0
Vitamin A source, other vegetables	1	0	0	0	0	0
Vitamin C–rich vegetables	1	0	0	0	0	0
Vitamin A–source fruit	0	0	0	0	0	1

[a] Best sources were those that contributed to at least 5 percent of the RNI for the chosen nutrient in the Best Diet B, a diet within upper and lower food group constraints but outside of average constraints, from Module 2.

[b] Refers largely to maize products, such as corn tortillas.

[c] Refers to Incaparina.

Appendix 12. FBRs Tested in Optifood for Breastfed Children 6–8 Months Using the the 2011 Guatemala HCES Dataset

Process of selecting food-based recommendations for breastfed children 6–8 months. The results of testing individual and combined FBRs for this target group are in Table A24. The FBRs tested for this target group using some alteration to dietary constraints included:

- Incaparina, 4 servings/week
- Incaparina, 7 servings/week
- Beans, 4 servings per week
- Beans, 7 servings per week
- Green leafy vegetables, 7 servings per week
- Other vegetables, 7 servings per week
- Maize products, 14 servings per week (included in all models as part of the dietary pattern)
- Meat or eggs, 3 servings per week
- Meat or eggs, 5 servings per week
- Meat or eggs, 7 servings per week

A set of four of the above FBRs— including Incaparina, vegetables, beans, and maize—in combination with breastfeeding, met at least 65 percent of RNI in a minimized diet for all modeled nutrients except iron, as shown in Tables A22–24.[39] While iron remained a problem nutrient if meat or eggs were modeled with these four FBRs, the content was slightly improved and it was decided to maintain this recommendation so that FBRs across age groups were consistent. However, if TIPs trials showed that MPE consumption was not feasible or acceptable for young children, this FBR could be removed from the list. The best set of recommendations for breastfed children 6–8 months, based on the 2011 Guatemala HCES apparent consumption data, includes:

- Breastfeed your child on demand.
- Feed your child maize products twice per day
- Feed your child vegetables, including green vegetables like amaranth leaves, every day.
- Feed beans to your at least three times per week.
- Give your child Incaparina at least four times per week.
- Give your child meat, fish, chicken, or eggs every day.[40]

The estimated cost of putting this set of FBRs into practice as part of the lowest-cost diet is 0.8 GTQ per child per day.

[39] For further details on minimized diets, please see glossary of terms and Appendix 1.
[40] Modeling daily MPE consumption required adjustments to model constraints and did not result in iron RNI being met. However, this FBR was included for consistency with WHO recommendations, as per the methods used in the 2012 FANTA Optifood analysis using 24-hour recall data. The feasibility of implementing the FBR would be determined via testing with TIPs.

Table A22. Summary of Results for FBRs Developed Using Optifood for Children 6–8 Months, Based on the 2011 Guatemala HCES Data and 2012 FANTA Optifood Study Data

	2012 FANTA Optifood Study	2011 Guatemala HCES
The maximum number of nutrients for which at least 65% of RNI was met in a minimized diet (from a possible maximum of 11)	9	10
Number of FBRs (individual food or food subgroup level recommendations) included in final set	6	5
Nutrients for which >=65% of RNI in minimized diets could not be met using FBRs and highest percentage of RNI achievable in minimized diets	Iron (62%) Zinc (61%)	Iron (42.6%)

Table A23. Details of Best Food-Based Recommendations Developed for Breastfed Children 6–8 Months, Based on the 2011 Guatemala HCES Data

FBR No.	Name/ Code	Content (Food or Food Subgroup)	Frequency (Servings/Week)	Estimated Serving Size (g)	Cost (GTQ) of the Lowest-cost Diet That Includes FBR/FBRs[a]
1	—	Breast milk	7	—	—
2	—	Maize products	14	20	0.4
3	Inc4	Incaparina	7	10	0.4
4	Beans4	Cooked beans	7	17	0.4
5	Veg7	Vegetables, especially green leafy	7	9.6	0.5
6	MPE3	Eggs, liver	7	15	0.7
Cost of putting all FBRs into practice in addition to the lowest-cost diet[b]					0.8

[a] This diet is based on average dietary patterns to meet energy requirements at the lowest cost.

[b] This diet is based on average dietary patterns modeled to meet energy requirements in combination with the complete set of FBRs.

Table A24. Select Results from the Systematic Evaluation of Alternative FBRs for Children 6–8 Months in the the 2011 Guatemala HCES Dataset Using the Module 3 Minimized Diet.[41] ***Table shows the % RNI covered by a minimized diet, expressing the level of acceptability achievable for a nutrient in the worst-case scenario where other foods included in addition to the FBR/FBRs had the lowest amount of that nutrient possible.***

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ) /Day	No. >=65 %
1	Bean7	70.9	70.9	76.3	73.2	51.1	77.3	168.6	67.4	91.1	23.4	61.2	0.6	8
1	Inc7	67.7	70.4	92.1	99.5	83	50.9	83.7	87	120.2	33.4	54.5	0.4	8
1	Inc4	64	70.4	75.2	85.7	66.1	50.8	73.1	78.5	107.3	24	40.9	0.4	7
1	Bean4	62.1	70.6	63.3	70.2	46.7	62.7	100.9	67.2	90.3	16.8	30.3	0.4	5
1	Bean3	61.1	70.6	59	69.2	45.2	57.8	83.7	67.2	90.3	14.6	29.2	0.4	5
1	GLV7	65	87.6	58.7	75.7	45.5	54.5	72.4	67.2	91	24.7	29	0.5	6
1	MPE5	60	70.4	55.1	70.8	46.1	55.8	59.5	93.7	90.3	12.6	28.8	0.5	4
1	GLV3	62	77.7	55.3	71	44.3	52.4	64.7	67.2	90.6	17.1	28.1	0.4	4
1	MPE3	59.9	70.4	53.9	68.5	43.6	53.3	59.2	79.1	90.3	11.9	27.8	0.4	4
1	OtherVeg7	59.8	70.9	53.2	68.1	43.7	52	60.8	67.2	90.3	11.4	27.7	0.3	4
3	Inc7 - GLV7 - MPE5	77.8	87.6	100.8	111	89.4	59.7	117	117.6	123.1	48	78.2	1	9
3	Inc7 - OtherVeg7 - MPE5	71.8	70.9	95	103.4	86	57.2	103.1	114.5	122	34.6	73.7	0.8	9
3	Inc4 - Bean4 - MPE3	72.5	70.7	87.7	89.6	73.1	65.2	131.7	98.3	108.1	29.8	71.9	0.7	10
3	Inc7 - GLV7 - MPE3	76	87.6	99.3	108.7	85.3	57.1	106.4	99.2	121.3	47.1	70.5	0.9	9
3	**Inc4 - Bean4 - GLV7**	**76.3**	**87.8**	**91.9**	**96.7**	**71.4**	**66.5**	**140.7**	**78.8**	**108.6**	**42.6**	**67.6**	**0.8**	**10**
3	Inc4 - Bean4 - OtherVeg7	70.4	71.2	86.3	89	69.6	64	126.8	78.8	107.9	29.4	63.1	0.6	8

[41] Each modeled diet is inclusive of breastfeeding and 14 servings/week of maize; final set/s marked in **bold**.

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ) /Day	No. >=65 %
3	Inc7 - GLV7 - OtherVeg7	74.4	88.6	98.9	108.4	85.6	57.2	102.1	87.3	121.1	46.8	62.8	0.7	8
3	Inc4 - MPE3 - Bean3	68.7	70.6	82.8	88.5	68	60.4	105.9	90.6	107.8	27.7	59.1	0.7	8
3	Inc4 - Bean3 - GLV3	68.9	77.9	84.1	91	68.8	59.5	105.1	78.7	107.9	32.8	51.5	0.6	8
3	Inc4 - GLV7 - MPE5	70.1	87.6	83.7	97.3	70.8	59.6	92.4	105.3	108.6	38.4	49.3	0.9	8
3	Bean4 - GLV7 - MPE5	69.9	87.8	71.8	81.7	51.5	71.5	126.2	94	91.9	31.3	46.8	1	8
3	Inc4 - OtherVeg7 - MPE5	64.8	70.9	78.1	89.6	69	57.2	78.4	105.2	107.9	25.2	44.8	0.7	7
3	Inc4 - GLV7 - MPE3	69.6	87.6	82.4	94.9	68.3	57	86.9	90.6	108.1	37.7	42.9	0.8	8
3	Inc4 - MPE3 - GLV77	69.6	87.6	82.4	94.9	68.3	57	86.9	90.6	108.1	37.7	42.9	0.8	8
3	Inc4 - GLV7 - OtherVeg7	69.6	88.6	82	94.6	68.7	57.2	88.4	78.8	108	37.4	42.8	0.6	8
3	Inc4 - MPE3 - GLV3	66.5	77.8	79	90.3	67.1	54.9	79.2	90.5	107.6	30.1	42	0.6	8
3	Bean4 - GLV7 - MPE3	68.2	87.8	70.6	79.4	49	68.8	115.6	79.4	91.3	30.5	39.1	0.8	8
3	Bean4 - MPE3 - GLV7	68.2	87.8	70.6	79.4	49	68.8	115.6	79.4	91.3	30.5	39.1	0.8	8
3	Bean4 - GLV7 - OtherVeg7	67.8	88.8	70.2	79.1	49.3	69	116.2	67.5	91.2	30.2	32.3	0.7	8
3	GLV7 - OtherVeg7 - MPE5	65.5	88.6	61.9	79.7	48.7	62.2	74.8	94	91.1	26	30.8	0.8	6

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ) /Day	No. >=65 %
3	MPE3 - Bean3 - GLV3	63.5	77.9	62.8	73.7	46.3	61.8	89.7	79.2	90.6	20.7	30.3	0.6	5
3	GLV7 - OtherVeg7 - MPE3	65.4	88.6	60.7	77.4	46.2	59.6	74.4	79.3	91.1	25.3	29.8	0.7	6
4	Inc7 - GLV7 - OtherVeg7 - MPE5	78.6	88.6	102.2	115.3	92.6	62.3	120.8	123.5	123.4	48.5	80.7	1.1	9
4	**Inc4 - Bean4 - Veg7 - MPE3**	**72.8**	**71.2**	**88.2**	**90.1**	**75.3**	**66.5**	**134.5**	**100.2**	**108.2**	**29.9**	**73.4**	**0.8**	**10**
4	Inc7 - GLV7 - OtherVeg7 - MPE3	76.8	88.6	100.2	109.5	85.8	59.7	109.8	99.3	121.3	47.3	72.9	0.9	9
4	Inc4 - Bean4 - GLV7 - OtherVeg7	77.1	88.9	92.7	97.4	71.9	69.1	144.1	79	108.7	42.8	70	0.8	10
4	Inc4 - MPE3 - Bean3 - GLV3	71.3	77.9	85.4	92	68.9	61.9	112.8	90.7	108.1	33.3	61.5	0.8	8
4	Inc4 - GLV7 - OtherVeg7 - MPE5	70.7	88.6	84.5	98	71.3	62.3	95.8	105.4	108.7	38.6	51.7	1	8
4	Bean4 - GLV7 - OtherVeg7 - MPE5	70.7	88.8	72.6	82.5	52	74.1	129.6	94.2	92.2	31.5	49.2	1	8
4	Inc4 - GLV7 - OtherVeg7 - MPE3	70	88.6	83.3	95.7	68.8	59.6	88.8	90.8	108.2	37.9	44	0.8	8

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ) /Day	No. >=65 %
4	Bean4 - GLV7 - OtherVeg7 - MPE3	69	88.8	71.4	80.2	49.5	71.5	119	79.5	91.4	30.7	41.5	0.9	8

Appendix 13. FBRs Tested in Optifood for Breastfed Children 9–11 Months Using the the 2011 Guatemala HCES Dataset

Process of selecting food-based recommendations for breastfed children 9–11 months. The results of testing individual and combined FBRs for this target group are in Table A27. The FBRs tested for this target group using some alteration to dietary constraints included:

- Incaparina, 7 servings per week
- Maize products, 14 servings per week (included in all models as part of the dietary pattern)
- Liver, 1 serving per week
- Beans, 4 servings per week
- Beans, 7 servings per week
- Green leafy vegetables, 5 servings per week
- Green leafy vegetables, 7 servings per week
- Meat, poultry, or eggs, 3 servings per week
- Meat, poultry, or eggs, 5 servings per week
- Meat, poultry, or eggs, 7 servings per week

A set of four to five of the above FBRs, in combination with breastfeeding, met at least 65 percent of RNI in a minimized diet for all modeled nutrients, as shown in Tables A25–27.[42] Only the recommendations for Incaparina seven times per week, maize products twice per day, and beans and GLV five times each per week were essential to meet nutrient requirements for this target group. However, for the sake of consistency with FBRs for younger children and to further maximize nutrient intake, the frequency for bean and GLV consumption was increased to seven servings per week. While it was possible to meet all modeled nutrient requirements using lower frequencies of MPE consumption, the FBR for daily consumption of MPE was used for consistency with WHO recommendations. The final set of FBRs for breastfed children 9–11 months, based on the 2011 Guatemala HCES apparent consumption data, includes:

- Breastfeed your child on demand.
- Feed your child Incaparina every day.
- Feed your child maize products twice per day.
- Feed your child green leafy vegetables, like amaranth leaves, every day
- Feed beans to your child every day.
- Give your child eggs or meat every day.

The estimated cost of putting this set of FBRs into practice as part of the lowest-cost diet is 2 GTQ per child per day.

[42] For further details on minimized diets please see glossary of terms and Appendix 1.

Table A25. Summary of Results for FBRs Developed Using Optifood for Breastfed Children 9–11 Months, Based on the 2011 Guatemala HCES and 2012 FANTA Optifood Study Data

	2012 FANTA Optifood Study Using 24-Hour Recall	2011 Guatemala HCES
The maximum number of nutrients for which at least 65% of RNI was met in a minimized diet (from a possible maximum of 11)	11	11
Number of FBRs (individual food or food subgroup level recommendations) included in final set	6	5
Nutrients for which >=65% of RNI in minimized diets could not be met using FBRs and highest percentage of RNI achievable in minimized diets	—	—

Table A26. Details of Best FBRs Developed for Breastfed Children 9–11 Months, Based on the 2011 Guatemala HCES Data

FBR No.	Name/ Code	Content (Food/Food Subgroup)	Frequency (Servings/Week)	Estimated Serving Size (g)	Cost (GTQ) of the Lowest-cost Diet That Includes FBR/FBRs[a]
1	—	Breast milk	7	—	—
2	—	Maize products	14	20	0.6
3	Incaparina7	Incaparina	7	15	0.7
4	Beans7	Cooked beans	7	26	0.7
5	GLV7	Green leafy vegetables (hierbas)	7	18	1.1
6	MPE3	Meat or eggs	7	20	1
Cost of putting all FBRs into practice in addition to the lowest-cost diet[b]					2

[a] This diet is based on average dietary patterns to meet energy requirements at the lowest cost.

[b] This diet is based on average dietary patterns modeled to meet energy requirements in combination with the complete set of FBRs.

Table A27. Select Results from the Systematic Evaluation of Alternative FBRs for Children 9–11 Months in the the 2011 Guatemala HCES Dataset in the Module 3 Minimized Diet.[43] ***Table shows the % RNI covered by a minimized diet, expressing the level of acceptability achievable for a nutrient in the worst-case scenario where other foods included in addition to the FBR/FBRs had the lowest amount of that nutrient possible.***

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ)/ Day	No. >= 65%
0	No FBRs	42.7	54.8	56	52.7	27.8	27.6	34.8	53.4	69.7	12.9	23.4	0.6	1
1	Incaparina7	53.5	54.8	110.1	98	84.8	27.6	71.2	82.6	113.5	44.2	57.1	0.7	6
1	GLV7	53	88.2	67.2	68.2	31.8	35	60.8	53.6	71.1	38.4	26.4	1.1	4
1	Bean7	51.2	55.4	90.8	59.9	39.5	72.3	197.8	53.4	69.7	32.2	32.5	0.7	4
1	Bean5	48.4	55.2	79.1	57.3	35.4	57.6	145.6	53.4	69.7	25.9	29.5	0.7	3
1	MPE3	42.7	54.8	56	54.4	27.8	31.5	35	68.8	69.7	13.3	24.1	0.7	2
1	Liver1	42.7	55.8	58.5	64.6	34.3	35.2	56.1	143.4	89.6	15.6	24.4	0.7	2
1	MPE5	42.8	54.8	56.4	56.8	30.9	35.1	35.5	84.4	69.7	13.8	25.4	0.9	2
1	GLV5	50	78.7	64	63.8	30.6	32.9	53.4	53.6	70.7	31.1	25.5	0.9	2
3	Incaparina7 - Bean5 - GLV7	69.8	88.6	146.9	119.5	97.6	65.1	208	82.9	114.9	83.3	66.7	1.3	11
3	**Incaparina7 - Bean7 - GLV5**	**69.6**	**79.2**	**156.3**	**117.8**	**100.8**	**77.7**	**252.8**	**82.9**	**114.5**	**82.6**	**69.2**	**1.2**	**11**
3	Incaparina7 - Bean7 - MPE3	62.4	55.4	149.4	108.8	98	76.4	234.4	98.2	113.5	65.3	68.1	1.1	9
3	Incaparina7 - Bean7 - Liver1	62.3	56.4	150.7	118.5	104.4	79.9	255.5	172.7	133.4	67.1	68.1	1	9
3	Incaparina7 - Bean7 - MPE5	62.6	55.4	150.7	111.8	101.5	80.3	234.9	113.8	113.5	66.3	69.5	1.3	9
3	Incaparina7 - GLV5 - Liver1	60.9	79.6	120.7	121.3	94.3	40.5	111.1	172.8	134.4	65.1	60.3	1.2	8
3	Incaparina7 - GLV7 - MPE3	63.9	88.2	121.7	116	88.9	38.9	97.4	98.3	114.9	70.4	61	1.4	8

[43] Each modeled diet is inclusive of breastfeeding and 14 servings/week of maize; final set/s of FBRs selected are marked in **bold**.

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ)/ Day	No. >= 65%
3	Incaparina7 - GLV7 - Liver1	63.8	89.2	124	125.8	95.5	42.6	118.5	172.8	134.8	72.4	61.2	1.3	8
3	Incaparina7 - GLV7 - MPE5	64	88.2	122.6	118.7	92.2	42.5	97.9	113.9	114.9	71.2	62.3	1.5	8
4	Incaparina7 - Bean5 - GLV5 - GLV7	69.8	88.6	146.9	119.5	97.6	65.1	208	82.9	114.9	83.3	66.7	1.3	11
4	Incaparina7 - Bean5 - GLV5 - MPE3	67	79.1	144.8	117.3	96.6	67.1	200.8	98.3	114.5	76.9	66.9	1.4	11
4	Incaparina7 - Bean5 - GLV5 - Liver1	66.9	80	146.3	127	103	70.6	221.9	172.8	134.4	78.7	67	1.3	11
4	Incaparina7 - Bean5 - GLV7 - MPE3	69.9	88.6	148.1	121.8	97.8	69.2	208.3	98.4	114.9	84.2	67.8	1.5	11
4	Incaparina7 - Bean5 - GLV7 - Liver1	69.8	89.6	149.6	131.5	104.2	72.8	229.3	172.9	134.8	86	67.9	1.4	11
4	Incaparina7 - Bean5 - GLV5 - MPE5	67.1	79.1	146.1	120.2	100	70.9	201.3	113.9	114.5	77.8	68.4	1.5	11
4	Incaparina7 - Bean5 - Bean7 - GLV5	69.6	79.2	156.3	117.8	100.8	77.7	252.8	82.9	114.5	82.6	69.2	1.2	11
4	Incaparina7 - Bean5 - GLV7 - MPE5	70	88.6	149.4	124.7	101.2	73.1	208.7	114	114.9	85.1	69.3	1.6	11
4	Incaparina7 - Bean5 - Bean7 - GLV7	72.6	88.8	159.6	122.3	102	79.8	260.2	82.9	114.9	89.9	70.1	1.4	11
4	Incaparina7 - Bean7 - GLV5 - GLV7	72.6	88.8	159.6	122.3	102	79.8	260.2	82.9	114.9	89.9	70.1	1.4	11

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ)/ Day	No. >= 65%
4	Incaparina7 - Bean7 - GLV5 - MPE3	69.8	79.2	157.8	120.2	101	81.8	253	98.4	114.5	83.5	70.3	1.5	11
4	Incaparina7 - Bean7 - GLV5 - Liver1	69.7	80.2	159.1	129.8	107.4	85.3	274.1	172.9	134.4	85.3	70.3	1.3	11
4	Incaparina7 - Bean7 - GLV7 - MPE3	72.8	88.8	161.1	124.7	102.2	84	260.5	98.4	114.9	90.8	71.2	1.6	11
4	Incaparina7 - Bean7 - GLV7 - Liver1	72.6	89.8	162.4	134.3	108.6	87.5	281.5	172.9	134.8	92.6	71.2	1.5	11
4	Incaparina7 - Bean7 - GLV5 - MPE5	69.9	79.2	159.1	123.2	104.4	85.7	253.5	114	114.5	84.5	71.8	1.6	11
4	**Incaparina7 - Bean7 - GLV7 - MPE5**	**72.9**	**88.8**	**162.4**	**127.7**	**105.6**	**87.9**	**260.9**	**114.1**	**114.9**	**91.8**	**72.7**	**1.8**	**11**
5	Incaparina7 - Bean5 - GLV5 - MPE3 - Liver1	67	80	147.1	127.9	103.1	72.8	222	183.1	134.4	79.1	67.3	1.4	11

Appendix 14. FBRs Tested in Optifood for Breastfed Children 12–23 Months Using the 2011 Guatemala HCES Dataset

Process of selecting food-based recommendations for breastfed children 12–23 months. The results of testing individual and combined FBRs for this target group are in Table A30. The FBRs tested for this target group using some alteration to dietary constraints included:

- Incaparina, 4 servings per week
- Incaparina, 7 servings per week
- Maize products, 14 servings per week (included in all models as part of the dietary pattern)
- Beans, 4 servings per week
- Beans, 7 servings per week
- Green leafy vegetables, 7 servings per week
- Meat or eggs, 3 servings per week
- Meat or eggs, 5 servings per week
- Meat or eggs, 7 servings per week

A set of five of the above FBRs, in combination with breastfeeding, met at least 65 percent of RNI in a minimized diet for all modeled nutrients as shown in Tables A28–30.[44] While it was possible to meet all modeled nutrient requirements using lower frequencies of MPE consumption, the FBR for daily consumption of MPE was used for consistency with WHO recommendations. The final set of FBRs for breastfed children 12–23 months, based on the 2011 Guatemala HCES apparent consumption data, includes:

- Breastfeed your child on demand.
- Feed your child maize products twice per day.
- Feed your child green leafy vegetables, like amaranth leaves, every day.
- Feed beans to your child every day.
- Give your child Incaparina every day.
- Give your child meat or eggs every day.

The estimated cost of putting this set of FBRs into practice as part of the lowest-cost diet is 3.3 GTQ per child per day.

Table A28. Summary of Results for FBRs Developed Using Optifood for Breastfed Children 12–23 Months, Based on the 2011 Guatemala HCES and 2012 FANTA Optifood Study Data

	2012 FANTA Optifood Study	2011 Guatemala HCES
The maximum number of nutrients for which at least 65% of RNI was met in a minimized diet (from a possible maximum of 11)	11	11

[44] For further details on minimized diets, please see glossary of terms and Appendix 1.

Number of FBRs (individual food or food subgroup level recommendations) included in final set	6	5
Nutrients for which >=65% of RNI in minimized diets could not be met using FBRs and highest percentage of RNI achievable in minimized diets	—	—

Table A29. Details of Best FBRs Developed for Breastfed Children 12–23 Months, Based on the 2011 Guatemala HCES Apparent Consumption Data

FBR No.	Name/ Code	Content (Food/Food Subgroup)	Frequency (Servings/Week)	Estimated Serving Size (g)	Cost (GTQ) of the Lowest-cost Diet That Includes FBR/FBRs[a]
1	—	Breast milk	7	—	—
2	—	Maize products	14	25	1.10
3	Incaparina7	Incaparina	4	19	1.3
4	Beans7	Cooked beans	4	45	1.5
5	GLV7	Green leafy vegetables (hierbas)	7	38	2.1
6	MPE3	Meat, eggs	7	25	1.7
Cost of putting all FBRs into practice in addition to the lowest-cost diet[b]					3.3

[a] This diet is based on average dietary patterns to provide energy requirements at the lowest cost.

[b] This diet is based on average dietary patterns modeled to meet energy requirements in combination with the complete set of FBRs.

Table A30. Select Results from the Systematic Evaluation of Alternative FBRs for Breastfed Children 12–23 Months in the 2011 Guatemala HCES Dataset in the Module 3 Minimized Diet.[45] ***Table shows the % RNI covered by a minimized diet, expressing the level of acceptability achievable for a nutrient in the worst-case scenario where other foods included in addition to the FBR/FBRs had the lowest amount of that nutrient possible.***

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ) /Day	No. > =65%
0	Optimized diets—outside of average FG patterns	99	485.1	210.5	164.3	128.4	109.5	221.2	99	237.8	99	264.5	2.6	11
0	Optimized diets—with average FG patterns	94	674.9	191.3	160.9	100	106.3	220.6	193.6	231.3	72.3	201.4	4	11
0	No FBRs	36.3	199.8	50	47.6	21.9	24.1	18.3	31	107.9	10	36.8	1.1	2
1	Incaparina7	47.7	199.8	105.1	95.3	73.6	24.1	42.8	52.8	196.1	37.4	98.6	1.3	6
1	Incaparina4	42.7	199.8	81.3	74.4	51.4	24.1	32.3	43.5	158.3	25.6	71.9	1.2	5
1	Bean7	44.6	204.2	83.8	54.1	32.1	58	120.9	31.2	107.9	26.1	52.6	1.5	4
1	GLV7	53.2	430.8	67.6	73.1	27.6	34.2	45.1	31.3	112.2	43.8	45.2	2.1	4
1	Bean4	39.2	201.6	61.3	49.2	24.9	35.8	55	31.1	107.9	15.6	42.3	1.2	2
1	MPE3	36.3	199.8	50.5	49	21.9	27.3	18.6	45.1	107.9	10.5	38.3	1.3	2
1	MPE5	36.3	199.8	51.7	51.4	24.5	30.7	19.4	59.6	110.1	11.1	40.9	1.5	2
2	Incaparina7 - GLV7	64.7	430.8	123	121.4	79.4	34.2	69.6	53.1	200.4	71.3	107.2	2.2	8
3	Incaparina4 - Bean7 - GLV7	68.4	435.2	134.8	108.8	67.8	68.3	161.6	44	162.6	76	97.7	2.5	10
3	Incaparina7 - Bean7 - GLV7	73.5	435.2	159.8	130.3	90.2	68.3	172.1	53.4	200.4	87.9	125.1	2.6	10
3	Incaparina7 - Bean4 - GLV7	67.8	432.6	135.5	124.9	82.8	46	106.2	53.2	200.4	77.2	113.4	2.4	9

[45] Each modeled diet is inclusive of breastfeeding and 14 servings/week of maize; final set/s of FBRs selected are marked in **bold**.

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ) /Day	No. > =65%
3	Incaparina7 - GLV7 - MPE3	64.7	430.8	123.9	123.5	79.6	37.3	69.8	67.2	200.4	71.9	109	2.4	9
3	Incaparina7 - GLV7 - MPE5	64.8	430.8	125.3	126.6	82.3	40.8	70.6	81.7	202.6	72.6	111.8	2.6	9
3	Incaparina7 - Bean7 - MPE5	56.8	204.2	144.9	109.8	87.3	65.1	146.3	81.7	198.3	55.5	121.6	2.1	9
4	**Incaparina7 - Bean7 - GLV7 - MPE3**	**73.7**	**435.2**	**161.5**	**132.6**	**90.4**	**71.7**	**172.3**	**67.5**	**200.4**	**88.7**	**127.3**	**2.9**	**11**
4	Incaparina4 - Bean7 - GLV7 - MPE5	68.7	435.2	138.3	114.4	70.7	75.3	162.7	72.6	164.8	77.5	103.1	2.9	11
4	**Incaparina7 - Bean7 - GLV7 - MPE5**	**73.8**	**435.2**	**163.3**	**136.1**	**93.1**	**75.4**	**173.1**	**82**	**202.6**	**89.4**	**130.5**	**3**	**11**
4	Incaparina4 - Bean7 - GLV7 - MPE3	68.6	435.2	136.4	111	68	71.6	161.9	58.1	162.6	76.7	99.9	2.8	10
4	Incaparina7 - Bean4 - GLV7 - MPE3	68	432.6	136.9	127	83	49.4	106.5	67.3	200.4	77.9	115.5	2.6	10
4	Incaparina7 - Bean4 - GLV7 - MPE5	68.1	432.7	138.7	130.3	85.7	53.1	107.3	81.8	202.6	78.6	118.7	2.8	10

Appendix 15. FBRs Tested in Optifood for Non-Breastfed Children 12–23 Months Using the 2011 Guatemala HCES Dataset

Process of selecting food-based recommendations for non-breastfed children 12–23 months.

The results of testing individual and combined FBRs for this target group are in Table A33. The FBRs tested for this target group using some alteration to dietary constraints included:

- Incaparina, 7 servings per week
- Incaparina, 14 servings per week
- Liver, 1 serving per week
- Maize products, 14 servings per week (included in all models as part of the dietary pattern)
- Beans, 7 servings per week
- Green leafy vegetables, 7 servings per week
- Dairy foods, 7 servings per week
- Meat or eggs, 3 servings per week
- Meat or eggs, 5 servings per week
- Meat or eggs, 7 servings per week

It was not possible to meet the requirements for calcium without including an FBR for daily dairy consumption and increasing the upper constraint for Incaparina to allow for the twice-daily consumption of a fortified porridge or *atole* (to replace breast milk). The final set of FBRs presented was designed to be as consistent as possible with the recommendations developed for breastfed children. This set met at least 65 percent of RNI in a minimized diet for all modeled nutrients in the minimized diet, as shown in Tables A31–33.[46] While it was possible to meet all modeled nutrient requirements using lower frequencies of MPE consumption, the FBR for daily consumption of MPE was used for consistency with WHO recommendations, as with the other target groups. The final set of FBRs for non-breastfed children 12–23 months, based on the 2011 Guatemala HCES apparent consumption data, includes:

- Feed your child maize products twice per day.
- Feed your child green leafy vegetables, like amaranth leaves, every day.
- Feed beans to your child every day.
- Give your child Incaparina porridge twice per day.
- Give your child meat or eggs every day.
- Give your child dairy foods every day.

The estimated cost of putting this set of FBRs into practice as part of the lowest-cost diet is 5.3 GTQ per child per day.

Table A31. Summary of Results for FBRs Developed Using Optifood for Non-Breastfed Children 12–23 Months, Based on the 2011 Guatemala HCES and 2012 FANTA Optifood Study Data

	2012 FANTA Optifood Study	2011 Guatemala HCES

[46] For further details on minimized diets, please see glossary of terms and Appendix 1.

The maximum number of nutrients for which at least 65% of RNI was met in a minimized diet (from a possible maximum of 11 nutrients)	11	11
Number of FBRs (individual food or food subgroup level recommendations) included in final set	6	6
Nutrients for which >=65% of RNI in minimized diets could not be met using FBRs and highest percentage of RNI achievable in minimized diets	—	—

Table A32. Details of Best FBRs Developed for Non-Breastfed Children 12–23 Months, Based on the 2011 Guatemala HCES Apparent Consumption Data

FBR No.	Name/Code	Content (Food/Food Subgroup)	Frequency (Servings/Week)	Estimated Serving Size (g)	Cost (GTQ) of the Lowest-cost Diet That Includes FBR/FBRs[a]
1	—	Maize products	14	25	3.1
2	Incaparina14	Incaparina	14	20	3.4
3	Beans7	Cooked beans	4	49	3.2
4	GLV7	Green leafy vegetables (hierbas)	7	37	3.9
5	MPE3	Meat or eggs	7	30	3.4
6	Dairy7	Dairy foods	7	30	3.8
Cost of putting all FBRs into practice in addition to the lowest-cost diet[b]					5.3

[a] This diet is based on average dietary patterns to provide energy requirements at the lowest cost.

[b] This diet is based on average patterns modeled to meet energy requirements in combination with the complete set of FBRs.

Table A33. Select Results from the Systematic Evaluation of Alternative FBRs for Non-Breastfed Children 12–23 Months in the 2011 Guatemala HCES Dataset in the Module 3 Minimized Diet.[47] ***Table shows the % RNI covered by a minimized diet, expressing the level of acceptability achievable for a nutrient in the worst-case scenario where other foods included in addition to the FBR/FBRs had the lowest amount of that nutrient possible.***

No. FBRs	FBRs/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ)/ Day	No. > =65%
0	Optimized diets - with FG	86.7	470.6	307.9	163.9	150.2	132	249.8	100	120.6	100	267.1	6.3	11
0	Optimized diets - without FG	99	281.8	285.3	168.3	171.1	99.1	199.4	103.8	224.1	99	330.1	4.3	11
0	No FBRs	11.1	33	81.5	43.1	28	36.2	20.1	15.8	15	23.2	43.1	3.1	1
1	Inc14	34	33	189.6	137.1	129.5	36.2	68.7	60	194	77.5	166.2	3.4	7
1	Inc7	22.4	33	134.7	90	78	36.2	44	37.9	104.4	50.2	104.2	3.2	5
1	GLV7	27.5	251.2	98	66.8	32.7	42.5	45.1	16.1	19	56.1	50.6	3.9	3
1	Liver1	11.2	37.2	83.9	54.6	33.5	40.5	33.9	77.7	54	25.3	43.9	3.1	2
1	Beans7	17.3	36.3	107.3	46.7	33.4	63	106.8	15.9	15	34.5	52.5	3.2	2
1	MPE3	11.1	33	81.5	44.1	28	37.7	20.1	19.5	15	23.3	44.2	3.1	1
1	MPE5	11.1	33	81.8	46	30.1	41.7	20.6	31.1	17.2	23.6	46.6	3.2	1
1	Dairy7	26.5	33.2	81.6	48.6	28	37.3	20.4	48.7	24.6	23.2	47.3	3.8	1
2	Inc7 - GLV7	38.8	251.2	150.9	113.7	83.2	42.5	69.3	38.2	108.5	83.1	111.8	4.1	8
2	Inc14 - Liver1	34	37.2	192.1	148.5	135.3	40.5	82.6	121.9	233.1	79.5	166.8	3.4	8
2	Inc14 - Dairy7	49.8	33.2	190.1	143.8	129.6	37.3	69.5	92.9	203.7	77.5	171.7	4.2	8
2	Inc14 - GLV7	50.3	251.2	206.1	161	135.1	42.5	94.1	60.3	198	110.5	174.2	4.3	8
3	Inc14 - GLV7 - Dairy7	66.1	251.4	206.9	168.1	135.1	43.6	94.9	93.1	207.7	110.5	179.7	5	10
3	Inc7 - Liver1 - GLV7	38.8	255.5	153.3	125.1	88.9	46.8	83.2	100	147.5	85.2	112.4	4.1	9

[47] Each modeled diet is inclusive of 14 servings/week of maize; final set/s of FBRs selected are marked in **bold**.

No. FBRs	FBRs/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ)/ Day	No. > =65%
3	Inc7 - GLV7 - Dairy7	54.3	251.4	151	119.4	83.2	43.6	70.1	71	118.2	83.1	116.5	4.9	9
3	Inc7 - Beans7 - GLV7	45.3	254.5	179.6	118.1	90.9	69.4	157	38.3	108.5	95	123.1	4.2	9
3	Inc14 - Liver1 - GLV7	50.3	255.5	208.6	172.3	140.8	46.8	108	122.1	237.1	112.5	174.7	4.3	9
3	Inc14 - Liver1 - Beans7	40.9	40.5	223.1	154.9	143.9	67.1	170.3	122	233.1	91.9	179.5	3.6	9
3	Inc14 - Beans7 - Dairy7	56.9	36.5	223.1	152.5	138.5	66.3	157.2	93.1	203.7	90.1	185.3	4.3	9
3	Inc14 - Beans7 - GLV7	57.3	254.5	237.9	168.1	143.9	69.4	181.8	60.4	198.1	123	187.1	4.4	9
4	**Inc14 - Beans7 - GLV7 - Dairy7**	**73.2**	**254.7**	**240.2**	**176.9**	**144.2**	**72.8**	**182.6**	**93.4**	**207.8**	**123.2**	**193.5**	**5.2**	**11**
4	Inc7 - Liver1 - Beans7 - GLV7	45.4	258.8	182	129.4	96.7	73.5	170.9	100.1	147.6	96.9	123.6	4.3	10
4	Inc7 - Beans7 - GLV7 - Dairy7	61.1	254.7	180.9	125.9	91.1	72.7	157.8	71.1	118.2	95	128.9	5	10
4	Inc14 - Liver1 - GLV7 - Dairy7	66.1	255.7	209.2	179.3	140.9	47.9	108.8	154.9	246.8	112.5	180.2	5.1	10
4	Inc14 - GLV7 - Dairy7 - MPE3	66.1	251.4	207.2	169.5	135.2	45.2	94.9	96.8	207.7	110.8	181.3	5.1	10
4	Inc14 - Liver1 - Beans7 - GLV7	57.3	258.8	240.2	179.2	149.6	73.5	195.7	122.3	237.2	125	187.6	4.5	10
5	Inc14 - Liver1 - Beans7 - GLV7 - Dairy7	73.2	259	242.4	188	149.8	76.9	196.5	155.2	246.9	125.1	193.9	5.3	11
5	**Inc14 - Beans7 - GLV7 - Dairy7 - MPE3**	**73.3**	**254.7**	**240.7**	**178.4**	**144.2**	**74.7**	**182.6**	**97.1**	**207.8**	**123.6**	**195.2**	**5.3**	**11**
6	Inc14 - Liver1 - Beans7 - GLV7 - Dairy7 - MPE3	73.3	259	242.9	189.5	149.9	78.8	196.5	158.9	246.9	125.5	195.6	5.3	11

Appendix 16. FBRs Tested in Optifood for the Lactating Woman Target Group Using the 2011 Guatemala HCES Dataset

Process of selecting food-based recommendations for lactating women. The results of testing individual and combined FBRs for this target group are displayed in Table A36. The FBRs tested for this target group using some alteration to dietary constraints included:

- Incaparina, 7 servings per week
- Incaparina, 14 servings per week
- Liver, 1 serving per week
- Maize products, 21 servings per week (included in all models as part of the dietary pattern)
- Beans, 7 servings per week
- Green leafy vegetables, 7 servings per week
- Green leafy vegetables, 14 servings per week
- Dairy foods, 4 servings per week
- Meat or eggs, 3 servings per week
- Vitamin C-rich fruit, 4 servings per week

It was not possible to meet the requirements for calcium without increasing the upper constraint to allow for the consumption of Incaparina twice per day. Furthermore, it was not possible to meet the RNI for vitamin C without including both vitamin C-rich fruit and GLV. The final FBRs for lactating women presented were designed to be as consistent as possible with the recommendations for pregnant women. This final set met at least 65 percent of RNI in a minimized diet for all modeled nutrients in a minimized diet, as shown in Tables A34–36.[48] The final set of FBRs for this target group, based on the 2011 Guatemala HCES apparent consumption data, includes:

- Eat maize products three times per day.
- Drink a thick *atole* made from fortified flour such as Incaparina twice per day.
- Eat beans every day.
- Eat green leafy vegetables every day.
- Eat liver at least once per week.
- Eat dairy foods four times per week.
- Eat a piece of fruit like orange, mango, or pineapple every day.

The estimated cost of putting this set of FBRs into practice as part of the lowest-cost diet is 12.9 GTQ per person per day.

[48] For further details on minimized diets, please see glossary of terms and Appendix 1.

Table A34. Summary of Results for FBRs Developed Using Optifood for Lactating Women, Based on the 2011 Guatemala HCES and the 2012 FANTA Optifood Study Data

	2012 FANTA Optifood Study	2011 Guatemala HCES
The maximum number of nutrients for which at least 65% of RNI was met in a minimized diet (from a possible maximum of 11)	11	11
Number of FBRs (individual food or food subgroup level recommendations) included in final set	6	7
Nutrients for which >=65% of RNI in minimized diets could not be met using FBRs and highest percentage of RNI achievable in minimized diets	—	—

Table A35. Details of Best FBRs Developed for Lactating Women, Based on the 2011 Guatemala HCES Apparent Consumption Data

FBR No.	Name/Code	Content (Food/Food Subgroup)	Frequency (Servings/Week)	Estimated Serving Size (g)	Cost (GTQ) of the Lowest-cost Diet That Includes FBR/FBRs[a]
1	—	Maize products	21	87	9
2	Incaparina14	Incaparina	14	25	9.8
3	Beans4	Cooked beans	4	96	9
4	GLV7	Green leafy vegetables (hierbas)	7	79	10.8
5	Liver1	Liver	1	25	9.4
6	Dairy4	Powdered milk and other dairy	4	25	10
7	VitCFruit4	Oranges, mango, pineapple, lemon	4	75	9.1
Cost of putting all FBRs into practice in addition to the lowest-cost diet[b]					12.9

[a] This diet is based on average dietary patterns to provide energy requirements at the lowest cost.

[b] This diet is based on average patterns modeled to meet energy requirements in combination with the complete set of FBRs.

Table A36. Select Results from the Systematic Evaluation of Alternative FBRs for Lactating Woman in the 2011 Guatemala HCES Dataset in the Module 3 Minimized Diet.[49] ***Table shows the % RNI covered by a minimized diet, expressing the level of acceptability achievable for a nutrient in the worst-case scenario where other foods included in addition to the FBR/FBRs had the lowest amount of that nutrient possible.***

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ) /Day	No. >= 65%
0	Optimized diets - without FG	99	99	298.5	158.8	196.2	142.6	206.5	99	111.2	99	122.8	14.5	11
0	Optimized diets - with FG	100	145.3	347.8	159.7	217.1	147.5	279.4	100	100	115.3	105.5	18	11
0	No FBR	21	14.5	151.9	64.7	99	72.2	106.6	3.5	11.2	49.2	46.9	9	4
1	Incaparina14	32.9	14.5	191	104.7	138.7	72.2	106.6	21.1	77.6	77.4	77	9.8	8
1	GLV7	38.1	81.3	162.4	80.1	101.8	74.8	119.5	3.7	13.7	80.3	50.1	10.8	7
1	GLV14	55.2	153	173.2	96.4	104.9	78.6	132.6	3.9	16.2	111.5	53.3	12.7	7
1	Liver1	21	16.5	154.1	76.9	105	76.3	120.6	70.6	48.4	52.2	48	9.4	6
1	MPE3	21	14.5	151.9	65.6	99	72.2	106.6	14.8	11.2	49.2	47.1	9.3	5
1	Dairy4	30.7	14.5	151.9	67.8	99	72.2	106.6	17.1	14.6	49.2	47.6	10	5
1	Incaparina7	26.8	14.5	171.3	82.7	118.7	72.2	106.6	12.3	44.4	63.3	61.8	9.1	5
1	Bean7	25.7	15.4	166.3	64.7	99	77.7	141.6	3.5	11.2	59.3	50.7	9	4
1	VC Fruit4	21	18.8	151.9	64.7	99	72.4	106.6	3.5	11.2	49.2	46.9	9.1	4
2	Bean7 - VCfruit4	25.7	19.8	166.3	64.7	99	77.9	141.7	3.5	11.2	59.3	50.7	9.1	4
2	Incaparina14 - Liver1	32.9	16.5	193.2	116.8	144.7	76.3	120.6	88.2	114.9	80.3	78.1	10.1	9
2	Incaparina14 - GLV7	50	81.3	201.3	119.9	141.5	74.8	119.5	21.3	80	108.4	80.1	11.6	9
2	Incaparina7 - Incaparina14	32.9	14.5	191	104.7	138.7	72.2	106.6	21.1	77.6	77.4	77	9.8	8
2	Incaparina14 - MPE3	32.9	14.5	191	104.7	138.7	72.2	106.6	32.4	77.6	77.4	77.2	10.1	8

[49] Each modeled diet is inclusive of 21 servings/week of maize; final set/s of FBRs selected are marked in **bold**.

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ) /Day	No. >= 65%
2	Incaparina14 - Dairy4	42.9	14.5	191	106.1	138.7	72.2	106.6	34.7	81.2	77.4	77.8	10.8	8
2	Incaparina7 - Liver1	26.8	16.5	173.5	95	124.7	76.3	120.6	79.4	81.7	66.3	63	9.4	8
2	Incaparina7 - GLV7	43.9	81.3	181.8	98.2	121.5	74.8	119.5	12.5	46.8	94.3	65	10.9	8
2	Liver1 - GLV7	38.1	83.3	164.6	92.4	107.8	78.9	133.6	70.7	51	83.3	51.2	11.2	8
3	Incaparina7 - Liver1 - GLV7	43.9	83.3	184	110.5	127.5	78.9	133.6	79.5	84.1	97.3	66.1	11.2	10
3	Bean7 - VCfruit4 - Incaparina14	38.5	19.8	205.2	104.7	138.7	77.9	145.9	21.1	77.6	87.4	81.1	9.8	8
3	Incaparina14 - Liver1 - GLV7	50	83.3	203.6	131.9	147.4	78.9	133.6	88.3	117.3	111.4	81.3	11.9	10
3	Incaparina7 - Incaparina14 - Liver1	32.9	16.5	193.2	116.8	144.7	76.3	120.6	88.2	114.9	80.3	78.1	10.1	9
3	Incaparina14 - Liver1 - MPE3	32.9	16.5	193.2	116.8	144.7	76.3	120.6	95.7	114.9	80.3	78.1	10.3	9
3	Incaparina14 - Liver1 - Dairy4	42.9	16.5	193.2	118.3	144.7	76.3	120.6	101.8	118.5	80.3	78.9	11.1	9
3	Incaparina7 - Incaparina14 - GLV7	50	81.3	201.3	119.9	141.5	74.8	119.5	21.3	80	108.4	80.1	11.6	9
3	Incaparina14 - GLV7 - MPE3	50	81.3	201.3	119.9	141.5	74.8	119.5	32.6	80	108.4	80.3	11.8	9
3	Incaparina14 - GLV7 - Dairy4	60	81.3	201.3	121.6	141.5	74.8	119.5	34.9	83.5	108.4	80.9	12.6	9
4	Bean7 VCfruit4 - Incaparina7 - Liver1	32	21.8	188	95	124.7	82.2	155.9	79.4	81.7	76.3	67	9.4	9
4	Bean7 VCfruit4 - Incaparina14 - Liver1	38.5	21.8	207.4	116.8	144.7	82.2	159.3	88.2	114.9	90.5	82.2	10.1	9

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ) /Day	No. >= 65%
4	Bean7 VCfruit4 - Incaparina14 - GLV7	55.9	86.6	215.7	119.9	141.5	80.4	160.7	21.3	80	118.5	84.3	11.6	9
4	Incaparina7 - Liver1 - GLV7 - MPE3	43.9	83.3	184	110.7	127.5	78.9	133.6	87	84.1	97.3	66.1	11.4	10
4	Incaparina7 - Liver1 - GLV7 - Dairy4	53.8	83.3	184	113.6	127.5	78.9	133.6	93.1	87.6	97.3	66.9	12.2	10
4	Incaparina7 - Incaparina14 - Liver1 - GLV7	50	83.3	203.6	131.9	147.4	78.9	133.6	88.3	117.3	111.4	81.3	11.9	10
4	Incaparina14 - Liver1 - GLV7 - MPE3	50	83.3	203.6	131.9	147.4	78.9	133.6	95.9	117.3	111.4	81.3	12.1	10
4	Incaparina14 - Liver1 - GLV7 - Dairy4	60	83.3	203.6	133.8	147.4	78.9	133.6	101.9	120.8	111.4	82.1	12.9	10
4	Incaparina7 - Incaparina14 - Liver1 - MPE3	32.9	16.5	193.2	116.8	144.7	76.3	120.6	95.7	114.9	80.3	78.1	10.3	9
4	Incaparina7 - Incaparina14 - Liver1 - Dairy4	42.9	16.5	193.2	118.3	144.7	76.3	120.6	101.8	118.5	80.3	78.9	11.1	9
4	Incaparina14 - Liver1 - Dairy4 - MPE3	42.9	16.5	193.2	118.5	144.7	76.3	120.6	109.3	118.5	80.3	78.9	11.3	9
4	Incaparina7 - Incaparina14 - GLV7 - MPE3	50	81.3	201.3	119.9	141.5	74.8	119.5	32.6	80	108.4	80.3	11.8	9
4	Incaparina7 - Incaparina14 - GLV7 - Dairy4	60	81.3	201.3	121.6	141.5	74.8	119.5	34.9	83.5	108.4	80.9	12.6	9

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ) /Day	No. >= 65%
4	Incaparina14 - GLV7 - Dairy4 - MPE3	60	81.3	201.3	122.5	141.5	74.8	119.5	46.2	83.5	108.4	81.2	12.8	9
5	Bean7 VCfruit4 - Incaparina14 - GLV7 - Dairy4	66.5	86.6	215.7	121.6	141.5	80.4	160.7	34.9	83.5	118.5	85.3	12.6	10
5	Bean7 VCfruit4 - Incaparina7 - Liver1 - GLV7	49.3	88.7	198.5	110.5	127.5	84.6	169.8	79.6	84.1	107.4	70.2	11.2	10
5	Bean7 VCfruit4 - Incaparina14 - Liver1 - GLV7	55.9	88.7	217.9	131.9	147.4	84.6	173.8	88.4	117.3	121.5	85.5	11.9	10
5	Bean7 VCfruit4 - Incaparina7 - Liver1 - MPE3	32	21.8	188	95.2	124.7	82.2	155.9	86.9	81.7	76.3	67	9.6	9
5	Bean7 VCfruit4 - Incaparina7 - Liver1 - Dairy4	42.3	21.8	188	98.3	124.7	82.2	155.9	93	85.1	76.3	67.9	10.5	9
5	Bean7 VCfruit4 - Incaparina7 - Incaparina14 - Liver1	38.5	21.8	207.4	116.8	144.7	82.2	159.3	88.2	114.9	90.5	82.2	10.1	9
5	Bean7 VCfruit4 - Incaparina14 - Liver1 - MPE3	38.5	21.8	207.4	116.8	144.7	82.2	159.3	95.7	114.9	90.5	82.3	10.3	9
5	Bean7 VCfruit4 - Incaparina14 - Liver1 - Dairy4	49.1	21.8	207.4	118.4	144.7	82.2	159.3	101.8	118.5	90.5	83.2	11.1	9
5	Bean7 - VCfruit4 - Incaparina7 - Incaparina14 - GLV7	55.9	86.6	215.7	119.9	141.5	80.4	160.7	21.3	80	118.5	84.3	11.6	9

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ) /Day	No. >= 65%
5	Bean7 - VCfruit4 - Incaparina14 - GLV7 - MPE3	55.9	86.6	215.7	119.9	141.5	80.4	160.7	32.6	80	118.5	84.7	11.9	9
5	Incaparina7 - Liver1 - GLV7 - Dairy4 - MPE3	53.8	83.3	184	113.8	127.5	78.9	133.6	100.6	87.6	97.3	66.9	12.5	10
5	Incaparina7 - Incaparina14 - Liver1 - GLV7 - MPE3	50	83.3	203.6	131.9	147.4	78.9	133.6	95.9	117.3	111.4	81.3	12.1	10
5	Incaparina7 - Incaparina14 - Liver1 - GLV7 - Dairy4	60	83.3	203.6	133.8	147.4	78.9	133.6	101.9	120.8	111.4	82.1	12.9	10
5	Incaparina14 - Liver1 - GLV7 - Dairy4 - MPE3	60	83.3	203.6	134	147.4	78.9	133.6	109.5	120.8	111.4	82.1	13.1	10
6	**Bean7 VCfruit4 - Incaparina14 - Liver1 - GLV7 - Dairy4**	**66.5**	**88.7**	**217.9**	**133.8**	**147.4**	**84.6**	**173.8**	**102**	**120.8**	**121.5**	**86.5**	**12.9**	**11**
6	Bean7 VCfruit4 - Incaparina14 - GLV7 - Dairy4 - MPE3	66.5	86.6	215.7	122.5	141.5	80.4	160.7	46.2	83.5	118.5	85.7	12.9	10
6	Bean7 VCfruit4 - Incaparina7 - Liver1 - GLV7 - MPE3	49.3	88.7	198.5	110.7	127.5	84.6	169.8	87.1	84.1	107.4	70.2	11.4	10

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ) /Day	No. >= 65%
6	Bean7 VCfruit4 - Incaparina7 - Liver1 - GLV7 - Dairy4	59.6	88.7	198.5	114	127.5	84.6	169.8	93.1	87.6	107.4	71	12.2	10
6	Bean7 VCfruit4 - Incaparina7 - Incaparina14 - Liver1 - GLV7	55.9	88.7	217.9	131.9	147.4	84.6	173.8	88.4	117.3	121.5	85.5	11.9	10
6	Bean7 VCfruit4 - Incaparina14 - Liver1 - GLV7 - MPE3	55.9	88.7	217.9	131.9	147.4	84.6	173.8	95.9	117.3	121.5	85.6	12.1	10
6	Incaparina7 - Incaparina14 - Liver1 - GLV7 - Dairy4 - MPE3	60	83.3	203.6	134	147.4	78.9	133.6	109.5	120.8	111.4	82.1	13.1	10
7	Bean7 VCfruit4 - Incaparina7 - Liver1 - GLV7 - Dairy4 - MPE3	59.6	88.7	198.5	114.4	127.5	84.6	169.8	100.6	87.6	107.4	71.1	12.5	10
7	Bean7 VCfruit4 - Incaparina14 - Liver1 - GLV7 - Dairy4 - MPE3	66.5	88.7	217.9	134	147.4	84.6	173.8	109.5	120.8	121.5	86.6	13.1	11
7	Bean7 VCfruit4 - Incaparina7 - Incaparina14 - Liver1 - GLV7 - MPE3	55.9	88.7	217.9	131.9	147.4	84.6	173.8	95.9	117.3	121.5	85.6	12.1	10

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ) /Day	No. >= 65%
7	Bean7 VCfruit4 - Incaparina7 - Incaparina14 - Liver1 - Dairy4 - MPE3	49.1	21.8	207.4	118.6	144.7	82.2	159.3	109.3	118.5	90.5	83.3	11.3	9

Appendix 17. FBRs Tested in Optifood for the Pregnant Woman Target Group Using the 2011 Guatemala HCES Dataset

Process of selecting food-based recommendations for pregnant women. The results of testing individual and combined FBRs for this target group are in Table A39. The FBRs tested for this target group included:

- Incaparina, 7 servings per week
- Incaparina, 14 servings per week
- Liver, 1 serving per week
- Maize products, 21 servings per week (included in all models as part of the dietary pattern)
- Beans, 7 servings per week
- Green leafy vegetables, 7 servings per week
- Green leafy vegetables, 14 servings per week
- Dairy foods, 4 servings per week
- Meat or eggs, 3 servings per week
- Vitamin C-rich fruit, 4 servings per week

It was not possible to meet the requirements for calcium and riboflavin without increasing the upper constraint on the enriched grain products subgroup (Incaparina) to allow for greater (12 servings per week) consumption of a fortified thick *atole*. The final set of FBRs presented was designed to be as consistent as possible with the recommendations for lactating women. This final set met at least 65 percent of RNI in a minimized diet for all modeled nutrients, as shown in Tables A37–39.[50] The final set of FBRs for this target group, based on the 2011 Guatemala HCES apparent consumption data, include:

- Drink a thick *atole* made from fortified flour such as Incaparina twice per day.
- Eat beans every day.
- Eat liver at least once per week.
- Eat dairy foods four times per week.
- Eat green leafy vegetables every day.
- Eat maize products three times per day,
- Eat vitamin C-rich fruit, like oranges, four times per week.

The estimated cost of putting this set of FBRs into practice as part of the lowest-cost diet is 11.6 GTQ.

[50] For further details on minimized diets, please see glossary of terms and Appendix 1.

Table A37. Summary of Results for FBRs Developed Using Optifood for Pregnant Women, Based on the 2011 Guatemala HCES and the 2012 FANTA Optifood Study Data

	2012 FANTA Optifood Study	2011 Guatemala HCES
The maximum number of nutrients for which at least 65% of RNI was met in a minimized diet (from a possible maximum of 11)	10	11
Number of FBRs (individual food or food subgroup level recommendations) included in final set	5	7
Nutrients for which >=65% of RNI in minimized diets could not be met using FBRs and highest percentage of RNI achievable in minimized diets	Iron (62%)	—

Table A38. Details of Best FBRs Developed for Pregnant Women, Based on the 2011 Guatemaal HCES Apparent Consumption Data

FBR No.	Name/Code	Content (Food/Food Subgroup)	Frequency (Servings/Week)	Estimated Serving Size (g)	Cost (GTQ) of the Lowest-cost Diet That Includes FBR/FBRs[a]
1	—	Maize products	21	87	7.3
2	Incaparina14	Incaparina	14	25	8.5
3	Beans7	Cooked beans	7	98	7.3
4	GLV7	Green leafy veg	7	77	9.1
5	Liver1	Liver	1	78	7.6
6	Dairy4	Powdered milk and other dairy	4	25	8.4
7	VitCFruit4	Oranges, mango, pineapple, lemon	4	75	7.3
Cost of putting all FBRs into practice in addition to the lowest-cost diet[b]					11.6

[a] This diet is based on average dietary patterns to provide energy requirements not met by the individual FBR at the lowest cost possible.

[b] This diet is based on average patterns modeled to meet energy requirements in combination with the complete set of FBRs.

Table A39. Select Results from the Systematic Evaluation of Alternative FBRs for Pregnant Woman in 2011 Guatemala HCES Dataset in the Module 3 Minimized Diet.[51] ***Table shows the % RNI covered by a minimized diet, expressing the level of acceptability achievable for a nutrient in the worst-case scenario where other foods included in addition to the FBR/FBRs had the lowest amount of that nutrient possible.***

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ)/ Day	No. > =65%
0	Optimized Diets - with FG	85.8	167.1	288.6	159.6	172.3	123.8	230.8	168.8	100	107.5	103.9	16.2	11
0	Optimized Diets - without FG	99	136.1	223.7	139.9	152.5	139.7	143.5	168.1	122.6	99	125.5	13.3	11
0	No FBRs	13.2	14.6	122.9	58.1	75.8	56.2	50.5	3	14.7	40.2	44.3	7.3	2
1	Incaparina12	25.3	14.6	154	99.4	108.2	56.2	61.1	19.4	97	65.2	74.2	8.5	6
1	Liver1	13.2	17.3	124.9	71.9	81.3	60.9	61.2	74.5	67.5	43.2	45.6	7.6	5
1	GLV7	30.2	104.3	132.5	75.7	78.6	59.6	63	3.2	18.3	70.4	47.9	9.1	5
1	Bean7	20.9	15.9	137.2	59.2	75.8	69.8	98.6	3	14.7	52.1	50.1	7.3	4
1	Incaparina7	20.2	14.6	141	81.2	94.5	56.2	56.4	12.5	62.7	54.6	61.6	8	3
1	VCfruit4	13.3	20.5	122.9	58.1	75.8	56.5	50.9	3	14.7	40.2	44.3	7.3	2
1	MPE3	13.2	14.6	122.9	59.3	75.8	57	50.5	15.1	14.7	40.2	44.7	7.7	2
1	Dairy4	23.9	14.6	122.9	62.4	75.8	56.2	50.5	17.6	21.8	40.2	45.4	8.4	2
2	Bean7 - VCfruit4	21	21.8	137.3	59.2	75.8	70.1	99.1	3	14.7	52.1	50.1	7.3	4
2	Liver1 - GLV7	30.2	107	134.5	89.6	84.1	64.2	73.7	74.7	71.1	73.4	49.2	9.4	8
2	Incaparina7 - GLV7	37.2	104.3	150.6	98.8	97.2	59.6	69	12.7	66.3	84.9	65.3	9.8	8
2	Incaparina12 - Liver1	25.3	17.3	156.1	113.1	113.9	60.9	71.9	90.9	149.8	68.2	75.5	8.8	8
2	Incaparina12 - GLV7	42.2	104.3	163.7	116.6	111.1	59.6	73.8	19.6	100.6	95.5	77.9	10.3	8
3	Bean7- VCfruit4 - Incaparina12	33.4	21.8	170.1	99.4	108.2	70.1	111.5	19.4	97	77.8	80.5	8.5	8
3	Incaparina7 - Liver1 - GLV7	37.2	107	152.6	112.6	102.8	64.2	79.8	84.2	119.1	87.9	66.6	10.1	9

[51] Each modeled diet is inclusive of 21 servings/week of maize; final set/s of FBRs selected are marked in **bold**.

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ)/ Day	No. > =65%
3	Incaparina12 - Liver1 - GLV7	42.2	107	165.8	130.2	116.8	64.2	84.6	91.1	153.4	98.5	79.2	10.6	9
4	Bean7- VCfruit4 - Liver1 - GLV7	37.9	114.1	149	91	84.1	78.4	123	74.7	71.1	85.5	55.2	9.4	9
4	Bean7 - VCfruit4 - Incaparina7 - Liver1	28.2	24.4	158.3	95	100	75	117.1	84.1	115.5	70.2	69.1	8.3	9
4	Bean7 - VCfruit4 - Incaparina7 - GLV7	45	111.5	165.9	98.8	97.2	73.6	119.2	12.8	66.3	97.3	71.5	9.8	9
4	Bean7 - VCfruit4 - Incaparina12 - Liver1	33.5	24.4	172.3	113.1	113.9	75	122.4	90.9	149.9	81	81.9	8.8	9
4	Bean7 - VCfruit4 - Incaparina12 - GLV7	50.3	111.5	179.9	116.6	111.3	73.6	124.5	19.6	100.6	108.1	84.3	10.3	9
4	Incaparina7 - Liver1 - GLV7 - MPE3	37.2	107	152.6	112.9	102.8	64.7	79.8	92.3	119.1	87.9	66.8	10.2	9
4	Incaparina7 - Liver1 - GLV7 - Dairy4	47.9	107	152.6	116.3	102.8	64.2	79.8	98.9	126.2	87.9	67.8	11.1	9
4	Incaparina7 - Incaparina12 - Liver1 - GLV7	42.2	107	165.8	130.2	116.8	64.2	84.6	91.1	153.4	98.5	79.2	10.6	9
4	Incaparina12 - Liver1 - GLV7 - MPE3	42.2	107	165.8	130.2	116.8	64.7	84.6	99.2	153.4	98.5	79.3	10.8	9
4	Incaparina12 - Liver1 - GLV7 - Dairy4	52.9	107	165.8	132.8	116.8	64.2	84.6	105.8	160.5	98.5	80.4	11.6	9
5	Bean7 - VCfruit4 - Incaparina7 - Liver1 - GLV7	45.1	114.1	168.1	112.7	102.8	78.4	130.1	84.3	119.1	100.4	72.9	10.1	10
5	Bean7 - VCfruit4 - Incaparina12 - Liver1 - GLV7	50.4	114.1	182.1	130.2	117.3	78.4	135.5	91.1	153.4	111.2	85.7	10.6	10
5	Bean7 - VCfruit4 - Liver1 - GLV7 - MPE3	37.9	114.1	149	91.4	84.1	79.2	123	82.8	71.1	85.5	55.4	9.8	9
5	Bean7 - VCfruit4 - Liver1 - GLV7 - Dairy4	48.7	114.1	149	96	84.1	78.9	123	89.4	78.2	85.5	56.5	10.6	9
5	Bean7 - VCfruit4 - Incaparina7 - Liver1 - MPE3	28.2	24.4	158.3	95.3	100	75.8	117.1	92.2	115.5	70.4	69.4	8.5	9

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ)/ Day	No. > =65%
5	Bean7 - VCfruit4 - Incaparina7 - Liver1 - Dairy4	39.3	24.5	158.3	99.3	100	75.4	117.1	98.8	122.6	70.2	70.6	9.3	9
5	Bean7 - VCfruit4 - Incaparina7 - GLV7 - MPE3	45	111.5	165.9	100	97.2	74.9	119.2	24.9	66.3	97.6	72.2	10	9
5	Bean7 - VCfruit4 - Incaparina7 - GLV7 - Dairy4	56.1	111.5	165.9	103.2	97.2	74	119.2	27.5	73.4	97.3	73	10.8	9
5	Bean7 - VCfruit4 - Incaparina7 - Incaparina12 - Liver1	33.5	24.4	172.3	113.1	113.9	75	122.4	90.9	149.9	81	81.9	8.8	9
5	Bean7 - VCfruit4 - Incaparina12 - Liver1 - MPE3	33.5	24.4	172.3	113.1	113.9	75.8	122.4	99	149.9	81.2	82.2	9	9
5	Bean7 - VCfruit4 - Incaparina12 - Liver1 - Dairy4	44.6	24.5	172.3	115.2	113.9	75.4	122.4	105.6	156.9	81	83.5	9.8	9
5	Bean7 - VCfruit4 - Incaparina7 - Incaparina12 - GLV7	50.3	111.5	179.9	116.6	111.3	73.6	124.5	19.6	100.6	108.1	84.3	10.3	9
5	Bean7 - VCfruit4 - Incaparina12 - GLV7 - MPE3	50.4	111.5	180	116.7	111.3	74.9	124.5	31.8	100.6	108.5	85.1	10.5	9
5	Bean7 - VCfruit4 - Incaparina12 - GLV7 - Dairy4	61.4	111.5	179.9	119	111.3	74	124.5	34.3	107.7	108.1	86	11.3	9
6	**Bean7 - VCfruit4 - Incaparina14 - Liver1 - GLV7 - Dairy4**	**65**	**114.2**	**182.1**	**132.9**	**117.3**	**78.9**	**135.5**	**105.8**	**160.5**	**111.2**	**87.5**	**11.6**	**11**
6	Bean7 - VCfruit4 - Incaparina7 - Liver1 - GLV7 - MPE3	45.1	114.1	168.1	112.9	102.8	79.2	130.1	92.4	119.1	100.6	73.2	10.3	10
6	Bean7 - VCfruit4 - Incaparina7 - Liver1 - GLV7 - Dairy4	56.2	114.1	168.1	117.2	102.8	78.9	130.1	99	126.2	100.4	74.5	11.1	10

No. FBRs	FBR/Set of FBRs Tested	Calcium %	Vitamin C %	Thiamin %	Riboflavin %	Niacin %	Vitamin B6 %	Folate %	Vitamin B12 %	Vitamin A RAE %	Iron %	Zinc %	Cost (GTQ)/ Day	No. > =65%
6	Bean7 - VCfruit4 - Incaparina12 - Liver1 - GLV7 - MPE3	50.4	114.1	182.2	130.2	117.3	79.2	135.5	99.2	153.4	111.4	86.1	10.8	10
6	Incaparina7 - Incaparina12 - Liver1 - GLV7 - Dairy4 - MPE3	52.9	107	165.8	133.1	116.8	64.7	84.6	113.8	160.5	98.5	80.5	11.8	9
7	Bean7 - VCfruit4 - Incaparina14 - Liver1 - GLV7 - Dairy4 - MPE3	65	114.2	182.2	133.1	117.3	79.9	135.5	114	160.5	111.4	87.9	11.8	11
7	Bean7 - VCfruit4 - Incaparina7 - Liver1 - GLV7 - Dairy4 - MPE3	56.2	114.1	168.1	117.6	102.8	79.9	130.1	107.1	126.2	100.6	74.8	11.3	10
7	Bean7 - VCfruit4 - Incaparina7 - Incaparina12 - Liver1 - Dairy4 - MPE3	44.7	24.5	172.3	115.5	113.9	76.4	122.4	113.7	156.9	81.2	83.9	10	9
7	Bean7- VCfruit4 - Incaparina7 - Incaparina12 - GLV7 - Dairy4 - MPE3	61.6	111.5	180	120.1	111.3	75.5	124.5	46.5	107.7	108.5	86.9	11.5	9

Appendix 18. Results from Testing Different FBFs in Complementary Feeding Diets for Children 6–11 Months Using the 2011 Guatemala HCES Dataset, as Individual FBRs and in Combination with Best Set of FBRs

Analysis of Alternative Fortified Blended Flours (FBF)

The best FBRs presented in this report all include a recommendation to consume Incaparina, a popular FBF that is commercially produced and sold in Guatemala. Incaparina was the only FBF modeled in the 2011 Guatemala HCES analysis, as it was the only product of this type that appeared in the food list.

Given that many programs aimed at reducing stunting in Guatemala include the distribution of an FBF, the 2014 FANTA Optifood report based on the 2012 FANTA Optifood study included an analysis to compare the nutrition potential of four different FBFs. This analysis was conducted for target groups with the highest nutrient requirements and the most limited gastric capacity—namely, breastfed children 6–8 months and breastfed children 9–11 months (FANTA 2014). Tables A40–A41 show the results of a similar analysis comparing diets for breastfed children 6–11 months using the 2011 Guatemala HCES data that included six FBFs used or under development in Guatemala: Bienestarina, corn-soy blend (CSB), corn-soy milk (CSM), fortified oats, Incaparina, fortified maize flour, and Vitacereal. Each FBF was tested as an FBR alone and in combination with the other FBRs developed for the two target groups,[52] without micronutrient supplementation. The Incaparina serving sizes[53] developed from the 2011 Guatemala HCES data for each target group were used for modeling each FBR. The results show the nutrients for which acceptability could be met (at least 65 percent of RNI in the minimized diet) using FBF alone, those met using FBF in combination with other FBRs, and those that could not be met using FBF in combination with other FBRs. The results demonstrate the potential of maximizing nutrient acceptability using an FBF alone and in conjunction with complementary FBRs.

KEY	
■	Possible to meet using FBF FBR alone
►	Possible to meet using FBF in combination with other FBRs
×	Not possible to meet requirement

[52] The best set of FBRs developed for these target groups included seven servings of FBF per week, seven servings of GLV, seven servings of beans, and three servings of meat or eggs.
[53] The FBF serving sizes used were 9.9 g for children 6–8 months, 14.6 g for children 9–11 months, and 19.6 g for breastfed children 12–23 months.

Table A40. Potential of Meeting Nutrient Acceptability Using Six Different Fortified Blended Flours Alone and within a Set of FBRs for Children 6–8 Months Using the 2011 Guatemala HCES Dataset

	Bienestarina	CSB	CSM	Fortified Oats	Incaparina	Fortified Maize Flour	Vitacereal
Calcium	▶	▶	■	▶	▶	▶	▶
Vitamin C	▶	▶	▶	▶	▶	▶	■
Thiamin	■	■	■	■	■	■	■
Riboflavin	■	■	■	■	■	▶	▶
Niacin	■	×	×	×	■	×	×
Vitamin B6	▶	▶	■	■	▶	▶	■
Folate	▶	▶	▶	■	■	▶	▶
Vitamin B12	▶	■	■	▶	■	▶	▶
Vitamin A (retinol equivalent [RE])	■	■	■	■	■	■	■
Iron	×	×	×	×	×	×	×
Zinc	×	×	×	×	×	×	×

Table A41. Potential of Meeting Nutrient Acceptability Using Six Different Fortified Blended Flours Alone and within a Set of FBRs for Children 9–11 Months Using the 2012 FANTA Optifood Study Dataset

	Bienestarina	CSB	CSM	Fortified Oats	Incaparina	Fortified Maize Flour	Vitacereal
Calcium	▶	■	■	▶	▶	▶	▶
Vitamin C	▶	■	■	▶	▶	▶	■
Thiamin	■	■	■	■	■	■	■
Riboflavin	■	■	■	■	■	▶	■
Niacin	■	▶	▶	■	■	×	▶
Vitamin B6	▶	▶	▶	■	▶	▶	▶
Folate	▶	▶	▶	■	■	▶	▶
Vitamin B12	▶	■	■	▶	■	▶	■
Vitamin A RE	■	■	■	■	■	■	■
Iron	▶	▶	▶	▶	▶	×	▶
Zinc	×	×	×	×	▶	×	▶

Incaparina is used to make *atole* as both a complementary and family food. Adopting an FBR of consuming one serving of Incaparina daily as thick *atole* for women or as porridge for children,[54] without other FBRs, would provide an acceptable quantity of six of the modeled nutrients for breastfed children 6–11 months. However, other foods would be needed to meet requirements for three nutrients (calcium, vitamin B6, and vitamin C), and iron and zinc requirements could not be met for children 6–8 months.

Vitacereal is a maize-soy meal fortified with iron, zinc, thiamin, riboflavin, vitamin B6, vitamin A, vitamin D, vitamin E, vitamin C, niacin, folic acid, vitamin B12, and iodine. The Government of Guatemala distributes Vitacereal to children 6–23 months and PLW. Without other FBRs, daily consumption of Vitacereal could meet the requirements of four to five nutrients for children 6–11 months. Complete acceptability was achievable for children 9–11 months if combined with other FBRs. However, for children 6–8 months, further supplementation would be necessary to meet niacin, iron, and zinc requirements.

It was not possible to achieve acceptability for all nutrients using an FBR of FBF as porridge alone for any of the seven tested FBFs. FBRs for Incaparina or Vitacereal, combined with other FBRs (daily consumption of beans and GLV and three servings per week of meat or eggs) met the requirements of all modeled nutrients for breastfed children 9–11 months using the 2011 Guatemala HCES data. A recommendation for Incaparina or Bienestarina consumption as a thick porridge, coupled with complementary FBRs, met all nutrients except zinc and iron for children 6–8 months using the 2011 Guatemala HCES data.

The results of this analysis show that iron and zinc requirements cannot be met using FBFs and that complementary FBRs and, in some cases, micronutrient supplementation are required to ensure acceptability. Tables A40–A41 also suggest that the amount of vitamin A provided in FBFs commonly used in Guatemala is sufficient and that further supplementation may not be necessary.

The nutrient composition of each FBF tested is presented in Table A42.

Table A42. Food Composition Values for Alternative FBFs Tested in Module 3: Bienestarina, CSB, CSM, Fortified Oats, Incaparina, Fortified Maize, and Vitacereal

Nutrient	Measurement	Bienestarina	CSB	CSM	Fortified Oats	Incaparina	Soy-Fortified Maize	Vitacereal
Food energy	kcal/100 g	384	376	375	369	368	360	380
Protein	g/100 g	21.3	17.2	21.35	15.5	20.7	14.9	9.5
Fat	g/100 g	5.6	9.7	6.76	6.1	5.3	1.6	4.3
Carbohydrate	g/100 g	63.2	61.7	57.84	64	64	71.1	71
Calcium	mg/100 g	310	831	1020	357	299	110	200
Iron	mg/100 g	20	17.49	17.54	28.93	14.9	2.9	14
Zinc	mg/100 g	0	5	5.51	3.07	16	1	8.3

[54] Preparing FBF as an individual thick, complementary feeding porridge, instead of a heavily diluted *atole* preparation for a whole family would mean that a child would ultimately consume a larger amount of FBF. As explained previously, the serving sizes modeled in this analysis reflected consumption of FBF as a thick porridge (9.9 g for children 6–8 months, 14.6 g for children 9–11 months, and 19.6 g for breastfed children 12–23 months).

Vitamin C	mg/100 g	0	40	41	0	0	0	140
Thiamin	mg/100 g	1.12	0.53	0.59	1.07	1.5	0.44	0.36
Riboflavin	mg/100 g	1.23	0.48	0.71	1.21	1.7	0.26	0.36
Niacin	mg/100 g	14.3	6.23	6.37	14.29	19.2	3.53	6.1
Vitamin B6	mg/100 g	0	0.5	0.51	1.43	0	0.3	0.44
Folate	µg dietary folate equivalents/ 100 g	0	300	0	254	213	0	83
Vitamin B12	µg/100 g	0	1	1.6	0	1.1	0	0.52
Vitamin A RE	µg retinol equivalents/ 100 g	1350	784	846	1072	213	662	249

Table A43 shows the nutrients for which acceptable adequacy (65 percent of RNI) were not achievable and the highest level of nutrient adequacy attainable as a percentage of RNI in a minimized diet, when testing the FBRs for each of the seven FBFs alone (without other FBRs) for children 6–8 and 9–11 months in the 2011 Guatemala HCES dataset. Table A44 compares the results of testing FBRs for the seven different FBFs in combination with the best set of FBRs for children 6–8 and 9–11 months in the 2011 Guatemala HCES dataset, including nutrients for which acceptability adequacy of at least 65 percent of RNI was not achieved and the highest level attainable as a percentage of RNI in a minimized diet.

Table A43. Comparison of the Results of Testing FBRs for Seven Different FBFs Alone (without Other FBRs) for Children 6–8 and 9–11 Months Using the 2011 Guatemala HCES Dataset: Nutrients for Which Acceptability (65% of RNI) Was Not Achieved and Highest Level Attainable as a Percentage of RNI in a Minimized Diet

Target Group	Bienestarina	CSB	CSM	Fortified Oats	Incaparina	Fortified Maize	Vitacereal
6–8 months	Calcium (48%) Vitamin C (45%) Vitamin B6 (47%) Folate (43%) Vitamin B12 (43%) Iron (35%) Zinc (22%)	Calcium (61%) Vitamin C (53%) Niacin (51%) Vitamin B6 (47%) Folate (43%) Iron (33%) Zinc (30%)	Vitamin C (53%) Niacin (52%) Folate (43%) Iron (32%) Zinc (31%)	Calcium (45%) Vitamin C (45.5%) Niacin (56%) Vitamin B12 (43%) Iron (31%) Zinc (25.5%)	Calcium (48.4%) Vitamin C (45.6%) Vitamin B6 (48%) Iron (35%) Zinc (46%)	Calcium (42%) Vitamin C (45%) Riboflavin (56%) Niacin (42%) Vitamin B6 (54%) Folate (44%) Vitamin B12 (43%) Iron (15.4%) Zinc (23%)	Calcium (45.7%) Riboflavin (60%) Niacin (51%) Vitamin B6 (62%) Folate (54%) Vitamin B12 (53%) Iron (28%) Zinc (35%)
9–11 months	Calcium (53.7%) Vitamin C (54.8%) Vitamin B6 (27.6%) Folate (34.8%) Vitamin B12 (53.4%) Iron (44.2%) Zinc (22.3%)	Niacin (49.1%) Vitamin B6 (27.6%) Folate (34.7%) Iron (40.1%) Zinc (33.8%)	Niacin (49.1%) Vitamin B6 (51.9%) Folate (34.7%) Iron (40.2%) Zinc (35%)	Calcium (55.4%) Vitamin C (54.8%) Vitamin B12 (53.3%) Iron (58.7%) Zinc (29.4%)	Calcium (54%) Vitamin C (54%) Vitamin B6 (27%) Iron (44%) Zinc (57%)	Calcium (46.4%) Vitamin C (54.8%) Riboflavin (60%) Niacin (39%) Vitamin B6 (41.7%) Folate (34.7%) Vitamin B12 (53.3%) Iron (16.5%) Zinc (24.6%)	Calcium (49%) Niacin (48%) Vitamin B6 (48%) Folate (50%) Iron (34%) Zinc (41%)

Table A44. Comparison of the Results of Testing FBRs for Seven Different FBFs in Combination with the Best Set of FBRs for Children 6–8 and 9–11 Months Using the 2011 Guatemala HCES Dataset: Nutrients for Which Acceptability (>=65% of RNI) Was Not Achieved and Highest Level Attainable as a Percentage of RNI in a Minimized Diet

Target Group	Bienestarina	CSB	CSM	Fortified Oats	Incaparina	Fortified Maize	Vitacereal
6–8 months	Iron (14.4%) Zinc (22.5%)	Niacin (58.5%) Iron (56.2%) Zinc (37.1%)	Niacin (58.8%) Iron (56.2%) Zinc (37.1%)	Niacin (44.8%) Iron (37.8%) Zinc (29.8%)	Iron (59%) Zinc (52.9%)	Niacin (44.8%) Iron (37.8%) Zinc (29.8%)	Niacin (58%) Iron (52.3%) Zinc (42.3%)
9–11 months	Zinc (36.4%)	Zinc (48%)	Zinc (49%)	Zinc (43.5%)		Niacin (56.7%) Iron (63%) Zinc (38.7%)	

Appendix 19. Nutrition Composition of Multiple Micronutrient Powder

Table A45. Nutrition Composition (per 1 g Sachet) of Multiple Micronutrient Powder Recommended for Distribution to Children 6–36 Months in Guatemala

Nutrient	Quantity
Vitamin A	400 µg retinol equivalents (RE)
Iron (encapsulated ferrous fumarate)	10 mg
Zinc gluconate	4.1 mg
Vitamin C (ascorbic acid)	30 mg
Folic acid	150 µg
Potassium iodate	90 µg
Thiamin	0.5 mg
Riboflavin	0.5 mg
Niacin	6 mg
Vitamin B6	0.5 mg
Vitamin B12	0.9 µg
Vitamin D	5 µg
Copper	0.56 mg
Selenium	17 µg
Vitamin E	5 mg