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

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Abbreviations and Acronyms

AME	adult male equivalent
APN	absolute problem nutrient
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
g	grams
GLV	green leafy vegetables
GTQ	Guatemalan quetzal
HCES	Household Consumption and Expenditure Survey
INCAP	Institute of Nutrition of Central America and Panama
INE	National Institute of Statistics (Instituto Nacional de Estadística)
LSHTM	London School of Hygiene and Tropical Medicine
MNP	multiple micronutrient powder
MPE	meat, poultry, eggs
PLW	pregnant and lactating women
PPN	partial problem nutrient
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

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).

What is Optifood

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 dietary 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.

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). *It is important to note that regardless of whether primary or secondary data are used, the FBRs developed using Optifood need to be tested at the household level—for example, using Trials of Improved Practices (TIPs)—to work directly with and within communities in the specific regions or agro-ecological zones to* *assess and validate their acceptability and feasibility, since the objective is a tailored set of FBRs that can be adopted by vulnerable families to improve their diets.*[1]

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 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. As such, in this report the comparative analysis between the Optifood inputs and results obtained using secondary HCES data and the primary 24-hour recall and food frequency data collected by FANTA with 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	**Step 2**	**Step 3**	**Step 4**	**Paso 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*

*SBCC = social and behavior change communication

This summary 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 (ENCOVI, 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). 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

[1] 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).

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.[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 2012). Food lists were derived from the closed questionnaire lists of foods reportedly purchased or produced by the 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.

[2] 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.

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 using secondary and primary data are compared below, followed by a comparison of Optifood outputs using the two datasets.

Optifood Inputs

Food lists. 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. This is 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 implication of this result is that with the use of the HCES 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 according to their needs and during all times of the year. If this assumption is not valid, the amount of each food available to each household member can be over or under-estimated.

Serving sizes. The results for portion sizes 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 (a fortified blended flour, FBF),[3] beans, eggs, and green leafy vegetables (GLV). The results also 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 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. 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 and verify preliminary portion sizes at the household level, which can be conducted as part of testing pilot FBRs by households.

Servings per week (model constraints).[4] The results show that 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 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 recommended dietary practices.

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

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, Optifood often optimized diets 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. 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-

[5] Problem nutrients, as defined in Optifood, are nutrients that are likely to remain low in diets due to the availability of and/or access to local food sources and existing dietary 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.

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 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 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 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. Differences between the FBRs are highlighted in bold and outlined in Table 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 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	10	**1. Eat Incaparina 2 times per day, serving size 25 g** 2. Eat maize products 3 times per day, serving size 87 g	11.6

	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		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	
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 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 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 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 directly with and within target communities 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 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: 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 sex, 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 (Menchú et al. 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 some food subgroups 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 (see "model contraints"). 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 represents the worst-case scenario for an individual nutrient 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 10th 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.