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USAID FROM THE AMERICAN PEOPLE

Household Food Insecurity and Nutritional Status of Women of Reproductive Age and Children under 5 Years of Age in Five Departments of the Western Highlands of Guatemala: An Analysis of Data from the National Maternal-Infant Health Survey 2008–09 of Guatemala

Camila Chaparro

March 2012

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FANTA-2 Bridge
FHI 360   1825 Connecticut Ave., NW   Washington, DC 20009-5721
Tel: 202-884-8000   Fax: 202-884-8432   Email: fantamail@fhi360.org   Website: www.fantaproject.org

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Contact information:

Food and Nutrition Technical Assistance II Project (FANTA-2) Bridge
FHI 360
1825 Connecticut Avenue, NW
Washington, DC 20009-5721
Tel: 202-884-8000
Fax: 202-884-8432
Email: fantamail@fhi360.org
Website: www.fantaproject.org

Contents

Abbreviations and Acronyms

BMI	body mass index
CDC	United States Centers for Disease Control and Prevention
cm	centimeter(s)
ELCSA	Escala Latinoamericana y Caribeña de Seguridad Alimentaria (Latin American and Caribbean Household Food Security Scale)
ENCOVI	Encuesta Nacional de Condiciones de Vida (National Living Conditions Survey)
ENSMI	Encuesta Nacional de Salud Materno Infantil (National Maternal-Infant Health Survey)
g	gram(s)
HAZ	height-for-age z-score
HFIAC	Household Food Insecurity Access Scale
HFSSM	Household Food Security Survey Module
INACG	International Nutritional Anemia Consultative Group
INE	Instituto Nacional de Estadística (National Institute of Statistics of Guatemala)
kg	kilogram(s)
L	liter(s)
m	meter(s)
U.S.	United States
USAID	United States Agency for International Development
WAZ	weight-for-age z-score
WHO	World Health Organization
WHZ	weight-for-height z-score

Background

The United States Agency for International Development (USAID) defines food security as occurring when "all people at all times have physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life"[1]. Achieving food security relies on fulfilling three elements:

- Adequate food availability
- Adequate access to food by all people
- Appropriate food utilization and consumption

Household food insecurity has been associated with several health and nutrition outcomes, in both developed and developing countries. By negatively affecting food consumption, either through reduced quality or quantity of food, household food insecurity can potentially worsen nutritional status. Food insecurity may also affect nutritional status through its effects on stress, depression, parenting, and infant feeding[2]. However, the relationship between household food insecurity and nutritional status of adults and children, particularly in developing countries, is not well established. In developed countries, household food insecurity has been associated with overweight and obesity among adults, particularly women, but not all studies have reported this relationship[3]. There are fewer studies from developing countries among adults and children, and the results have been mixed: In Malaysia, household food insecurity was associated with obesity among rural women[4], while in Trinidad and Tobago, household food insecurity was associated with underweight among adults[5]. Among children, in one study from Nepal, where 69% of households were considered food insecure, the household food insecurity level was not significantly associated with stunting, underweight, or anemia among children under 2 years of age when other factors (such as socioeconomic status, maternal height and education, and infant feeding practices) were controlled for[6]. The authors concluded that household food security was likely necessary, but not sufficient alone, to ensure good nutritional status of children in the Nepalese setting. In contrast, in rural Bangladesh, child growth (weight and length gain) and attained weight and length through 2 years of age were significantly positively associated with household food security status (i.e., higher food security was associated with better growth outcomes)[7]. A complementary study on the same population also found a positive relationship between household food security and child development, as measured through language expression and comprehension at 18 months of age[8]. Similarly in Colombia, stunting and underweight among preschool children were significantly inversely associated with household food security (i.e., greater food security was associated with lower levels of stunting and underweight)[9].

Tools commonly used to measure food security at the household level include the United States (U.S.) Household Food Security Survey Module (HFSSM)[1] and the Household Food Insecurity Access Scale (HFIAS)[10]. Both tools, as well as others developed for particular contexts, such as Latin America (described below), intend to capture the experience of food insecurity through administration of a set of questions about different "domains" of food insecurity. The HFSSM is an 18-item questionnaire that asks respondents about uncertainty or anxiety about food supplies, experiences running out of food, perceptions of insufficient quantity or quality of food, reported reductions or adjustments in normal food intake (including substituting fewer and cheaper foods), and associated consequences, such as physical feelings of hunger or weight loss[11]. Responses to the questions in the scale are used to create a continuous numeric food insecurity "score," which can then be compared to established cut-points to categorize the level of food insecurity experienced by the household. The HFIAS, a 9-item questionnaire, was developed for use in developing country settings based on this same approach, and queries respondents about three domains of food insecurity, including anxiety/uncertainty about the household food supply, insufficient quality of food (including variety and food preferences), and insufficient food intake and its physical consequences[10]. A third tool that has been developed for use in Latin America in particular is the Latin American and Caribbean Household Food Security Scale (ELCSA), which was recently harmonized for use across the entire region, including Guatemala[12]. The ELCSA has been incorporated into the most recent National Living Conditions Survey 2011 (ENCOVI) for Guatemala, and the results were recently published[13].

[1] The U.S. HFSSM is available at http://www.ers.usda.gov/briefing/foodsecurity/surveytools/hh2008.pdf.

In 2008–2009, a nationally representative reproductive health survey, the National Maternal-Infant Health Survey (ENSMI), was conducted in Guatemala, and, for the first time, a food-security module was included[14]. The validity of this set of questions to be interpreted as a food security scale was established using the Rasch measurement model (see report by Deitchler and Nord in Annex 1).[2] In addition, recommendations for tabulation of the household food insecurity score and cutoffs for levels of food security were proposed so that these data could be analyzed and interpreted. As the ENSMI survey also collected nutritional data on women of reproductive age and children under 5 years of age, including anthropometric measures (height and weight) and hemoglobin concentration, the household food security data could additionally be analyzed in relation to nutritional indicators among these groups.

[2] The food security module included in the ENSMI 2008–2009 did not reflect a standard set of questions from the HFSSM, HFIAS, or ELCSA. Annex 1 explains the process for analyzing and interpreting this set of questions as a food security scale.

Objectives

The primary objectives of this paper are to:

- Describe the levels of household food security in the Western Highlands of Guatemala (specifically, the departments of Quetzaltenango, San Marcos, Huehuetenango, Quiché, and Totonicapán [**Figure 1**]), which are the focus of the U.S. Government's activities in Guatemala, including USAID/Guatemala's current health and nutrition strategy
- Describe the household characteristics as well as the characteristics of female respondents and their children that are associated with household food security
- Explore the relationships between household food security and nutritional outcomes in women of reproductive age (15–49 years of age) and children under 5 years of age in this same region

Though the primary focus of these analyses is on the Western Highlands, for comparative purposes, national-level data (including all 22 departments) were also analyzed.

Figure 1: Map of Guatemala identifying the five departments comprising the Western Highlands

Methods

Data

Household- and individual-level data (females 15–49 years of age and children under 5 years of age) from the 2008–2009 ENSMI were provided by the U.S. Centers for Disease Control and Prevention (CDC)/Atlanta.[3] The ENSMI survey was carried out in Guatemala under the supervision and coordination of the National Institute of Statistics of Guatemala (INE), the Universidad del Valle, the Ministry of Health and Social Assistance of Guatemala, and the CDC. The survey design and sampling method for this nationally representative cross-sectional survey has been described elsewhere[14]. Briefly, data collection occurred between October 2008 and June 2009. The ENSMI sample was selected from 5,060 cartographic sectors established from the 2002 census by INE (and designated the "master sample"); a simple random sample of 733 sectors was selected from this master sample to comprise the ENSMI sub-sample and within each sector a predetermined number of households was selected (in the case of the female-respondent survey, the number of households selected was 30). In each selected household, a household survey was completed, and, if available, one woman of reproductive age (15–49 years) was randomly selected to be interviewed. For some indicators (such as anthropometry), data on all of the female respondent's children under 5 years of age in the household were collected; for others (e.g. data on prenatal care), only the youngest child under 5 years of age was included. A total of 20,768 households had complete interviews, corresponding to 16,819 completed interviews with women of reproductive age, between 10,065 and 10,100 children (0–59 months of age) with anthropometric measurements[4] and 8,820 children (6–59 months of age) with hemoglobin measurements. In the Western Highlands (i.e., the departments of Quetzaltenango, San Marcos, Huehuetenango, Quiché, and Totonicapán), 4,542 households had complete household interviews (2,366 households with children under 5), corresponding to 3,762 completed interviews with women of reproductive age, 2,477 to 2,490 children between 0 and 59 months of age with anthropometric measurements,[5] and 2,157 children between 6 and 59 months of age with completed hemoglobin measurements.

Household food insecurity classification

The calculation of the household food security score was based on responses to five questions in the ENSMI household questionnaire [with each response coded as yes (1) or no (0)]:

- In the past 6 months,[6] have you worried about a lack of food in the household?
- In the past 30 days, was there insufficient money in the household to buy food?
- In the past 30 days, did a member of your household eat less than they wanted to because of lack of money?
- In the last 30 days, did a member of your household skip breakfast, lunch, or dinner because of lack of money?
- In the last 30 days did a member of your household complain about hunger because of insufficient food in the household?

Based on the scoring and tabulation recommendations of Deitchler and Nord (Annex 1), the possible household food security score, calculated as the sum of the responses to these questions, could range from a low of 0 (all responses coded "no" or 0, representing the most food *secure* state) to 5 (all

[3] Full report and data are available at http://www.healthmetricsandevaluation.org/ghdx/record/guatemala-reproductive-health-survey-2008-2009.
[4] There were slightly more weight measurements (n = 10,065) than length/height measurements (n = 10,100).
[5] There were slightly more weight measurements (n = 2,490) than length/height measurements (n = 2,477).
[6] The remaining four questions used a recall period of 30 days, while the first question in the module referred to the 6 months prior to the survey. For the purposes of analyses and interpretation, we assumed that the reference period for the overall classification was the 30 days previous to the survey.

responses coded "yes" or 1, representing the most food *insecure* state). The categories of food security were then defined as follows:

- Score of 0 or 1 = food secure
- Score of 2 or 3 = moderately food insecure
- Score of 4 or 5 = severely food insecure

Apart from the above questions used to construct the household food security score, the module also asked whether households had to decrease or eliminate certain foods in the last 6 months due to lack of money. For households that decreased or eliminated foods in the past 6 months, data were collected on the foods decreased (up to 4), the foods eliminated (up to 5), and the foods that were substituted for the eliminated foods (up to 5).

Other relevant data

Relevant variables that were selected from the ENSMI survey for the present analysis, in addition to variables related to the household food insecurity module, included household- and individual-level (female and child) variables.

- **Socioeconomic/demographic and household variables:** Household location (urban/rural), access to electricity, access to a toilet (private or shared) connected to a sewage system, access to piped water (via the public water supply, a public tap, or other piped source of water) or bottled water, number of household members, number of children under 5 years of age in the household, sex of the household head, and socioeconomic status quintile[7]
- **Female/maternal variables:** Age, parity (number of live births), education level (also of her spouse, if available), current employment status (also of her spouse, if available), ethnicity (indigenous vs. "ladino"[8]), marital status, experienced intra-household violence in the last 12 months (physical, sexual, or emotional), height, weight, and hemoglobin concentration[9]
- **Child variables[10]:** Age, sex, birth order, height, weight, and hemoglobin concentration

In addition to the nutritional status variables for women and children available in the dataset (height, weight, and hemoglobin concentration), additional indices were used or calculated for the purposes of analysis. For women, height and weight were used to calculate body mass index (BMI, as kg/m^2) for the classification of underweight (BMI < 18.5 kg/m^2), overweight (BMI ≥ 25 and < 30 kg/m^2), and obesity (BMI ≥ 30 kg/m^2). Short stature among women was classified as height less than 145 cm. Women that were pregnant at the time of the survey were excluded from analyses of anthropometric data (weight, height, and BMI) due to the effects of pregnancy on weight gain.

For children, weight-for-age, weight-for-height, and height-for-age z-scores (WAZ, WHZ, and HAZ, respectively) using the World Health Organization (WHO) 2006 Growth Standards were available in the dataset. The prevalence of stunting (HAZ < −2), underweight (WAZ < −2), and wasting (WHZ < −2), as well as further classifications of each index in terms of severity (moderate or severe), were calculated using standard definitions (between −2 and −3 z-scores = moderate; less than −3 z-scores = severe). The

[7] Socioeconomic status quintile was available in the dataset and constructed for the entire sample using principal components analysis of the "goods and services index" created from variables related to household possessions (e.g., radio, television, mobile telephone), access to household services (e.g., tubed water, electricity), and other household characteristics (e.g., household size, type of floor).
[8] "Ladino" is the term used to refer to the "non-indigenous" or mestizo population in Guatemala, utilizing Spanish as its native language.
[9] Hemoglobin measurements were attempted for all women selected for the survey: Of the 16,819 completed interviews with eligible females at the national level, 16,137 provided hemoglobin measurements.
[10] Data for these variables were collected for all children in the household under five, with the exception of hemoglobin concentration which was only collected on children 6-59 months of age. There were 8,820 hemoglobin measurements taken from children (national level).

prevalence of overweight among children was defined as a WHZ > +2. Biologically improbable values for WAZ, HAZ, and WHZ (WAZ < −6 or > +5, HAZ < −6 or > +6, and WHZ < −5 or > +5) were excluded.[11]

Hemoglobin values were adjusted for altitude[15], and anemia was defined as a hemoglobin concentration < 120 g/L for non-pregnant women of reproductive age and < 110 g/L for children under 5 years of age and pregnant women[16]. Severe anemia was defined as a hemoglobin concentration < 70 g/L for children 6–59 months of age and women of reproductive age (both pregnant and non-pregnant)[16].

Statistical analysis

SAS for Windows version 9.2 was used for data analysis. Households in the departments of Quetzaltenango, San Marcos, Huehuetenango, Quiché, and Totonicapán were grouped together to comprise the Western Highlands region. National-level data (including households from all 22 departments in Guatemala) were used for comparative purposes.[12] Sample weights for households and female respondents were used as appropriate and according to CDC recommendations.[13]

To describe the characteristics of households in each level of food security, as well as the nutritional outcomes associated with each level of food security, descriptive statistics (i.e., means and frequencies) were tabulated for the variables identified above (in the "Data" section), stratified by food insecurity status ("food secure," "moderately food insecure," "severely food insecure"). To better understand how food insecurity affects the household diet, the foods most commonly decreased, eliminated, or substituted for by households were also compiled. Linear regression analysis (taking into account the survey design and sampling weights) was performed to test for differences among continuous outcome variables (e.g., HAZ, hemoglobin concentration) by food security classifications (using dummy variables). For variables expressed as percentages or proportions (e.g., prevalence of stunting), chi-square tests (taking into account the survey design and sampling weights) were used to assess differences between food security classifications. Differences between means or proportions were considered statistically significant if $p < 0.05$.

Multiple linear or logistic regression models were used to quantify the association between household food security and nutritional outcomes among women of reproductive age and children, while also accounting for other covariates potentially associated with the outcome variables of interest. Separate regression models were created using national data (all 22 departments) and using only data from the Western Highlands. For women of reproductive age, the outcome variables explored were hemoglobin concentration (g/L) and BMI (kg/m^2).[14] For BMI, because both high and low BMI are associated with negative health outcomes, two categorical outcome variables were created and separate multiple logistic regressions performed: underweight (defined as BMI < 18.5 kg/m^2) vs. normal weight (≥ 18.5 and < 25 kg/m^2) and overweight (BMI > 25 kg/m^2) vs. normal weight (≥ 18.5 and < 25 kg/m^2). In both cases, "normal weight" was the reference category. For children under 5 years of age, the outcome variables used were WAZ, HAZ, and hemoglobin concentration (g/L).

[11] Following WHO recommendations for flagging extreme values (see http://www.who.int/childgrowth/software/readme_sas.pdf).
[12] The five departments of the Western Highlands were included in the 22 departments comprising national-level data. Thus, differences that may exist between the Western Highlands departments and other departments may be somewhat masked by comparing the Western Highlands to national-level data. Tests for statistical significance were not done for these comparisons.
[13] Personal communication, Paul Stupp/CDC. December 1, 2011. Sampling weight information is also available in the GTM_RHS_2008_README.zip file at http://www.healthmetricsandevaluation.org/ghdx/record/guatemala-reproductive-health-survey-2008-2009.
[14] A regression model was not created for female height since the time periods for accruing height in this group (women 15–49 years of age) do not coincide with the period reflected by the household food security variable. That is, we would not anticipate that household food security status in the last month to affect height of women of this age category. To some extent, the same may be true with the relationship with BMI (or child height), but we may expect BMI, which takes into account weight, to be more closely associated with recent food security and dietary patterns than maternal height.

Independent variables considered for entry into the regression models included the variables outlined in the "Data" section above. In addition to those variables, "(child age in months)^2" was created and used in the regression models for the child nutritional outcomes to explore whether the relationship with age was non-linear. Prior to selection for entry into the regression models, bivariate correlations were run between the independent variables to assess the strength and statistical significance of relationships between the independent and dependent variables, and also to avoid multicollinearity (defined as a correlation coefficient > 0.6) between independent variables.[15] Three of the independent variables exhibited multicollinearity: age of the female respondent, parity of the female respondent, and child birth order. Therefore, for entry into the regression model, the variable most highly correlated with the outcome variable of interest was chosen, and the other variables were not entered. For the female outcome variables underweight and overweight/obesity, the age of the female respondent was used (i.e., parity was not entered); for hemoglobin concentration, parity of the female respondent was used (i.e., maternal age was not entered). For the child outcome variables WAZ and HAZ, parity of the female respondent was used (maternal age and child birth order were not entered); for hemoglobin concentration, child birth order was used (maternal age and parity were not entered). Dummy variables were created to control for department and included in all regression models.[16]

[15] The socioeconomic status composite variable available in the dataset was not included in the regression models primarily because it was created based on several covariates also of interest for their relationship to nutritional status (e.g., household size, access to sewage systems or tubed water). Including the socioeconomic status variable at the same time as these other covariates would affect the interpretation of the socioeconomic status variable.

[16] Coefficients for the department dummy variables are not included in the results tables presented.

Results

Characteristics of the five departments comprising the Western Highlands region

Overall, compared to the national average, the five departments comprising the Western Highlands tend to have lower access to some services (e.g., sewage systems), have a greater percentage of the population in the lowest socioeconomic quintile, and have a larger percentage of indigenous people (**Table 1**). Four of the 5 departments have a prevalence of stunting and underweight among children less than 5 years of age greater than the national averages for both indicators (and three of the five departments—Totonicapán, Quiché and Huehuetenango—are among the four departments with the highest prevalence of stunting in the country). Quetzaltenango, however, does appear to be different in many respects from the other 4 departments, including household characteristics (e.g., greater access to electricity and sewage than other departments and also the national average), socioeconomic status (a much larger percentage of households fell in the medium to high quintiles of socioeconomic status as compared to other departments and the national average), and indicators of child undernutrition (e.g., underweight and stunting, which were both lower than the other 4 departments and also the national average).

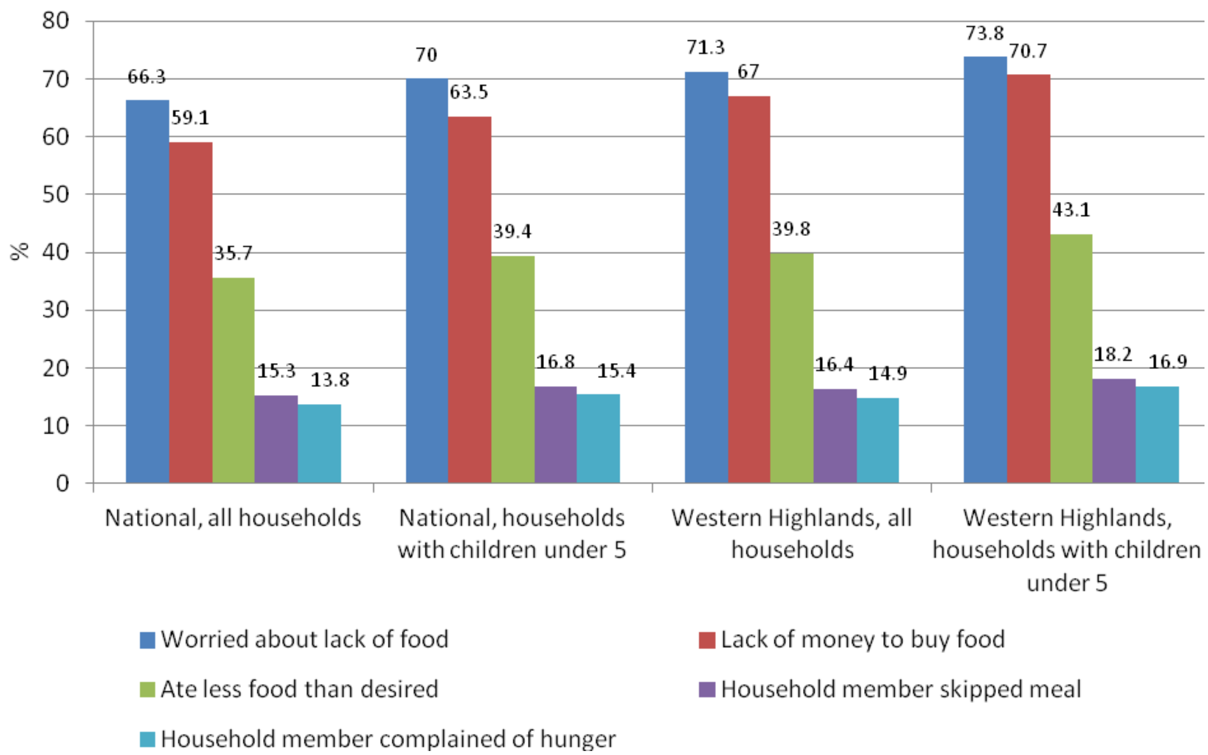
Table 1: Selected socio-demographic and nutritional characteristics of households, women of reproductive age, and children under 5 years of age, from the five departments of the Western Highlands, relative to the averages of the Western Highlands combined and national averages (all 22 departments, including the 5 departments of the Western Highlands)

Characteristic		Quetzal-tenango	San Marcos	Huehue-tenango	Quiché	Totoni-capán	WESTERN HIGHLANDS	NATIONAL
Household								
Access to electricity (% yes)		94.9	87.8	74.9	68.7	91.3	82.3	83.9
Access to piped or bottled water (% yes)		78.0	81.7	85.2	74.6	77.0	79.9	79.6
Access to toilet and sewage system (% yes)		52.2	23.9	21.1	13.1	23.9	26.3	40.3
Socioeconomic quintile (%)	High (Q5)	24.5	7.9	6.8	3.3	7.5	9.8	19.7
	Medium (Q3)	27.9	26.7	20.1	14.1	17.7	21.8	19.9
	Low (Q1)	5.4	20.1	33.7	46.5	30.1	27.2	20.3
Women of reproductive age (15–49 years of age)								
Primary education or less of female respondent (%)		56.9	75.6	87.1	86.2	75.3	77.3	67.0
Ethnicity of female respondent (% indigenous)		46.8	28.7	60.2	93.1	94.5	60.7	38.4
Children (0–59 months of age)								
Prevalence (%) of stunting in children < 5		41.9	51.4	67.7	72.1	80.7	62.4	48.4
Prevalence (%) of underweight in children < 5		10.6	14.6	22.3	21.4	24.2	18.7	13.2

Prevalence of household food security in the Western Highlands and nationally

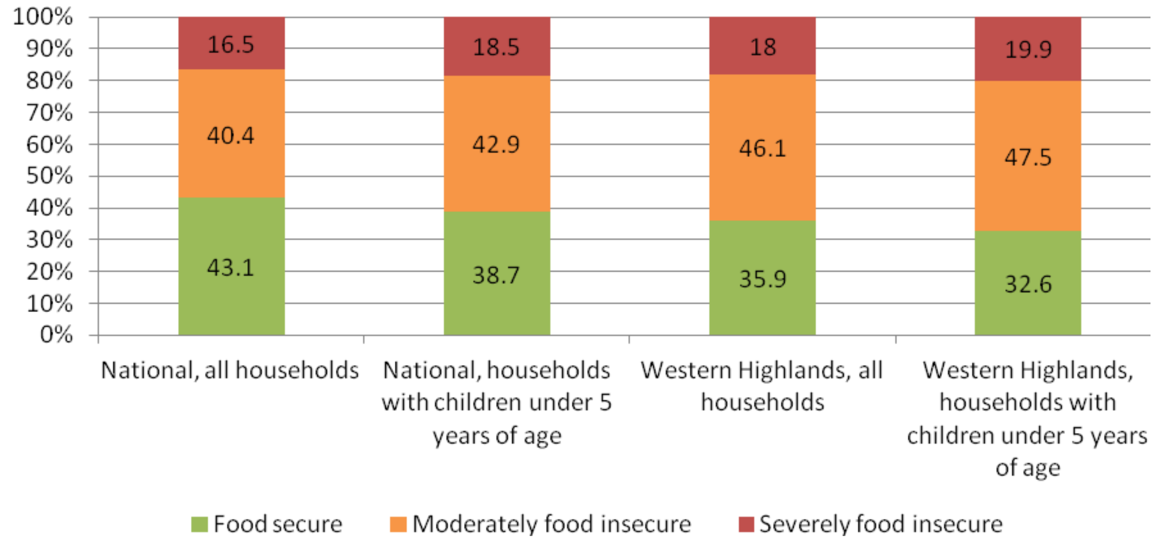
In the Western Highlands region as a whole, close to three-quarters of all households (71.3%) reported worrying about the amount of food in the household, and roughly two-thirds (67.0%) reported having insufficient money in the past 30 days to buy food (**Figure 2**). Lower percentages of households reported eating less food than usual, or had family members that skipped meals or complained of hunger in the 30 days prior to the survey, items that generally reflect more severe levels of household food insecurity. A similar pattern of response was seen among Western Highland households with children under 5 years of age, (though with slightly higher percentages across all food security items). At the national level, the pattern of responses was similar, with slightly lower percentages of households experiencing each item of the food security scale compared to the Western Highlands.

Figure 2: Percentage of households with and without children under 5 years of age that experienced specific food-insecurity-related conditions in the last 1 month (30 days) preceding the survey: nationally (all departments) and restricted to the five departments of the Western Highlands combined



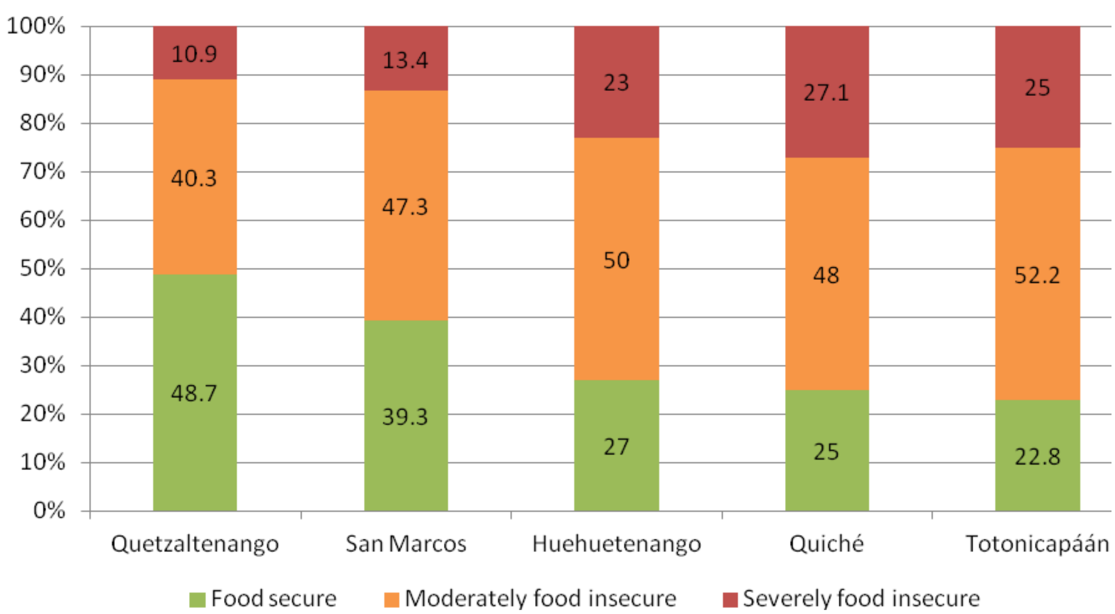
In the Western Highlands, close to two-thirds of all households (64.1%) experienced either moderate or severe food insecurity in the month preceding the survey, with households with children under 5 years of age tending toward higher levels of moderate or severe food insecurity (67.4%) (**Figure 3**). The percentage of households considered food insecure (moderate or severe) in the Western Highlands was higher than what was experienced at the national level (56.9% for all households and 61.4% for households with children under 5 years of age). Severe food insecurity was experienced by close to one-fifth of households in the Western Highlands, which was also higher than what was seen at the national level.

Figure 3: Percentage of households, with and without children under 5 years of age, in each category of food security: food secure, moderately food insecure, and severely food insecure; data are presented nationally (all departments) and restricted to the five departments of the Western Highlands combined



Examination of household food insecurity classification (for households with children under 5) for each department of the Western Highlands (**Figure 4**) shows that four of the five departments share a similar distribution of household food insecurity: The largest percentage of households falls into the moderately food insecure category. The exception is the department of Quetzaltenango, which shows the largest percentage (close to half) of households with children under 5 years of age falling into the food secure classification. This result is in line with the characteristics of households, women of reproductive age, and children under 5 years of age shown in **Table 1** for this department, which were dissimilar from other departments in the Western Highlands and, for some variables, "better off" than the national average.

Figure 4: Percentage of households with children under 5 years of age in each category of food security (food secure, moderately food insecure, and severely food insecure) for each of the five departments of the Western Highlands



A separate question (not included in the food insecurity scale) asked households whether they decreased or eliminated certain foods in the past 6 months due to lack of money (**Table 2**). At the national level, 62% of all households and 66% of households with children under 5 years of age reported decreasing consumption of certain foods in the past 6 months. In the Western Highlands, 68% of all households and 72% of households with children under 5 years of age reported decreasing consumption of certain foods. The five most commonly decreased foods were beef, chicken, beans, rice, and sugar (in decreasing order of reported frequency) at both the national level and in the Western Highlands (for all households).

A much lower percentage of all households (those with and without children under 5) reported *eliminating* particular foods in the past 6 months due to lack of money—between 14.2% and 15.6% at the national level, and between 11.6% and 12.7% in the Western Highlands (**Table 2**). The five foods most commonly eliminated by households in the Western Highlands were beef, milk, chicken, *Incaparina*,[17] and cereal (in decreasing order of reported frequency). Nationally, the same five foods were most commonly eliminated, but cereal tended to be eliminated more frequently than *Incaparina*. In terms of what was used to replace the foods that were eliminated, in the Western Highlands, the five most commonly reported substitute foods were "atol de masa,"[18] herbs/vegetables, coffee, beans, and chicken. At the national level, the five most commonly reported substitute foods were beans, herbs/vegetables, coffee, "atol de masa," and eggs.

Table 2: Percentage of households, with and without children under 5 years of age, who reported decreasing and/or eliminating certain foods in the past 6 months: nationally (all departments) and restricted to the five departments of the Western Highlands combined

	Decreased consumption of certain foods (%)	Eliminated consumption of certain foods (%)
National		
All households (n = 20,768)	61.7	14.2
Households with children under 5 years of age (n = 9,723)	65.8	15.6
Western Highlands		
All households (n = 4,542)	67.6	11.6
Households with children under 5 years of age (n = 2,366)	71.6	12.7

Food security status and household, female, and child characteristics in the Western Highlands

Overall, household and female characteristics followed a pattern of distribution across the categories of food security that were generally in line with expectations about food-insecure households and their association with overall poverty. In comparison to food-secure households, households in the Western Highlands with food insecurity were more likely to be rural, have more household members as well as more members under 5 years of age, be classified in the lower socioeconomic quintiles, and have less access to such services as electricity, piped water, and toilets connected to sewage systems (**Table 3**).

[17] Incaparina is a fortified blended food, originally developed in Guatemala. It is composed of corn and soy flour, fortified with vitamins and minerals, and is promoted for a variety of uses, including as a complementary food for young children (prepared as a porridge or drink), as well as for pregnant/lactating women (http://www.incaparina.com).

[18] "Atol de masa" is a drink made of corn dough (or "masa") diluted with water and frequently sweetened with sugar or other sweeteners and sometimes flavored. It is commonly served warm, and is primarily consumed by women and children.

Table 3: Characteristics of households with children under 5 years of age, the female respondents from these households, and children under 5 years of age in the Western Highlands, stratified by household food insecurity status[1]

Characteristic	All	Food secure	Moderately food insecure	Severely food insecure
Households with children under 5 years of age	**n = 2,366**	**n = 754**	**n = 1,124**	**n = 488**
Location (% rural)	73.1	61.2[a]	78.4[b]	79.9[b]
Household size (mean)	6.7	6.3[a]	6.9[b]	7.1[b]
Number of children < 5 years of age in household (mean)	1.5	1.4[a]	1.5[b]	1.6[c]
Sex of household head (% male)	81.2	83.4	80.0	80.1
Socioeconomic quintile[2] (%)				
High (Q5)	5.7	12.4[a]	3.1[b]	0.7[c]
Medium (Q3)	20.5	27.3[a]	19.6[b]	11.6[c]
Low (Q1)	33.3	16.9[a]	36.3[b]	53.2[c]
Access to electricity (% yes)	78.9	86.6[a]	78.2[b]	68.3[c]
Access to piped or bottled water (% yes)	78.8	80.0	79.2	75.6
Access to toilet (private or shared) connected to sewage system (% yes)	21.0	33.8[a]	16.3[b]	11.0[c]
Female respondent (in households with children under 5 years of age)	**n = 2,244**	**n = 708**	**n = 1,073**	**n = 463**
Marital status (% married)	68.8	70.4	68.4	67.2
Age, years (mean)	27.5	27.4[a]	27.0[a]	28.9[b]
Education (% primary or less)	82.6	74.7[a]	84.9[b]	90.0[c]
Education of spouse (% primary or less)	77.5	69.2[a]	80.6[b]	87.0[c]
Currently working (% yes)	31.0	33.4	30.6	28.1
Currently spouse working (% yes)	95.8	97.3[a]	96.0[a]	92.9[b]
Ethnicity (% indigenous)	64.8	57.1[a]	66.4[b]	73.2[c]
Parity (mean)	3.0	2.5[a]	3.1[b]	3.7[c]
Experienced intra-familiar violence in last 12 months (physical, sexual, or verbal) (% yes)	16.6	14.6[a]	16.0[a]	21.1[b]
Children (under 5 years of age)	**n = 2,439**	**n = 701**	**n = 1,182**	**n = 556**
Age, months (mean)	29.8	28.7[a]	30.2[ab]	30.4[b]
Sex (% male)	50.0	53.7	47.4	50.8
Birth order (mean)[3]	3.7	3.0[a]	3.9[b]	4.2[c]

[1] Values for the three levels of food security with different superscript letters are significantly different from each other ($p < 0.05$). Statistical differences were not tested between "All" and the three categories of food insecurity.
[2] Socioeconomic quintiles constructed at the national level.
[3] Birth order was measured for all children under 5.

As compared to women from food-secure households, women from households experiencing food insecurity were more likely to have completed only primary education or less (as were their husbands) and to report their ethnicity as indigenous. There was not a significant association between employment of the female respondent (either outside or inside the home) and food security status, though husbands from households with severe food insecurity were less likely to be employed compared to the other two categories. Women from food-insecure households were generally of greater parity (had experienced more live births) at the time of the survey, and those from severely food insecure households were more likely to have experienced intra-familiar violence (physical, sexual, or verbal) in the 12 months previous to the survey compared to women from households in the other two categories of food security. Children under 5 years of age from households with food insecurity that were included in the current survey were likely to be of higher birth order than food-secure households, because of higher parity of women in food insecure households overall.

Food security status and nutritional outcomes among women of reproductive age: Anthropometric measurements and anemia

On average, non-pregnant women in the Western Highlands from households with children under 5 years of age had a mean weight of 53.1 kg, height of 145.9 cm, and BMI of 24.9 kg/m^2 (**Table 4**). Weight and height of women of reproductive age were lower if they came from households with food insecurity, though there was not a significant difference in the weight of women from moderately vs. severely insecure households.[19] Short stature among women (height < 145 cm) was associated with greater food insecurity. In contrast, however, the prevalence of underweight was not associated with food security classifications and was overall low. The relationship between BMI and food security status was similar to that of weight: There was not a significant difference in the BMI of women from households classified as moderately or severely food insecure, though both were significantly lower than the BMI of women in food secure households. A “U-shape” pattern was observed for both overweight and obesity across food insecurity categories, whereby the percentage of women overweight or obese in severely food insecure households was greater than the proportion of women overweight or obese in moderately food insecure households, and approaching the levels seen in the food secure households. As mentioned previously, an association between food insecurity and high BMI has been demonstrated in developed countries[3] and in a few developing countries[5].

Women of reproductive age from food secure or moderately food insecure households had greater hemoglobin concentration than women from severely food insecure households. The percentage of non-pregnant women that were anemic was similar between food secure and moderately food insecure households (20.3% and 21.6%, respectively), but significantly less than the percentage of women from severely food insecure households experiencing anemia (29.4%). There were no differences in the percentage of pregnant women with anemia across food security classifications, suggesting that anemia during pregnancy may transcend household food security classifications or, more likely, that the sample size was too limited to detect a difference (sample sizes for pregnant and non-pregnant women with hemoglobin values are provided as footnotes to **Table 4**). Severe anemia was nonexistent in this population.

[19] It is important to note when reviewing the relationships between food security categorizations and nutritional outcome variables, such as weight or height, that the food security score can be interpreted only to reflect experiences in the past 30 days, whereas nutritional outcomes, such as weight and particularly height, are outcomes that accrue during a much longer period of time, not captured in their entirety by the food security recall period. Thus, bivariate associations between food security status and maternal height or weight, and the associated calculated indices, do not necessarily reflect a causal association (i.e., food insecurity causes lower maternal height, or food security causes increased BMI) because one cannot establish with certainty an appropriate temporal sequence. While this caution holds for all bivariate associations made in this analysis to a certain extent, it is particularly true for the nutritional outcome variables of women.

Table 4: Anthropometry and hemoglobin concentration of female respondents[1] of households with children under 5 years of age in the Western Highlands, stratified by household food insecurity status[2]

Characteristic	All (n^4 = 1,974)	Food secure (n^4 = 626)	Moderately food insecure (n^4 = 934)	Severely food insecure (n^4 = 414)
Weight, kg (mean)	53.1	55.3[a]	51.8[b]	52.4[b]
Height, cm (mean)	145.9	146.9[a]	145.7[b]	144.9[c]
% short stature (< 145 cm)	42.6	36.2[a]	43.6[b]	50.9[c]
BMI kg/m^2 (mean)	24.9	25.6[a]	24.4[b]	25.0[b]
% underweight (< 18.5 kg/m^2)	1.6	1.5	1.6	1.6
% overweight (≥ 25 kg/m^2 and < 30 kg/m^2)	32.8	34.8	30.6	34.7
% obese (≥ 30 kg/m^2)	10.1	14.2[a]	7.4[b]	10.1[c]
% overweight/obese (≥ 25 kg/m^2)	42.9	48.9 [a]	38.0 [b]	44.8[a]
Hemoglobin, g/L (mean)[3]	127	129[a]	127[ab]	126[b]
% anemic non-pregnant women (< 120 g/L)	22.7	20.3[a]	21.6[a]	29.4[b]
% severe anemia (< 70 g/L)	0.17	0.00	0.24	0.26
% anemic pregnant women (< 110 g/L)	30.2	33.7	27.6	33.8
% severe anemia (< 70 g/L)	0.0	0.0	0.0	0.0

[1] For all anthropometric data, only non-pregnant women were included. Women responding as "unsure" about their pregnancy status were counted as "non-pregnant.. For the determination of the average hemoglobin concentration, data for all eligible women (pregnant, non-pregnant, and "unsure" status) were combined. Hemoglobin cutoffs for anemia based on pregnancy status (< 120 g/L for non-pregnant women; < 110 g/L for pregnant women) were used.
[2] Values for the three levels of food security with different superscript letters are significantly different from each other ($p < 0.05$). Statistical differences were not tested between "All" and the three categories of food insecurity.
[3] Hemoglobin values are adjusted for altitude.
[4] The sample size reflects the number of observations for anthropometric measurements (from which pregnant women were excluded from analysis). The denominators for the hemoglobin data for non-pregnant/pregnant women are as follows: All: 1,941/180; Food secure: 613/49; Moderately food insecure: 921/98; Severely food insecure: 407/33.

Multiple logistic regression models were created to model the probability of underweight among women of reproductive age using national data (all 22 departments) and only in the 5 departments of the Western Highlands.[20] As shown in **Table 5**, which presents the results of both models, few variables, including the food security variables, were significantly associated with underweight among women of reproductive age. However, underweight among women is generally very low in Guatemala, both nationally (1.6% among non-pregnant women 15–49 years of age that had a child in the past 5 years[14]) and in the Western Highlands (1.6% among non-pregnant women 15–49 years of age), which makes it more difficult to detect significant associations in the regression model. Variables that were significantly associated with female underweight included marital status (in the national model only), education level of the respondent, and age and ethnicity (indigenous vs. ladino). Relative to the odds of underweight among unmarried women, women that were married had a 0.59 lower odds of being underweight. Relative to women with a primary education or less, having more than a primary education was associated with a greater odds of underweight, and this effect was stronger in the Western Highlands model compared to the national-level model. Nationally, the odds of being underweight among women with greater than

[20] For this analysis, only non-pregnant women between the ages of 18 and 49 with normal BMI (≥ 18.5 and < 25 kg/m^2) and underweight BMI (< 18.5 kg/m^2) were included (n = 7,280 at the national level; n = 1,728 at the level of the Western Highlands).

primary education was 1.7 times higher than the odds for women with primary education or less; in the Western Highlands, the odds of being underweight among women with greater than primary education was 3.1 times higher than the odds for women with primary education or less. Older females and indigenous women both had lower odds of underweight than younger women or non-indigenous women, respectively.

Table 5: Multiple logistic regression model of underweight among women 18–49 years of age (normal vs. underweight) for national-level data and using data only from the Western Highlands, in both cases including only non-pregnant women ages 15–49; odds ratios significant at the < 0.05 level are bolded; model controlled for department (dummy variables not shown)

	National n = 7,280		Western Highlands n = 1,728	
Variable	Odds ratio (95% CI)	p-value	Odds ratio (95% CI)	p-value
Moderate insecure vs. food secure[1]	1.04 (0.71–1.51)	0.85	0.75 (0.39–1.42)	0.37
Severely food insecure vs. food secure[1,2]	1.01 (0.64–1.58)	0.98	0.82 (0.26–2.57)	0.73
Rural household (1 = yes,[1] 0 = no)	1.03 (0.68–1.55)	0.91	1.17 (0.55–2.49)	0.69
Number of household members	0.97 (0.92–1.03)	0.29	0.92 (0.80–1.06)	0.26
Male head of household (1 = yes, 0 = no[1])	1.21 (0.85–1.72)	0.29	1.26 (0.54–2.95)	0.59
Number of household members under 5 years of age	0.96 (0.77–1.21)	0.74	1.23 (0.73–2.07)	0.44
Access to electricity (1 = yes, 0 = no[1])	1.0 (0.63–1.57)	0.99	0.74 (0.26–2.16)	0.59
Access to toilet/sewage (1 = yes, 0 = no[1])	1.06 (0.72–1.56)	0.78	1.67 (0.77–3.61)	0.20
Access to piped water (1 = yes, 0 = no[1])	1.03 (0.70–1.53)	0.87	1.95 (0.82–4.59)	0.13
Female respondent married (1 = yes, 0 = no[1])	**0.59 (0.36–0.96)**	**0.04**	0.97 (0.38–2.48)	0.95
Primary education or less of female respondent (1 = yes,[1] 0 = no)	**1.68 (1.20–2.34)**	**0.002**	**3.14 (1.39–7.08)**	**0.006**
Female respondent not employed (1 = yes,[1] 0 = no)	0.76 (0.56–1.04)	0.08	0.76 (0.39–1.46)	0.41
Age of female respondent (years)	**0.97 (0.95–1.00)**	**0.03**	**0.87 (0.79–0.96)**	**0.006**
Female respondent indigenous (1 = yes, 0 = no[1])	**0.53 (0.31–0.90)**	**0.02**	**0.42 (0.19–0.93)**	**0.03**
Female respondent experienced intra-familial violence in last 12 months (1 = yes, 0 = no[1])	0.96 (0.59–1.57)	0.86	0.25 (0.05–1.17)	0.08

[1] Designates reference category for purpose of analysis.
[2] For severely food insecure vs. moderately food insecure: National odds ratio (95% CI) = 0.96 (0.66–1.40), p = 0.88; Western Highlands odds ratio (95% CI) =1.10 (0.33–3.2), p = 0.88.

A multiple logistic regression model was also created to model the probability of overweight/obesity among women of reproductive age at the national level (using data from all 22 departments) and in the Western Highlands.[21] As shown in **Table 6**, the food security variables were not associated with overweight/obesity at the national level; in the model for the Western Highlands, women from moderately food insecure households had a 0.83 lower odds of being overweight or obese compared to the odds of women from food secure households. Other variables that were significantly associated with overweight

[21] For this analysis, only non-pregnant women between the ages of 18 and 49 with normal BMI (≥ 18.5 and < 25 kg/m^2) and overweight or obese BMI (≥ 25 kg/m^2) were included (n = 14,930 at the national level; n = 3,286 at the level of the Western Highlands).

and obesity in the two logistic regression models included rural/urban location of the household, the number of household members under 5, access to electricity (in the national model only), access to a toilet/sewage system, marital status, education level, employment status (national model only), and age of female respondent. Women from households with greater numbers of children under 5 years of age had lower odds of being overweight or obese than those of women with fewer young children in the household. Women from rural households also had lower odds of being overweight or obese, both at the national level and in the Western Highlands: Being in a rural household was associated with a 0.77–0.83 lower odds of overweight/obesity compared to the odds of overweight/obesity in an urban household. However, having access to a toilet/sewage or electricity/water (variables likely associated with higher socioeconomic status) was associated with greater odds of the female respondent being overweight or obese (by 1.42 and 1.30, respectively, in the national-level model; only access to a toilet/sewage was significant in the Western Highlands model). Women that were married had a 1.43–1.67 greater odds of being overweight or obese compared to non-married women. Relative to women with a primary education or less, women with more than a primary education had 0.77 lower odds of being overweight or obese at the national level, and 0.66 lower odds of being overweight or obese in the Western Highlands. Relative to the odds of unemployed women, being employed was associated with a 1.23 greater odds of being overweight/obese in the national model. Ethnicity of the female respondent was also significantly associated with overweight/obesity: Indigenous women had a 0.75–0.88 lower odds of overweight/obesity than ladino women, for the Western Highlands and national models, respectively.

A multiple linear regression model was created to analyze the relationship between female hemoglobin concentration and food insecurity status, as well as other variables potentially related to this outcome at the national level (all 22 departments) and only for the Western Highlands. Independent variables entered into the model are shown in **Table 7**, along with the regression coefficients and p-values for each variable. In the model using national data, women of reproductive age from severely food insecure households had hemoglobin concentrations approximately 1 g/L lower than their peers from food secure households. In the Western Highlands, there was not a significant association between food security status and female hemoglobin concentration, but this could be due to the smaller sample size for this model or that other factors play a larger role in affecting hemoglobin concentration than overall household food security. More children in the household under 5 years of age was marginally significantly associated with lower female hemoglobin concentration. Access to electricity and sewage systems had a significant positive association with female hemoglobin at the national level, such that access to either service conferred an increase of 2.2 or 1.2 g/L, respectively (national model only). At the national level as well as in the Western Highlands, having only a primary education was associated with a lower hemoglobin concentration; however, the magnitude of effect was much larger in the Western Highlands model than in the national model (2.1 g/L increase in hemoglobin concentration associated with greater than primary education, compared to 0.76 g/L). Greater parity of the female respondent was also associated with lowered hemoglobin concentration, possibly due to the effects of multiple pregnancies or close birth spacing on iron status. The magnitude of effect was similar in both models. As would be expected, due to the hemodilution effects of pregnancy, as well as increased iron requirements and thus greater risk of anemia, female respondents that were pregnant at the time of the survey had lower hemoglobin (approximately 13 g/L lower in both models) than non-pregnant respondents. No other variables in the model were significant at the $p < 0.05$ level.

Table 6: Multiple logistic regression model of female overweight and obesity (normal vs. overweight/obese) for national-level data, and using data only from the Western Highlands, in both cases including only non-pregnant women ages 15–49; odds ratios significant at the < 0.05 level are bolded; model controlled for department

	National n = 14,930		Western Highlands n = 3,286	
Variable	**Odds ratio (95% CI)**	**p-value**	**Odds ratio (95% CI)**	**p-value**
Moderate insecure vs. food secure[1]	1.00 (0.90–1.10)	0.95	0.83 (0.68–1.01)	0.07
Severely food insecure vs. food secure[1,2]	0.91 (0.80–1.05)	0.20	0.88 (0.67–1.14)	0.32
Rural household (1 = yes,[1] 0 = no)	**1.20 (1.05–1.37)**	**0.008**	**1.30 (1.00–1.68)**	**0.05**
Number of household members	0.99 (0.96–1.01)	0.19	0.99 (0.95–1.02)	0.44
Male head of household (1 = yes, 0 = no[1])	0.96 (0.85–1.08)	0.50	1.10 (0.87–1.39)	0.43
Number of household members under 5 years of age	0.94 (0.88–1.01)	0.07	**0.87 (0.77–0.98)**	**0.02**
Access to electricity (1 = yes, 0 = no[1])	**1.42 (1.24–1.64)**	**< 0.0001**	1.21 (0.92–1.59)	0.18
Access to toilet/sewage (1 = yes, 0 = no[1])	**1.30 (1.14–1.48)**	**< 0.0001**	**1.33 (1.03–1.72)**	**0.03**
Access to piped water (1 = yes, 0 = no[1])	1.11 (0.98–1.26)	0.09	1.08 (0.85–1.37)	0.54
Female respondent married (1 = yes, 0 = no[1])	**1.67 (1.47–1.90)**	**< 0.0001**	**1.43 (1.15–1.78)**	**0.001**
Primary education or less of female respondent (1 = yes,[1] 0 = no)	**0.77 (0.68–0.87)**	**< 0.0001**	**0.66 (0.51–0.85)**	**0.001**
Female respondent not employed (1 = yes,[1] 0 = no)	**1.23 (1.11–1.36)**	**0.0001**	1.09 (0.89–1.34)	0.39
Age of female respondent (years)	**1.06 (1.06–1.07)**	**< 0.0001**	**1.06 (1.05–1.07)**	**< 0.0001**
Female respondent indigenous (1 = yes, 0 = no[1])	**0.88 (0.77–1.00)**	**0.05**	**0.75 (0.60–0.94)**	**0.01**
Female respondent experienced intra-familial violence in last 12 months (1 = yes, 0 = no[1])	0.99 (0.87–1.12)	0.85	0.93 (0.75–1.15)	0.49

[1] Designates reference category for purpose of analysis
[2] For severely food insecure vs. moderately food insecure: National odds ratio (95% CI) = 0.92 (0.80–1.05), p = 0.20; Western Highlands odds ratio (95% CI) =1.05 (0.82–1.36), p = 0.68.

Table 7: Multiple linear regression models of hemoglobin concentration (g/L) of women of reproductive age (15–49 years of age) for national-level data and using data only from the Western Highlands; β-coefficients significant at the < 0.05 level are bolded; model controlled for department

	National n = 16,137 Model R^2 = 0.088 (p < 0.0001)		Western Highlands n = 3,541 Model R^2 = 0.098 (p < 0.0001)	
Variable	**β-coefficient**	**p-value**	**β-coefficient**	**p-value**
Intercept	**129.2**	**< 0.0001**	**125.0**	**< 0.0001**
Moderately food insecure vs. food secure	−0.44	0.21	0.20	0.79
Severely food insecure vs. food secure[1]	**−1.01**	**0.02**	−0.93	0.25
Rural household (1 = yes, 0 = no)	0.96	0.12	0.05	0.96
Number of household members	0.09	0.16	0.12	0.33
Male head of household (1 = yes, 0 = no)	−0.54	0.16	−0.23	0.76
Number of children less than 5 years of age in the household	**−0.39**	**0.05**	−0.48	0.24
Access to electricity (1 = yes, 0 = no)	**2.23**	**0.0002**	1.50	0.18
Access to toilet connected to sewage system (1 = yes, 0 = no)	**1.17**	**0.03**	1.94	0.09
Access to piped/bottled water (1 = yes, 0 = no)	0.75	0.17	0.92	0.42
Female respondent married (1 = yes, 0 = no)	0.03	0.94	0.26	0.73
Primary education or less of female respondent (1 = yes, 0 = no)	**−0.76**	**0.05**	**−2.11**	**0.03**
Female respondent not currently employed (1 = yes, 0 = no)	−0.34	0.31	−1.07	0.11
Parity of female respondent (no. of live births)	**−0.27**	**0.0002**	**−0.27**	**0.04**
Female respondent indigenous (1 = yes, 0 = no)	−0.77	0.19	−0.19	0.86
Female respondent experienced intra-familial violence in last 12 months (1 = yes, 0 = no)	−0.001	0.98	−0.002	0.82
Female respondent currently pregnant (1 = yes, 0 = no/unsure)	**−13.38**	**< 0.0001**	**−13.63**	**< 0.0001**

[1] For the comparison of severely food insecure vs. moderately food insecure: National model β-coefficient = −0.57 (p = 0.17); Western Highlands model β-coefficient = −1.12 (p = 0.11).

Food security status and nutritional outcomes among children under 5 years of age: Anthropometric measurements and anemia

Children from households in the Western Highlands with anthropometric measurements had a mean age of 29.8 months, were 50% male, and were on average between the third and fourth child born in the family (**Table 8**). There were no significant differences in mean weight (10.9 kg) or height (80.6 cm) of children under 5 years of age across household food security classifications (**Table 8**). However, compared to food secure households, children from food insecure households had lower mean WAZ, as well as lower mean HAZ. Both stunting and underweight prevalence tended to increase with increasing food insecurity, though there were no significant differences in these indicators between all food security categories. In contrast to WAZ and HAZ, there was not a significant relationship between food insecurity status and WHZ. As previous analyses of ENSMI data have shown, mean WHZ values in Guatemala are close to 0 (i.e., the median of the reference population) and the percentages of children with wasting (WHZ < −2) are very low (1.0% in the Western Highlands and 1.4% nationally[14]). Interestingly, however, similar to maternal overweight and obesity, child overweight showed a "U-shaped" relationship with food security, whereby children in the food secure and severely food insecure categories showed similar levels of overweight (4.5% and 4.6%, respectively), which were higher than those in the moderately food insecure category (2.4%).

Close to half of the children (47%) 6–59 months of age in the Western Highlands were anemic (< 110 g/L). Hemoglobin concentration did not vary by food security classification. There was a trend toward higher levels of anemia among children from households classified as severely food insecure, but this was not statistically significant. Severe anemia was rare in this population.

Table 8: Anthropometry and hemoglobin concentration of children under 5 years of age in the Western Highlands, stratified by household food insecurity status[1]

Characteristic	All (n = 2,439)	Food secure (n = 701)	Moderately food insecure (n = 1,182)	Severely food insecure (n = 556)
Age, months (mean)	29.8	28.7[a]	30.2[ab]	30.4[b]
Weight, kg (mean)	10.9	11.1	10.9	10.9
Length or height, cm (mean)	80.6	80.9	80.6	80.2
WAZ (mean)	−1.2	−0.9[a]	−1.2[b]	−1.3[b]
% underweight (< −2)	18.7	15.9[a]	18.7[ab]	22.3[b]
% moderately underweight (< −2 and ≥ -3)	15.6	14.3	15.0	18.6
% severely underweight (< −3)	3.1	1.6[a]	3.7[b]	3.8[b]
HAZ (mean)	−2.3	−2.0[a]	−2.4[b]	−2.5[b]
% stunted (< −2)	62.5	50.4[a]	65.9[b]	71.1[b]
% moderately stunted (< −2 and ≥ -3)	32.6	29.0	33.5	35.4
% severely stunted (< −3)	29.9	21.3[a]	32.4[b]	35.6[b]
WHZ (mean)	0.3	0.3	0.3	0.3
% wasted (< −2)	1.0	1.3	0.9	1.0
% moderately wasted (< −2 and ≥ -3)	0.7	0.7	0.8	0.9
% severely wasted (< −3)	0.3	0.7	0.09	0.2
% overweight (> +2 and ≤ +3)	3.5	4.5[a]	2.4[b]	4.6[a]
% obese (> +3)	1.0	0.8	1.3	0.8
% overweight/obese (> +2)	4.5	5.3	3.6	5.4
Hemoglobin, g/L (mean)[2]	109	110	110	109
% anemic (< 110 g/L)	47.0	46.4	46.0	49.7
% severe anemia (< 70 g/L)	0.8	0.7	0.7	1.1

[1] Values for the three levels of food security with different superscript letters are significantly different from each other ($p < 0.05$). Statistical differences were not tested between "All" and the three categories of food insecurity.
[2] Hemoglobin values adjusted for altitude. Hemoglobin was measured only on children 6–59 months of age.

Multiple linear regression models were created for WAZ, HAZ, and hemoglobin concentration to explore the relationship between each of these variables and household food security status using national data (all 22 departments) and just 5 departments belonging to the Western Highlands. Independent variables entered into these models are shown in **Tables 9**, **10**, and **11**, respectively.

For WAZ (**Table 9**), the linear regression model explained approximately 24% of the variability in WAZ among children under 5 years of age using national data, and 23% using data from the Western Highlands. At the national level, household food security classification was significantly associated with WAZ (i.e., greater food security was associated with a higher WAZ), though not in the Western Highlands model. In the national model, other variables significantly associated with child WAZ included: child age at the time of the survey measurements (older children tended to have lower WAZ); child's age squared (indicating that the relationship between child age and WAZ is non-linear); access to toilet/sewage system in the household (access increased WAZ by 0.12); number of children in the household under 5 years of age (an increase by one child was associated with a 0.04 reduction in WAZ); maternal education (having a primary education or less decreased child WAZ by 0.19); maternal age (a unit increase in maternal age was associated with a 0.01 increase in WAZ); mother's parity (children whose mother had had more live births tended to have lower WAZ); maternal height and weight (both positively associated with child WAZ); and mother's current pregnancy status (children of women that were pregnant at the time of the survey tended to have a lower WAZ, by 0.15). Fewer of the aforementioned variables were significant in the model using data from the Western Highlands only, though the direction of effects were similar to that of the national-level model.

For HAZ (**Table 10**), the multiple regression model explained 38% of the variation in HAZ among children under 5 years of age using national data, and 35% of the variation in HAZ using only data from the Western Highlands. In the regression model using national data, food insecurity at the household level was significantly associated with HAZ, such that children in moderately food insecure households had 0.08 lower HAZ and children in severely food insecure households had 0.09 lower HAZ than children from food secure households. Similar to the model for WAZ, older children had lower HAZ, but so did boys, and these relationships were seen in both the national and Western Highlands models, with about similar magnitudes of effect. In terms of household or demographic characteristics, children from rural households, as compared to urban households, in both the national and Western Highlands models, were more likely to have lower HAZ, by 0.13 nationally and 0.21 in the Western Highlands. Access to services, such as electricity and toilets/sewage systems, were significantly positively associated with HAZ in the national-level model, conferring a 0.11 and 0.12 increase in HAZ, respectively. Similar to the WAZ model, several maternal characteristics were significantly associated with child HAZ, including maternal education level, maternal age, maternal parity, indigenous ethnicity of the mother, maternal height and weight, and current pregnancy status. Having a mother with more than a primary education conferred a 0.23 greater HAZ in the national model, and 0.26 greater HAZ in the Western Highlands model, compared to mothers with a primary education or less. Each unit increase in maternal age was associated with a 0.01 to 0.02 greater HAZ. A unit increase in maternal parity (i.e., an additional live birth) was associated with a 0.05 to 0.08 lower HAZ in her child. Children of indigenous mothers had 0.15 to 0.22 lower HAZ, as compared to children of ladino mothers (national and Western Highlands models, respectively). Similar to the WAZ model, the mother's current pregnancy status was negatively associated with HAZ, and the magnitude of effect (0.23 in the national model) was one of the largest for the variables included in the regression models. Maternal weight and height were both significantly positively associated with child HAZ, whereby a cm increase in maternal height was associated with a 0.06 (national model) or 0.05 (Western Highlands model) greater HAZ, and a kg increase in maternal weight was associated with a 0.01 or 0.02 greater HAZ (national and Western Highlands models, respectively).

Table 9: Multiple linear regression model of child WAZ for national-level data and using data only from the Western Highlands; β-coefficients significant at the < 0.05 level are bolded; model controlled for department

	National n = 10,366 Model R^2 = 0.238 (p < 0.0001)		Western Highlands n = 2,512 Model R^2 = 0.232 (p < 0.0001)	
Variable	**β-coefficient**	**p-value**	**β-coefficient**	**p-value**
Intercept	**−5.63**	**< 0.0001**	**−5.26**	**< 0.0001**
Moderately food insecure vs. food secure	**−0.06**	**0.02**	−0.03	0.51
Severely food insecure vs. food secure[1]	**−0.09**	**0.009**	−0.02	0.78
Age of child (months)	**−0.04**	**< 0.0001**	**−0.05**	**< 0.0001**
Child's age squared	**0.0005**	**< 0.0001**	**0.0007**	**< 0.0001**
Boy (1 = yes, 0 = no)	−0.03	0.12	−0.01	0.85
Rural household (1 = yes, 0 = no)	−0.01	0.70	−0.05	0.44
Number of household members	0.00	0.91	−0.005	0.60
Male head of household (1 = yes, 0 = no)	0.04	0.31	0.09	0.16
Number of children under 5 years of age in the household	**−0.04**	**0.03**	0.02	0.58
Access to electricity (1 = yes, 0 = no)	0.06	0.07	0.05	0.35
Access to toilet connected to sewage system (1 = yes, 0 = no)	**0.12**	**0.0002**	**0.20**	**0.001**
Access to piped/bottled water (1 = yes, 0 = no)	0.05	0.17	−0.05	0.40
Mother married (1 = yes, 0 = no)	−0.04	0.35	−0.01	0.90
Primary education or less of mother (1 = yes, 0 = no)	**−0.19**	**< 0.0001**	−0.12	0.10
Mother not currently employed (1 = yes, 0 = no)	0.01	0.59	−0.07	0.15
Age of mother (yrs)	**0.01**	**0.01**	−0.001	0.88
Parity of mother (no. of live births)	**−0.05**	**< 0.0001**	−0.01	0.46
Mother indigenous (1 = yes, 0 = no)	−0.05	0.13	−0.05	0.36
Mother currently pregnant (1 = yes, 0 = no/unsure)	**−0.15**	**0.0004**	−0.12	0.08
Maternal height (cm)	**0.03**	**< 0.0001**	**0.03**	**< 0.0001**
Maternal weight (kg)	**0.02**	**< 0.0001**	**0.02**	**< 0.0001**

[1] For the comparison of severely food insecure vs. moderately food insecure: National model β-coefficient = −0.03 (p = 0.32); Western Highlands model β-coefficient = 0.01 (p = 0.85).

Table 10: Multiple linear regression model of child HAZ for national-level data and using data only from the Western Highlands; β-coefficients significant at the < 0.05 level are bolded; model controlled for department

	National n = 10,312 Model R^2 = 0.384 (p < 0.0001)		Western Highlands n = 2,496 Model R^2 = 0.351 (p < 0.0001)	
Variable	**β-coefficient**	**p-value**	**β-coefficient**	**p-value**
Intercept	**−10.02**	**< 0.0001**	**−9.39**	**< 0.0001**
Moderately food insecure vs. food secure	**−0.08**	**0.02**	−0.03	0.59
Severely food insecure vs. food secure[1]	**−0.09**	**0.02**	−0.01	0.90
Age of child (months)	**−0.06**	**< 0.0001**	**−0.07**	**< 0.0001**
Child's age squared	**0.0008**	**< 0.0001**	**0.00095**	**< 0.0001**
Boy (1 = yes, 0 = no)	**−0.08**	**0.0005**	**−0.09**	**0.01**
Rural household (1 = yes, 0 = no)	**−0.13**	**0.0008**	**−0.21**	**0.003**
Number of household members	−0.004	0.61	−0.01	0.50
Male head of household (1 = yes, 0 = no)	0.01	0.77	0.07	0.32
Number of children under 5 years of age in the household	**−0.12**	**< 0.0001**	**−0.07**	**0.04**
Access to electricity (1 = yes, 0 = no)	**0.11**	**0.006**	0.12	0.08
Access to toilet connected to sewage system (1 = yes, 0 = no)	**0.12**	**0.0006**	0.07	0.29
Access to piped/bottled water (1 = yes, 0 = no)	0.01	0.73	−0.08	0.22
Mother married (1 = yes, 0 = no)	−0.01	0.80	0.05	0.57
Primary education or less of mother (1 = yes, 0 = no)	**−0.23**	**< 0.0001**	**−0.26**	**0.002**
Mother not currently employed (1 = yes, 0 = no)	0.02	0.43	−0.02	0.70
Age of mother (yrs)	**0.02**	**< 0.0001**	**0.01**	**0.04**
Parity of mother (no. of live births)	**−0.08**	**< 0.0001**	**−0.05**	**0.007**
Mother indigenous (1 = yes, 0 = no)	**−0.15**	**< 0.0001**	**−0.22**	**0.003**
Mother currently pregnant (1 = yes, 0 = no/unsure)	**−0.23**	**< 0.0001**	−0.15	0.07
Maternal height (cm)	**0.06**	**< 0.0001**	**0.05**	**< 0.0001**
Maternal weight (kg)	**0.01**	**< 0.0001**	**0.02**	**< 0.0001**

[1] For the comparison of severely food insecure vs. moderately food insecure: National model β-coefficient = −0.02 (p = 0.46); Western Highlands model β-coefficient = 0.02 (p = 0.72)

For child hemoglobin concentration (**Table 11**), the multiple regression model explained approximately 14% of the variation in the outcome variable using national data and 16% using data only from the Western Highlands. In the national model, the food security level of the household was significantly associated with hemoglobin concentration, such that children in moderately food insecure households had 0.91 g/L lower hemoglobin concentration and children in severely food insecure households had 1.29 g/L lower hemoglobin concentration than children from food secure households. Other variables that were associated with hemoglobin concentration include the age of the child (both national and Western Highlands models), with older children having higher hemoglobin concentration. Child sex was marginally significantly associated with hemoglobin concentration in the model using data from the Western Highlands (p = 0.06), with boys having significantly lower hemoglobin concentration (by 1.03 g/L) than girls. In terms of household characteristics, a greater number of children in the household was associated with lower hemoglobin concentration of the measured child (national model). Unexpectedly, access to electricity was significantly negatively associated with hemoglobin concentration, such that access conferred a 1.2 g/L decrease in hemoglobin concentration. In contrast, access to sewage services as well as piped water were positively associated with hemoglobin concentration, with the greatest magnitudes of effect in the Western Highland model. Maternal weight was positively associated with the child's hemoglobin concentration in the model using national-level data, such that a 1 kg increase in maternal weight was associated with a 0.05 g/L greater hemoglobin concentration.

Table 11: Multiple linear regression model of child hemoglobin concentration (g/L) for national-level data and using data only from the Western Highlands; β-coefficients significant at the < 0.05 level are bolded; model controlled for department

	National n = 8,959 Model R^2 = 0.137 (p < 0.0001)		**Western Highlands n = 2,150 Model R^2 = 0.160 (p < 0.0001)**	
Variable	**β-coefficient**	**p-value**	**β-coefficient**	**p-value**
Intercept	**92.0**	**< 0.0001**	**83.3**	**< 0.0001**
Moderately food insecure vs. food secure	**−0.91**	**0.02**	0.26	0.71
Severely food insecure vs. food secure[1]	**−1.29**	**0.01**	0.05	0.96
Age of child (months)	**0.47**	**< 0.0001**	**0.43**	**< 0.0001**
Child's age squared	**−0.003**	**0.0002**	−0.002	0.12
Boy (1 = yes, 0 = no)	−0.47	0.13	−1.03	0.06
Birth order	−0.12	0.34	−0.14	0.53
Rural household	0.78	0.22	1.45	0.15
Number of household members	−0.16	0.12	−0.27	0.13
Male head of household (1 = yes, 0 = no)	−0.22	0.69	−0.71	0.40
Number of children under 5 years of age in the household	**−0.56**	**0.04**	−0.20	0.70
Access to electricity (1 = yes, 0 = no)	**−1.18**	**0.03**	−1.32	0.19
Access to toilet connected to sewage system (1 = yes, 0 = no)	0.51	0.43	**2.75**	**0.02**
Access to piped/bottled water (1 = yes, 0 = no)	**1.67**	**0.005**	**2.25**	**0.03**
Mother married (1 = yes, 0 = no)	0.13	0.86	0.13	0.93
Primary education or less of mother (1 = yes, 0 = no)	−0.86	0.12	0.30	0.77
Mother not currently employed (1 = yes, 0 = no)	−0.03	0.94	0.74	0.34
Age of mother (yrs)	0.04	0.34	0.04	0.62
Mother indigenous (1 = yes, 0 = no)	−0.21	0.69	0.72	0.48
Mother currently pregnant (1 = yes, 0 = no/unsure)	−0.58	0.31	0.69	0.47
Maternal height (cm)	0.02	0.51	0.04	0.57
Maternal weight (kg)	**0.05**	**0.02**	0.05	0.25

[1] For the comparison of severely food insecure vs. moderately food insecure: National model β-coefficient = −0.37 (p = 0.38); Western highlands model β-coefficient = −0.21 (p = 0.78).

Summary and Conclusions

Approximately two-thirds of households in the Western Highlands region experienced some degree of food insecurity in the month prior to the survey. A greater percentage of households with children under 5 years of age tended to experience food insecurity, both in the Western Highlands and nationally. According to survey data, two-thirds of households also reported decreasing consumption of some foods in the past 6 months due to lack of money. In most cases, the foods decreased were animal-source foods (such as beef and chicken), which are rich sources of bioavailable nutrients, and also more expensive than other food items. When foods were eliminated by a household (an occurrence reported by a much smaller percentage of the population, between approximately 12% and 15%), they also tended to be animal-source foods, and they were commonly replaced with less nutrient rich options, such as “atol de masa” or coffee. However, the second most common replacement food in the Western Highlands and nationally were herbs/vegetables, which, depending on the dietary patterns of the household, could be a positive shift in terms of dietary diversity and intake of some nutrients, though such foods won’t adequately replace the nutrient-rich and bioavailable animal-source foods being eliminated.

Households experiencing moderate or severe food insecurity in the Western Highlands tended to be rural, larger, with more children, and with less access to services, such as sewage and electricity. Women of reproductive age from these households were more likely to have a primary education or less, to report their ethnicity as indigenous, to be of greater parity, and to have experienced intra-familiar violence in the past 12 months. In terms of nutritional status, overall, approximately 43% of women of reproductive age in the Western Highlands were of short stature, and approximately the same percentage of women were either overweight or obese. Anemia affected roughly a quarter of non-pregnant women 15–49 years of age, and approximately 30% of pregnant women of the same age range. More than 60% of children under 5 years of age were stunted, close to one-fifth were underweight, while only 1% were considered wasted. Anemia affected close to half of all children under 5 years of age in the Western Highlands.

Regression models to evaluate predictors of nutritional status of women of reproductive age and children under 5 years of age were created to explore the relationship of these outcome variables with food security status, while taking into account the effects of other covariates that are also known to contribute to nutritional status outcomes in women and children. Using national-level data, household food security status was associated with hemoglobin concentration of women of reproductive age and with child WAZ, HAZ, and hemoglobin concentration. However, similar regression models, including data only from the five departments comprising the Western Highlands, did not show significant associations between the food security variables and nutritional status of women and children. The lack of a significant relationship in the Western Highlands could be due to smaller sample sizes for these analyses, rather than to other variables being more important for nutritional status in the Western Highlands. However, as shown in the regression models, food security status of the household is but one of several factors associated with nutritional outcomes of women and children.

While the goal of these analyses was not to provide a comprehensive analysis of all the potential explanatory variables for the chosen nutritional outcomes of women and children, several associations from the regression models warrant additional comment, particularly those that replicate findings from other settings and those that stand out as unexpected or challenging to interpret. For the model of maternal overweight and obesity, many variables that are typically associated with higher socioeconomic status or urbanization (for example, access to services, such as electricity, sewage, piped water, and urban location of the household) were associated in a positive direction with the odds of female overweight/obesity—that is, access to these services (as a proxy for socioeconomic status) or being in an urban environment was associated with greater odds of overweight or obesity. These associations fit the pattern commonly seen in developing countries of higher socioeconomic classes being more at risk of overweight and obesity. However, in the same model, more highly educated women had lower odds of being overweight/obese, which more typically fits the pattern seen in developed countries, where women of higher socioeconomic/education levels tend to experience less overweight and obesity than lower-income/less well educated populations. One possibility is that the model is capturing a period of transition, where women of both high income/education and lower income/education are being affected by overweight and obesity. The prevalence of overweight and obesity among women of reproductive age in

Guatemala is very high—estimated at approximately 43% in the Western Highlands and approximately 51% nationally[14]. The percentage of women that are overweight or obese has also increased over the past approximately decade and a half: The 1995 ENSMI estimated that 34.4% of women of reproductive age (nationally) were either overweight or obese, representing an increase of approximately 15 percentage points in the 13-year period between 1995 and 2008. Greater increases in overweight/obesity prevalence were experienced by rural populations during this same time period (an increase of 18.4 percentage points in rural populations vs. 12.3 percentage points in urban populations) and indigenous groups (18.4 percentage points among indigenous groups vs. 14.9 percentage points among non-indigenous groups)[14]. These results, together with the data presented here, suggest that overweight/obesity is becoming more pervasive throughout different groups and classes in Guatemala.

Many of the maternal variables were highly significantly associated with child WAZ and/or HAZ, including maternal age, height and weight, education level, parity, and ethnicity (indigenous or ladino). Maternal height has been shown to be associated with child nutritional outcomes in other analyses, likely reflecting both the intergenerational transmission of nutritional status from mother to child as well as other factors (biological, cultural, or socioeconomic), both observable and unobservable, that may be associated with maternal height and can affect child nutritional status. In the regression models for HAZ and WAZ, having more than a primary education was associated with a magnitude of effect on these indices that was the largest of the variables included in the regression model (in the case of WAZ, 0.19; for HAZ, 0.23–0.26). The importance of maternal education, and education of women and girls, for the nutritional well-being of children has been identified repeatedly and is a focus of many development programs and goals; the current analysis confirms its importance, particularly in the context of Guatemala.

Maternal pregnancy status at the time of the survey was inversely associated with child WAZ and HAZ, and the magnitude of the effect was fairly large in both cases (−0.15 for WAZ and −0.23 for HAZ). While current pregnancy status is associated with many other covariates that could independently affect these outcomes (e.g., parity, household characteristics and size, variables reflecting socioeconomic status or ethnicity), many of these variables were also included in the model. Therefore, current pregnancy status at the time the child was measured may be capturing an effect on child nutritional status that isn't represented by other maternal or household variables included in the model. Infant feeding variables were not included in the current analysis of predictors of nutritional status of children; if a new pregnancy is associated with weaning of the last-born child (and possibly worsened nutritional status as a result), one possible explanation of the relationship between current pregnancy status and lower child WAZ and HAZ may be through this pathway.

Finally, in the regression models for HAZ and hemoglobin concentration of children, child sex was significantly associated with these two outcome variables, such that male children tended to have lower HAZ as well as lower hemoglobin concentration (the latter was only marginally significant, and in the Western Highlands regression model only). A meta-analysis of data from Demographic and Health Surveys in Africa has shown that male children tend to be at greater risk of stunting than female children[17], with greater inequities in the lower socioeconomic groups. Several studies have also shown that male infants and children tend to be at greater risk of iron deficiency and anemia than females[18].

The current analysis presents an overview of household food security in the Western Highlands of Guatemala, as well as an analysis of how food security and other variables are associated with nutritional outcomes of women of reproductive age and children under 5 years of age. There are several limitations with the current analysis that should be highlighted. As mentioned earlier, the household food security questions reflect only conditions in the previous 1 month, and many of the outcomes being explored here accrue over a much longer time period, thus requiring some assumptions about the food security status of the household over the long term. The current analysis also did not assess the time of year that the survey was implemented to account for potential seasonal patterns of food insecurity (and possibly nutritional status, particularly wasting).[22] In addition, because of the cross-sectional nature of the study, it

[22] Added to this, the ENSMI data were collected between October 2008 and June 2009, which may have missed a period of food scarcity in some departments that occurs between July and September. Because the food security questions largely reflected conditions in the month prior to the survey, omitting this period of the year could potentially affect overall levels of food security.

is impossible to establish a temporal relationship (and thus causality) between food security status and nutritional outcomes. Longitudinal studies, which track these conditions over time, would be better suited for understanding and exploring the temporal nature of the relationship between food security status and nutritional outcomes. Several variables that may also contribute to the nutritional outcomes of interest were not included in the regression models (e.g., infant feeding practices or morbidity among children, iron-folic acid supplementation among women); however, as mentioned previously, the goal of this analysis was to explore the relationship between household food security and nutritional status specifically, not necessarily explore the relationship between all potential explanatory variables and the nutritional outcomes of interest.

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Annex 1. Validation of a Food Insecurity Scale for the ENSMI 2008

Megan Deitchler, FANTA-2/FHI 360 and Mark Nord, Economic Research Service/USDA

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Methods and Results

For the purpose of identifying a valid food insecurity scale from the ENSMI data, we used questions 31 thru 35 (31: Worry about lack of food; 32: Lack of money for food; 33: Eat less because of lack of money for food; 34: Skip a meal because of lack of money; 35: Hungry because of lack of food in the house). We did not include question 36 (36: decrease the quantity of food or eliminate some food because of lack of money) in our analysis because it seemed to us that these elements of food insecurity were already addressed by the preceding questions. We analyzed the data against the Rasch measurement model using conditional maximum likelihood estimation in SAS and applied the household weight variable in all analysis. Any household with missing data for the frequency component of questions 31, 32, 33, 34 or 35 was omitted from the analysis. Given the very small number of households with missing data, we do not expect that our exclusion of these households in any way affected the results below.

Our primary criterion for assessing the fit of the data to the Rasch model was item infit and outfit statistics. Infit and outfit statistics measure the difference between the model's theoretical expectation of how an item should perform and the actual performance of that item. It is desirable to have infits and outfits in the range of 0.7-1.3. However, it is generally agreed that infits are more important than outfits when evaluating the fit of the data to the Rasch model. It is acceptable for outfits to fall outside of the 0.7-1.3 range. In some cases, this indicates items for which comprehension could be improved, but in other cases the high outfit may result from just one or two highly unexpected responses.

We explored the validity of a dichotomous scale (using 2 categories for each question) and a trichotomous scale (using 3 categories for each question based on how often the condition was experienced). For the dichotomous scale, we evaluated if the rarely response category functioned better when combined with the never response category (i.e. never/rarely vs. sometimes/always) or when combined with the sometimes and always response category (i.e. never vs. rarely/sometimes/always).

The first dichotomous scale (never/rarely vs. sometimes/always) was not a good fit to the Rasch model. There appeared to be evidence of two factors being represented by the data, which is a violation of one of the assumptions of the Rasch model. In addition, a relatively small proportion of the entropy of the data was accounted for by the model. The second dichotomous scale (never vs. rarely/sometimes/always) was a much better fit to the Rasch model. Only one factor appeared to be represented by the data (as assumed by the Rasch model), all infits were in the range of 0.7-1.3, and only one outfit ("Worry") fell outside of the desired 0.7-1.3 range (**Table 1**).

Given the poor fit of the first dichotomous scale (never/rarely vs. sometimes/always), we did not explore the never/rarely combined category for the trichotomous scale. Instead, we limited our analysis to a scale consisting of items 31 thru 35 with the rarely response category combined with the sometimes response category (never vs. rarely/sometimes vs. always). The infits and outfits of the trichotomous scale were not as good as those for the dichotomous scale (**Table 2**). In addition, the effective item severity parameters (technically the Rasch-Thurstone thresholds) for the upper threshold of all items clustered together, indicating that the response category of “always” was not able to differentiate varying levels of food insecurity across the different questions. The use of “always” in the questionnaire made the responses to the questions so severe that they became practically unusable. In the future, we would suggest “often” (“frecuentemente”) be used instead of “always” (“siempre”). This might give a more usable trichotomous scale.

We then undertook further analysis of the best performing scale (i.e. the second dichotomous scale, never vs. rarely/sometimes/always) to examine scale performance across language groups. Results of overall model fit by language group suggested the consistency of responses to be somewhat lower for questionnaires in Q’eqchi’ and K’iche’ than in Spanish and Kachikel. These differences were not so great as to be worrisome. However, the consistency of responses for questionnaires in Mam was much lower. Further attention to the Mam translation of scale items and frequency responses would therefore be recommended in the future.

Across language groups (Kachikel, Q’eqchi’, K’iche’, Mam compared to Spanish), we found that the measure was reasonably consistent (**Figure 1**). Although there was a reversal of order (relative to Spanish interviews) between the two least severe items (“Worry” and “No money”), this was so consistent across indigenous language groups that we suspect either a subtle difference in translation that is pervasive, or an actual difference in the experience and management of food insecurity. If the latter is the case, this could be related to a predominance of subsistence agriculture, in which households manage their food supply so they don’t actually run out of food, by eating less and less as stores run low. This could change the relationship between worrying about food shortage and not having enough money to buy food.

Next, we examined how the dichotomous scale items (never vs. rarely/sometimes/always) performed in comparison to the same items in the US food insecurity scale (HFSSM) using Current Population Survey (CPS) 2009 data. The consistency of responses in ENSMI was somewhat better than in the US CPS. This indicates that the ENSMI questions were clear, that respondents paid attention, understood the questions, and responded thoughtfully, and that the objective conditions elicited by the questions were well ordered in the experience of respondents. This bodes very well for the reliability of the measure. In addition, the Rasch item severity parameters for the ENSMI data were similar to those of the US CPS 2009 data (**Figure 2**). This implies that the latent trait – the condition of food insecurity being measured – is pretty similar in the two countries, and that a prevalence estimation based on similarly severe cut-offs would be comparable. In other words, although the prevalence of food insecurity is higher in Guatemala, the measuring stick is nearly invariant to the measuring stick used in the US.

Tabulation Recommendation

Based on the above results, we recommend that questions 31 thru 35 of the ENSMI data be analyzed as a dichotomous food insecurity scale with a “no” response to each question coded as “0” and a “yes” response to each question coded as “1”. A household’s raw scale score can be tabulated by summing a household’s “0”/”1” responses to questions 31 thru 35, with a range of 0 to 5 possible.

To tabulate the percent of households moderately food insecure, or percent of households very food insecure, we suggest that cut-offs be established that are meaningful in Guatemala, and reflect the definition and experience of food insecurity in the country. In the US a cut-off of >=2 and >=4 would be used to reflect these categories of food insecurity, based on the concepts represented by questions 31 thru 35. Households with a raw scale score of 0 or 1 would thus be classified as food secure; households with a raw scale score of 2 or 3 as moderately food insecure; and households with a raw scale score of 4 or 5 as severely food insecure. These same cut-offs would work well for the ENSMI data, particularly given the reversal of order between the least two severe items that was shown in figure 1.

If the assumption underlying figure 1 is correct, that, on average, the five items "mean the same thing" in the various languages, then prevalence rates based on the above cut-offs (>=2 and >=4) would be minimally biased because one of these items is a bit more severe and the other a bit less severe in the indigenous languages than in Spanish, such that the severity indicated by a raw score of "2" would be pretty nearly the same. This is even more true at the putative "severe food insecurity" threshold (>=4), where the severity scores are nearly the same for the two items in all language groups, and the reversals don't mean much. This is a very encouraging result and supports meaningful comparison of prevalence rates across these language groups.

If it is of interest to undertake substantive analysis with the food insecurity scale and explore the extent to which food insecurity is associated with other outcomes (e.g. anthropometry), the above categorical variable could be used, or, if preferred, the household raw scale score could instead be used, given that the raw scale score is linear in terms of the Rasch measure of severity represented by each unit on the scale score (**Figure 3**). Note, however, if the raw scale score is used for substantive analyses, the "0" value should be treated as a dummy variable where households with a score of "0" are coded as "0" and households with a score between 1 and 5 are coded as "1". A separate variable reflecting the raw scale score of households with a value between 1 and 5 should accompany this dummy variable in the analysis.

Finally, it should be noted that for the purpose of this analysis, we ignored the temporal disparity between questions 31 (6 month recall period); and questions 32 thru 35 (30 day recall period). In the future, we recommend the same recall period be used for all questions. The 30 day recall period appeared to perform well for questions 32 thru 35, so it would seem to make sense to use the 30 day recall period for question31 as well. Future surveys in Guatemala may want to consider harmonizing this scale with the Escala Latino-americana/Caribena de Seguridad Alimentaria (ELCSA) in order to be comparable with results from other survey work in Guatemala. In addition, it may be useful to consider incorporating the Household Hunger Scale (HHS) in future surveys in order to provide national HHS data for Feed the Future and Title II Programs.

Table 1. Infit and Outfits for Dichotomous Scale Items (never vs. rarely/sometimes/always)

ENSMI Question Number	Scale Item	Infit	Outfit
31	Worry	1.11	3.72
32	No Money	0.86	1.23
33	Ate Less	0.85	0.94
34	Skipped Meal	0.88	0.76
35	Hungry	0.95	0.84

Table 2. Infit and Outfits for Trichotomous Scale Items (never. vs. rarely/sometimes vs. often)

ENSMI Question Number	Scale Item		Infit	Outfit
31	Worry	(Lower threshold)	1.14	1.31
31	Worry	(Upper threshold)	1.33	3.04
32	No Money	(Lower threshold	0.92	0.79
32	No Money	(Upper threshold)	1.24	2.95
33	Ate Less	(Lower threshold)	0.78	0.73
33	Ate Less	(Upper threshold)	1.05	1.60
34	Skipped Meal	(Lower threshold)	0.79	0.50
34	Skipped Meal	(Upper threshold)	0.76	0.86
35	Hungry	(Lower threshold	0.80	0.48
35	Hungry	(Upper threshold)	0.73	0.91

Figure 1. Comparison of item severity parameters by interview language

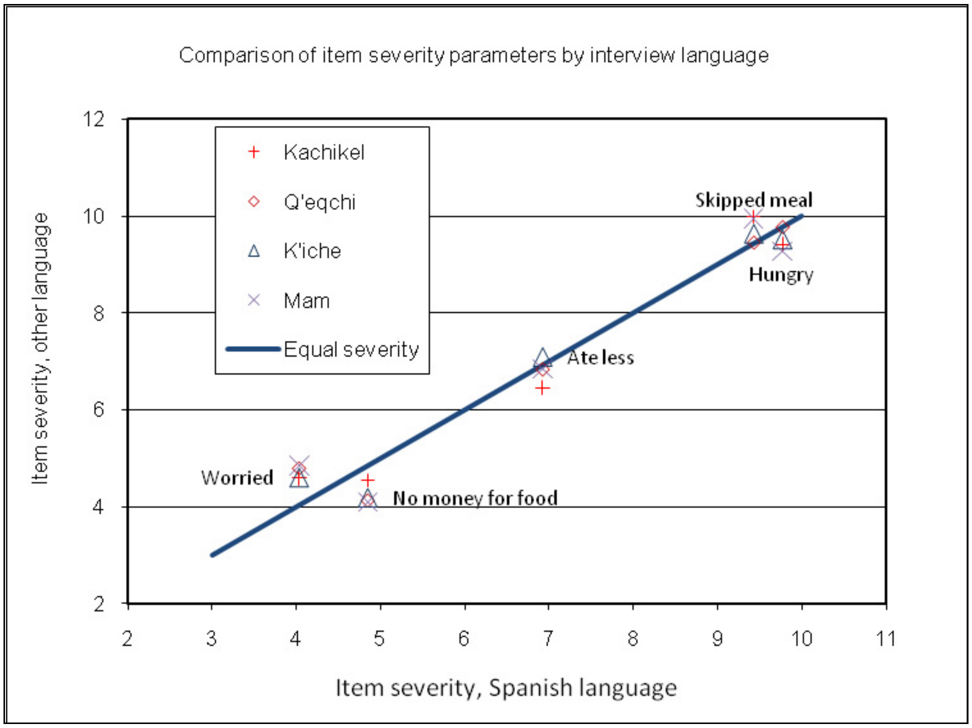

Figure 2. Comparison of severity of equivalent items in Guatemala MCH 2010 survey and U.S. Current Population Survey (2009)

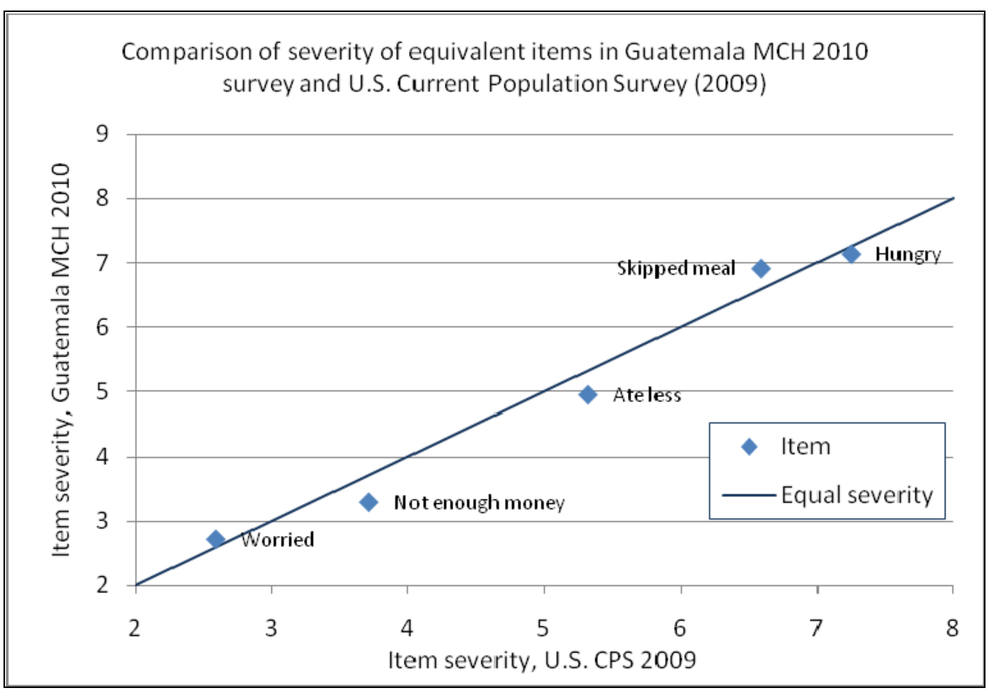

Figure 3. Rasch measure versus raw score on dichotomous scale (to assess extent to which raw score is linear)