

Advances in Developing Country Food Insecurity Measurement

Household Food Insecurity and Food Expenditure in Bolivia, Burkina Faso, and the Philippines^{1,2}

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ABSTRACT This study examined the association between food insecurity, determined by a modified version of the U.S. Household Food Security Survey Module (US HFSSM), and total daily per capita (DPC) consumption (measured as household expenditures) in Bolivia, Burkina Faso, and the Philippines. Household food insecurity was determined by an adapted 9-item US HFSSM version. A short version of the World Bank's Living Standards Measurement Study (LSMS) consumption module measured household expenditures. Focus groups were used to adapt the survey instrument to each local context. The sample ($n \sim 330$ per country) includes residents of urban and rural areas. A 12-month food expenditure aggregate was generated as part of the total household expenditures calculation. DPC food expenditure, which represented over 60% of the total household consumption, as well as expenditures on specific food groups correlated with food insecurity both as a continuous Food Insecurity Score (FinSS) and a tricategorical food insecurity status variable. ANOVA and regression analysis were executed adjusting for social and demographic covariates. Food-secure households have significantly higher ($P < 0.05$) total DPC food expenditures as well as expenditures on animal source foods, vegetables, and fats and oils than moderately and severely food-insecure households. The results offer evidence that the US HFSSM is able to discriminate between households at different levels of food insecurity status in diverse developing world settings. *J. Nutr.* 136: 1431S–1437S, 2006.

KEY WORDS: • food insecurity • per capita food expenditure • Bolivia • Burkina Faso • Philippines

Food security is defined as a state in which “all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preference for an active and health life (1).” In the United States, hunger has been associated with severe levels of food insecurity and

results from the involuntary reduction of food intake and a disturbance in normal eating patterns (2). In 2004, worldwide, over 800 million people were affected by food insecurity, with the vast majority living in developing countries (3). These data, though, understate the prevalence of “hidden hunger,” which is characterized by vitamin and mineral deficiencies without severe clinical symptoms, making the total number of individuals with some degree of either food insecurity or malnutrition probably much higher (4,5).

Hunger has long been a concern of world leaders, as evidenced by the 1948 Universal Declaration of Human Rights (5), stating “Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food. . .” At the 1996 World Food Summit in Rome, Italy, representatives from 186 countries reaffirmed access to adequate, safe, and nutritious food as a fundamental right for inhabitants throughout the world (1). The goal was set to cut the number of hungry people in half by the year 2015. Unfortunately, rather than seeing a decrease in food insecurity, some regions have even experienced an increase since the 1996 World Food Summit (3).

One of the limitations of food security interventions is the lack of adequate program monitoring and evaluation (6). Many

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development organizations and governments are attempting to fight hunger through food security interventions, but valid, low-cost, and easy-to-use household food insecurity measures are needed to monitor and evaluate program impact (7).

The United States Department of Agriculture (USDA)⁴ developed the Household Food Security Survey Module (US HFSSM), a set of questions based on the overall food insecurity experience that can be administered in a survey and reported as either a continuous score of the severity of the phenomenon or as a categorical indicator of food security status (8). Recent research in the United States has confirmed that the US HFSSM is a valid and useful method for measuring household food insecurity (9–14). Freedom from Hunger (FFH) is an international nongovernmental organization based in California and has, since 1946, been offering innovative strategies to help families suffering from chronic hunger and poverty around the world. In 1990, FFH developed the first integrated microcredit/health and nutrition education program: *Credit with Education* (CwE), which currently serves ~330,000 low-income families. Local nonprofit, credit union, or rural bank partners organize Credit Associations (CAs) of ~20–30 members, primarily women, who regularly meet and jointly guarantee each others' loans. FFH identified the US HFSSM as a potentially useful tool for tracking change in clients' food insecurity status and poverty over time.

The US HFSSM and similar tools have been modified and successfully tested in studies conducted with Latinos in California, Venezuela, Mexico, and Ecuador (13–20) as well as in Brazil and Colombia, where adapted and validated local versions of the US HFSSM are currently being used in nationwide health and nutrition surveys (21,22). Outside the Americas, adapted versions of the US HFSSM have been used in the context of emergency situations or humanitarian relief operations (23,24).

Finally, other household food security scales, which use context-specific questions that are slightly different from those in the US HFSSM, have been generated in other developing countries based on in-depth assessments and understanding of the local experiences with food insecurity (25–27).

These research experiences led FFH to undertake a study with the goal of testing the US HFSSM as a proxy for measuring poverty (e.g., total DPC <\$1) in a variety of developing countries where local partners implement the CwE strategy.

The present analysis explores how total food expenditure and expenditures on specific food groups are associated with food insecurity, as measured by our modified versions of the US HFSSM. Food insecurity should be, if measured properly, associated with reductions not only in food quantity but also in food quality (1). The US HFSSM contains items that ask individuals about having to reduce the quantity and quality of their food consumption. Therefore, not only would we expect total food expenditure to decline with increasing food insecurity, as indicated by the US HFSSM, but also expenditures on certain food groups, comprised of higher-quality or more expensive items such as animal-source foods. In order to assess how well the US HFSSM functions across a range of settings and as a proxy indicator of overall and within-group food expenditures, this hypothesis is tested by examining the association between locally adapted versions of the US HFSSM and total DPC expenditures in study settings located in Bolivia, Burkina Faso, and the Philippines (28).

SUBJECTS AND METHODS

A cross-sectional study was conducted to assess the correlation between household food insecurity, determined by a 9-item modified US HFSSM, and DPC expenditures, measured by the consumption module of the Living Standards Measurement Study (LSMS) developed and used by The World Bank (29). The statistical analysis of the datasets in this study was approved by the Internal Review Board on Human Studies at The Ohio State University.

FFH conducted the study in partnership with local CwE-implementing institutions and local research firms. These institutions provided the survey teams and the logistic support to define the study sites and to access CA members. Field work and data collection were conducted between April 2003 and January 2004 by trained local interviewers. Survey interviews were conducted in either Aymara or Spanish in Bolivia, in Mòoré in Burkina Faso, and in Tagalog or English in the Philippines.

Survey instrument

The survey instrument used in Bolivia and Burkina Faso incorporated 2 modules: the modified US HFSSM and the LSMS Consumption Module. For the Philippines, a third group of poverty indicators developed by the Center for Institutional Reform and the Informal Sector at the University of Maryland was added to the survey, but results on this third module are not included in this paper.

Modification of the US HFSSM. The original 18-item US HFSSM was modified to focus only on household and adult food insecurity by excluding the 8 items related to the food insecurity of children (Table 1). This decision was made because differences in children's age and gender, number of children in the household, as well as differences in family structure (e.g., monogamous/polygamous) could affect responses to the children items. As shown in Table 1, another major change, introduced to make the questionnaire easier to understand, was to ask each question in a "yes/no" response format, followed by a frequency-of-occurrence related question (*How often did this occur?*) with 3 response options: *often, sometimes, or rarely*. The only question without a follow-up was related to weight loss (question 8). A third important change was to split the US HFSSM question about adults cutting the size of meals or skipping meals into 2 separate questions

TABLE 1

Adapted U.S. Household Food Security Survey Module (US HFSSM)¹

1	Were you worried that your food would run out before you had money to buy more? A) Yes B) No – Go to question 2 ²
1a	How often did this occur? ³ 1) Often 2) Sometimes 3) Rarely
2	The food you had didn't last, and you did not have enough money to buy more?
3	Did you have to eat the same foods daily because you did not have money to buy other foods?
4	Have you or any other adult in your household cut the size of your meals because you did not have enough money to buy food?
5	Did you skip some of your daily meals because you did not have enough money for food? ⁴
6	Did you ever eat less than you felt you should because you did not have enough money to buy food?
7	Were you ever hungry and did not eat because you did not have money to buy enough food?
8	Did you lose weight because you did not have enough money to buy food?
9	Did you or another adult in your household ever not eat for a whole day because you did not have enough money to buy food?

¹ Time frame of reference for all the questions was the last 12 months.

² All questions had this response format.

³ Follow-up question applied to all questions excepting question 8.

⁴ Daily meal: breakfast, lunch, tea or dinner.

⁴ Abbreviations used: CA, Credit Association; CwE, Credit with Education; DPC, daily per capita; FFH, Freedom from Hunger; FinSS, Food Insecurity Score; LSMS, Living Standards Measurement Study; USDA, US Department of Agriculture; US HFSSM, United States Household Food Security Survey Module.

(questions 4 and 5). These behaviors seem to be quite distinct, indicating different levels of severity of household food insecurity.

Consumption module. LSMS surveys provide robust measurements of multiple aspects of household welfare (covering topics such as housing, education, health, agriculture, expenditures, and income) and have been widely used in developing countries to measure poverty. They have also been used to construct the US\$1 per day and US\$2 per day poverty lines used by the World Bank (30). For the purpose of this paper, only the LSMS modules for household expenditures, and more specifically food expenditures, are used as a point of reference for assessing the US HFSSM.

The survey's consumption module included the following sections: Household roster (household size, age, relationship to respondent, marital status of respondent, head of household, urban or rural location of the household, CwE membership); Education expenditures for each household member (currently enrolled in school, educational level, expenditures on tuition, textbooks, transportation, school uniforms); Food expenditures (Food and cooking fuel [about 75 food items/country]: cereals, meats, fruits, vegetables, legumes, tubers, dairy products, sugar, spices, beverages, oils and fats, and cooking fuel [gas, kerosene, charcoal, wood, etc.]; Food as payment for employment; Food consumed from own business; and Food consumed out of home); Nonfood item expenditures; Daily expenses; Health expenditures; Dwelling expenses and services; Remittances of cash and goods; and Durable goods.

Subjects

In each country, the goal was to interview 300 households. The sample was a convenience sample of CwE clients and nonclients (2/3 and 1/3 of the sample, respectively) with rural and urban residents (2/3 and 1/3, respectively). The study sites were defined by the local FFH partners based on the logistic support they could provide to the study. With a sampling frame based on list of local CAs and CwE clients, CwE client subjects were randomly selected. In the same community, 4–5 nonclient subjects were also interviewed in an effort to broaden the socioeconomic range of the survey sample. The main selection criterion for nonclients was that they did not participate in any microcredit program. Interviewers sought subjects who would be wealthier or poorer than CwE members using the following criteria for the selection: 1) Rural wealthier nonclients were subjects who typically had income-generating activities other than agriculture, especially trading. In urban sites, they were store, small hotel, or restaurant owners. 2) Rural poorer nonclients were subsistence farmers or farm laborers who worked for others and relied on wages. In urban areas, poorer nonclient subjects were people working in services such as shoe shining, or with very small businesses selling bread, fruits, or vegetables.

Study site

The study was carried out in primarily rural areas with a rather small central urban district. In Bolivia, the study took place in Achacachi province ~100 km from the capital La Paz. Located on the high plains of the *altiplano*, Achacachi is characterized by a harsh climate, poor soils, and rich Aymaran culture. In Burkina, the survey was conducted in the capital city Ouagadougou and surrounding areas. CwE members typically invest their loans in agricultural trade, food processing, and stocking agricultural commodities, either to realize profits from price increases or for use in later production. In the Philippines, the study site was the province of Occidental Mindoro. As the seventh largest island in the Philippines, Mindoro's economy is also largely based on agriculture, although with a greater variety of products.

Cognitive testing and field testing of the survey tool

To identify understanding, cognitive, or perception problems, each of the survey instrument's sections (i.e., US HFSSM and expenditures survey) was discussed with the interviewers and CwE staff during several –days of training. Interviewers' local cultural knowledge provided valuable contributions to the instruments' adaptation. Wording of specific questions was revised based on their suggestions. Subsequently, focus groups with CwE clients living in locations similar to the study sites were conducted to examine their understanding of the survey questions. Question wording and acceptability were discussed.

Data analysis

Data analysis was conducted using the software STATA version 8.0 (StataCorp) as well as SPSS version 12.0 (SPSS Inc.).

Modified US HFSSM. Response options to the initial questions in the US HFSSM were “yes” or “no,” and the responses to the follow-up frequency-of-occurrence questions were “often,” “sometimes,” or “rarely.” A set of dichotomous variables was coded 1 for affirmative responses to the initial questions followed by an “often” or “sometimes” response to the follow-up question. Responses of “no” to the initial question, as well as responses of “rarely” to the follow-up were coded with 0, even if the response to the initial question was “yes.” Item responses were summed to calculate the raw scale score, registering the most severe food insecurity that occurred at any time during the year (other than “rarely”). Because there was no follow-up to the question about losing weight, we included it in the scale with “yes” responses coded as 1 and “no” responses coded as 0. The result of this was a raw household food insecurity score (FinSS) ranging between 0 and 9 points, with 0 corresponding to the most food-secure households and 9 to the households most severely affected by food insecurity. Based on the cutoff points suggested by the USDA for a 10-item version of the US HFSSM, a categorical food insecurity status variable was generated with 3 food insecurity levels: Food-secure households (0–2 FinSS points); moderately food insecure households (3–5 points); severely food-insecure households (6–9 points) (31).

Consumption module. An initial procedure to identify outliers and missing data was conducted. For missing data, median values were substituted from subjects with similar characteristics (client/nonclient; urban/rural; age of respondent; amount of the item consumed; frequency of consumption; etc.), as suggested by Deaton (30).

For each consumption module section, aggregates were calculated, as well as an overall total expenditure per household. For all sections on food expenditures (i.e., purchased, consumed from own production, received as gift or payment, consumed from own business or out of home) aggregates were calculated and summed into a total food expenditure value for a 1-y period. Because some foods are purchased, consumed, or received as payment at different times in the year, the survey tool included daily, weekly, monthly, and yearly periods for all food items and cooking fuel. The total food expenditure was divided by the number of household members, those who shared consumption for at least 3 mo during the last 12 mo, as suggested by the World Bank (30). Finally, annual per capita food expenditure was divided by 365 d to create a continuous variable for DPC food expenditure.

Statistics

Statistical analysis was performed separately for each of the study settings. Descriptive statistics were generated for each country sample. DPC total food expenditures, DPC expenditures by food group (cereals, dairy, meats, all animal-source foods, fruits, vegetables, legumes, roots and tubers, oils and fats) and DPC expenditures on cooking fuel as continuous variables were correlated with the raw household FinSS using Pearson correlation tests. DPC expenditures by food group and DPC cooking fuel expenditures were also correlated with the 3-level food insecurity categorical variable using 1-way ANOVA procedures. Differences among food insecurity categories' mean expenditures were examined using Bonferroni multiple-comparison test. An ANOVA model that included several social and demographic covariates was constructed to assess the correlation of DPC total food expenditures and the categorical food insecurity variable. Following ANOVA, a Wald test was used to determine differences in mean food expenditures among food-insecurity categories. With the same covariates, a multiple linear regression model was developed to determine coefficients of DPC expenditures associated with the continuous FinSS.

RESULTS

The total sample size by study setting was: Bolivia = 327 households; Burkina Faso = 330; and the Philippines = 349. **Table 2** shows the sample characteristics for the 3 study settings. In general, the samples included two-thirds CwE program

TABLE 2
Characteristics of the sample

	Bolivia (n = 327)	Burkina Faso (n = 330)	Philippines (n = 349)
Membership in Credit with Education			
Clients	66.7% (218)	63.6% (210)	67.6% (236)
Nonclients	33.3% (109)	36.4% (120)	32.4% (113)
Gender of respondent, % female	83.2%	96.1%	100% (349)
Age of respondent, y	39.3 ± 14.4	38.5 (± 12.5)	37.0 (± 11.6)
Area of residence			
Urban	25.7% (84)	30.9% (102)	13.5% (47)
Rural	74.3% (243)	69.1% (228)	86.5% (302)
Household size, no. of persons	4.9 (± 2.2)	11.4 (± 6.7)	5.3 (± 2.1)
Marital status of respondent			
Married or with partner	76.4% (250)	90.6% (299)	91.4% (319)
Single, widow, divorced	23.6% (77)	9.4% (31)	8.6% (30)
Educational level of respondent			
<Elementary	20.2% (66)	85.8% (283)	20.9% (73)
Elementary	51.1% (167)	10.9% (36)	21.8% (76)
>Elementary	28.8% (94)	3.3% (11)	57.3% (200)
Food insecurity raw score (0–9)			
Affirmative responses, n	4.5 (± 2.7)	5.1 (± 3.1)	2.3 (± 2.5)
Food-security status			
Food-secure (0–2)	29.7% (97)	27.0% (89)	64.5% (225)
Moderately food-insecure (3–5)	26.9% (88)	21.8% (72)	21.5% (75)
Severely food-insecure (6–9)	43.4 (142)	51.2% (169)	14.0% (49)
Consumption/capita/day, US\$	1.7 (± 1.2)	0.7 (± 1.0)	1.1 (± 0.9)
Consumption food share ¹ , %	61.4	66.3	63.4

¹ Proportion of daily per capita total expenditure spent on food and fuel.

clients and one-third nonclients, and over two-thirds of the respondents lived in rural communities. Respondents' average age ranged from 37 to 39 y; the majority were female (83–100%) and married or living with a partner (76–91%). Respondents' educational level was generally low, but it varied from country to country. About 86% of the Burkinabé respondents had not completed elementary school, whereas in the Philippines over 50% of the respondents reported a higher than elementary education. The average household size in Bolivia and in the Philippines was 5 members, which was about half of the average household size in the Burkina Faso sample, where over 40% of the respondents reported living in polygamous households. Mean DPC consumption was higher in Bolivia than in Burkina Faso and the Philippines (US\$1.7, US\$0.7, and US\$1.1, respectively). The proportion of the total DPC expenditures on food and cooking fuel ranged between 61% and 66%. The mean household FinSS was lower in the Philippines (2.3 points) than in Bolivia and Burkina Faso (4.5 and 5.1 points, respectively). The degree of household food insecurity is quite striking: >50% of the Burkinabé respondents experienced severe food insecurity. In Bolivia, 70% of the survey respondents experienced either moderate or severe food insecurity. Consequently, the percentage of food-secure households was higher in the Philippines than in Bolivia and Burkina Faso (65%, 30%, and 27%, respectively).

Bivariate analysis. In the 3 study settings, statistically significant negative correlations were found between the food-

group specific and total DPC food expenditure variables, and the continuous food insecurity score and the tricategorical food insecurity status variable (Tables 3 and 4). In the 3 study settings, the group with the lowest food insecurity score (0 points) showed the highest mean DPC food expenditure (Table 3). A trend toward lower DPC food expenditure is observed as food insecurity scores increase, with a clearer, stronger relation in the Bolivia sample. For all 3 study settings, the food-secure group (FinSS 0–2 points) had a significantly higher total DPC food expenditure compared with each of the food-insecure categories. In the Bolivia sample, total DPC food expenditure was also significantly higher in the moderately food-insecure households (FinSS 3–5 points) than in the severely food-insecure households (FinSS 6–9 points). In the Philippines and in Burkina Faso, the difference between moderate and severe was not statistically significant. Furthermore, no differences in DPC expenditures were found between any of the food insecurity categories in the Burkinabé rural group.

With regard to specific DPC food group expenditures, statistically significant negative correlations with the continuous FinSS were found in all 3 study settings for animal source foods, vegetables, and oils and fats. In addition, significant differences between the food-secure category and the 2 food-insecure categories were found for DPC expenditures for these same food groups. In Bolivia, these differences were found for almost all groups with the exception of expenditures on fish and cooking fuel.

Multivariate analysis. The association between total DPC food expenditure and both the continuous FinSS and the tricategorical food insecurity status variable remained statistically significant once tested in ANOVA and linear regression models with covariates ($P < 0.05$). In order to test the association of

TABLE 3

Pearson correlation between daily per capita food expenditures and food insecurity score by food groups

Food groups	Bolivia <i>R</i>	Burkina Faso <i>R</i>	Philippines <i>R</i>
Animal-source foods ¹	−0.38 ***	−0.31 ***	−0.26 ***
Dairy ²	−0.33 ***	−0.11 *	−0.18 ***
Eggs	−0.18 ***	−0.21 ***	−0.18 ***
Meats ³	−0.34 ***	−0.33 ***	−0.24 ***
Fish	−0.08	−0.13 ***	−0.11 *
Cereals ⁴	−0.23 ***	−0.05	−0.11 *
Tubercles ⁵	−0.25 ***	−0.27 ***	0.05
Vegetables ⁶	−0.25 ***	−0.13 *	−0.17 ***
Fruits ⁷	−0.28 ***	−0.07	−0.16 ***
Legumes ⁸	−0.25 ***	0.04	−0.06
Oils and fats ⁹	−0.20 ***	−0.19 ***	−0.24 ***
Cooking fuel ¹⁰	−0.03	−0.09	−0.07
Total foods ¹¹	−0.39 ***	−0.15 **	−0.27 ***

Significance: * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

¹ All meats, fish, dairy products, and eggs.

² Milk, cheese, cream, and yogurt.

³ Beef, chicken, pork, lamb, llama, sausages.

⁴ Rice, bread, corn, quinoa, corn and wheat flour, biscuits, noodles, couscous.

⁵ Potatoes, sweet potatoes, manioc, cassava, gabi, oca, chuño.

⁶ Tomatoes, onions, carrots, peas, lettuce, eggplant, leafy vegetables.

⁷ Papaya, mango, citrus fruits, bananas, apples, pineapple, avocado.

⁸ Beans, mongo, lentils, garbanzo beans, peanuts.

⁹ Cooking oil, margarine, lard.

¹⁰ Gas, petroleum, wood, charcoal.

¹¹ About 75 food items, cooking fuel, foods received as payment for work, foods consumed out of the home, and foods consumed out of own business.

TABLE 4

Daily per capita food expenditures by food security status¹

Food category		Food security status			P-value
		Food secure	Moderately food insecure	Severely food insecure	
Animal-source ²	Bolivia	3.7 ^a	2.4 ^b	1.8 ^c	0.000
	Burkina Faso	34.4 ^a	20.1 ^b	13.3 ^b	0.000
	Philippines	11.48 ^a	6.89 ^b	5.63 ^b	0.000
Dairy ²	Bolivia	0.85 ^a	0.50 ^b	0.40 ^b	0.000
	Burkina Faso	3.8	1.8	1.1	0.187
	Philippines	1.42 ^a	0.66 ^b	0.53 ^b	0.002
Eggs ²	Bolivia	0.24 ^a	0.17 ^b	0.17 ^b	0.007
	Burkina Faso	1.49 ^a	0.24 ^b	0.18 ^b	0.000
	Philippines	1.18 ^a	0.78 ^b	0.72 ^b	0.005
Meats ²	Bolivia	2.10 ^a	1.30 ^b	0.90 ^b	0.000
	Burkina Faso	19.2 ^a	9.6 ^b	6.1 ^b	0.000
	Philippines	5.37 ^a	2.96 ^b	1.70 ^b	0.000
Fish ²	Bolivia	0.47	0.39	0.37	0.325
	Burkina Faso	9.9	8.4	5.9	0.121
	Philippines	3.51	2.48	2.68	0.084
Cereals ²	Bolivia	1.6 ^a	1.3 ^b	1.1 ^c	0.000
	Burkina Faso	120.2	79.8	95.5	0.055
	Philippines	11.6	9.1	8.6	0.101
Tubercles ²	Bolivia	1.3 ^a	1.1 ^{a,b}	0.84 ^b	0.001
	Burkina Faso	3.68 ^a	1.82 ^b	0.96 ^b	0.000
	Philippines	0.46	0.48	0.80	0.312
Vegetables ²	Bolivia	0.87 ^a	0.75 ^{a,b}	0.59 ^b	0.000
	Burkina Faso	25.7 ^a	15.8 ^{a,b}	15.4 ^b	0.041
	Philippines	2.60 ^a	2.00 ^{a,b}	1.66 ^b	0.016
Fruits ²	Bolivia	0.52 ^a	0.38 ^b	0.32 ^b	0.000
	Burkina Faso	5.26	6.17	4.50	0.635
	Philippines	2.18 ^a	1.08 ^b	1.02 ^b	0.012
Legumes ²	Bolivia	0.06 ^a	0.04 ^{a,b}	0.03 ^b	0.001
	Burkina Faso	16.9	13.8	17.0	0.698
	Philippines	0.67	0.57	0.37	0.413
Oils and fats ²	Bolivia	0.26 ^a	0.19 ^b	0.18 ^b	0.002
	Burkina Faso	11.1 ^a	5.6 ^b	5.5 ^b	0.001
	Philippines	0.62 ^a	0.46 ^b	0.35 ^b	0.001
Cooking fuel ²	Bolivia	0.60	0.52	0.55	0.799
	Burkina Faso	36.0	27.2	25.5	0.300
	Philippines	2.44	1.64	2.31	0.216
Total foods ³	Bolivia	10.56 ^a	7.89 ^b	6.37 ^c	0.000
	Burkina Faso	297.80 ^a	195.06 ^b	211.17 ^b	0.027
	Philippines	41.38 ^a	29.03 ^b	25.38 ^b	0.014

¹ Mean DPC expenditures are reported in local currency (Exchange rate at the time of the study: Bolivianos 7.7/US\$1; CFA Francs 570/US\$1; Filipino Pesos 55/US\$1).

² One-way ANOVA test of significance.

³ Adjusted by membership in the local CwE program; rural or urban location of the household; age, gender, educational level, and marital status of the interviewee; self-perception as head of the household; household size, number of children under 5 years of age, and number of adults over 65 years of age; ownership of the dwelling; and number of durable goods.

Different superscript denote statistically significant differences between food security categories $P < 0.05$.

hold size; number of children under 5 y of age; number of adults over 65 y of age; ownership of the respondent's dwelling (owned/not owned); and number of durable goods. As shown in Table 4 (P -value, last row), differences in total DPC food expenditure between the food-secure households and moderately and severely food-insecure households remained significant in the covariate adjusted ANOVA model, but a statistically significant difference between the moderately and the severely food-insecure group was found only in Bolivia. In the Philippines, a trend toward a lower food expenditure in more food-insecure groups was found, but the difference between the 2 food-insecure categories was not significant ($P = 0.46$). In Burkina, a non-significantly higher food expenditure was found in the severely food-insecure group in comparison with the moderately food-insecure group. When analyzed separately from the rural sample, the Burkinabé urban severely food-insecure households showed the lowest food expenditure when compared with the urban moderately food-insecure and food-secure households (mean DPC food expenditure: 216.3, 227.7, and 431.8, respectively; results not shown in the tables). Nevertheless, statistically significant differences were found only between the food-secure group and the 2 food-insecure categories. Differences between the food-insecure categories were not statistically significant.

With the continuous FinSS (0–9 points) used as an independent variable, the same covariates from the previous ANOVA model were included in a multiple linear regression model. This model was replicated using separately total DPC food expenditure or food group specific DPC expenditures as dependent variables. As shown in Table 5, for each increasing point in the food insecurity score (i.e., deterioration in the food insecurity status), total DPC food expenditure was significantly lower in 2 of the study sites: Bolivia (0.54 Bolivianos) and the Philippines (1.96 Pilipino Pesos) ($P < 0.05$). In Burkina, a nonsignificantly lower food expenditure of 5.08 Francs for each higher point in the FinSS was found ($P = 0.16$). Nevertheless, when the Burkina dataset was analyzed again separately by location of the household (urban/rural), the urban group was statistically significantly lower by 25.45 Francs for each higher point in the FinSS ($P = 0.003$; $R^2 = 0.38$). The rural sample showed no decreasing total DPC food expenditure coefficient with increase in the FinSS.

For specific food groups, the aggregate variable of animal-source food expenditures showed the strongest negative association with FinSS in the 3 countries. DPC expenditures in meats and oils and fats were the food groups with a significantly decreasing expenditure throughout the 3 study settings. Expenditures on other food groups showed a significant negative relationship with food insecurity only for 1 or 2 countries, especially in Bolivia, where the DPC expenditures on vegetables and fruits were significantly higher as the FinSS were lower. These 2 food groups showed a statistically marginal decrease in the Philippines ($P = 0.06$ and 0.1 , respectively). No statistically significant associations with FinSS were found for DPC expenditures in cooking fuel.

DISCUSSION

The results of this study show both the usefulness and limitations of adapted versions of the US HFSSM for evaluating the food insecurity status of vulnerable populations in diverse developing world settings. In general, the findings show the expected negative correlation of US HFSSM outcomes of food insecurity with expenditures on food, especially the decreased consumption of animal-source foods as the level of food insecurity becomes more severe. The strongest correlations were

the categorical food-insecurity variable with DPC food expenditure, an ANOVA model was constructed including total DPC food expenditure as the dependent variable and the following covariates: membership in the local CwE program (yes/no); rural or urban location of the household; age, gender, educational level, and marital status of the interviewee; self-perception as head of the household; household size, number of children under 5 years of age, and number of adults over 65 years of age; ownership of the dwelling; and number of durable goods.

TABLE 5

Multiple regression coefficient of daily per capita food expenditure by Food Insecurity Score^{1,2}

Food group	Bolivia (Bolivianos)			Burkina (CFA Francs)			Philippines (Filipino Pesos)		
	Regression coefficient	P	R-Square	Regression coefficient	P	R-Square	Regression coefficient	P	R-Square
Total foods	-0.54	0.000	0.42	-5.08	0.155	0.20	-1.96	0.001	0.23
Animal-source foods	-0.21	0.000	0.37	-2.10	0.000	0.23	-0.57	0.009	0.25
Dairy	-0.07	0.000	0.21	-0.22	0.291	0.09	-0.11	0.018	0.20
Eggs	-0.01	0.012	0.14	-0.14	0.002	0.09	-0.04	0.186	0.14
Meats	-0.12	0.000	0.32	-1.41	0.000	0.20	-0.34	0.016	0.20
Fish	-0.01	0.598	0.13	-0.33	0.234	0.12	-0.08	0.387	0.14
Cereal	-0.04	0.021	0.26	0.27	0.893	0.09	-0.56	0.038	0.09
Tubercles	-0.09	0.000	0.26	-0.24	0.002	0.22	0.03	0.334	0.05
Vegetables	-0.04	0.000	0.25	-1.01	0.089	0.10	-0.10	0.061	0.17
Fruits	-0.02	0.000	0.23	-0.17	0.478	0.04	-0.12	0.101	0.20
Legumes	-0.01	0.003	0.13	0.26	0.62	0.07	-0.02	0.553	0.06
Oils and fats	-0.01	0.05	0.23	-0.49	0.019	0.13	-0.03	0.009	0.25
Cooking fuel	-0.01	0.572	0.08	-0.70	0.412	0.11	-0.03	0.703	0.06

¹ Adjusted by membership in the local CwE program; rural or urban location of the household; age, gender, educational level, and marital status of the interviewee; self-perception as head of the household; household size, number of children under 5 years of age, and number of adults over 65 years of age; ownership of the dwelling; and number of durable goods.

² Coefficients are reported in local currency (Exchange rate at the time of the study: Bolivianos 7.6/US\$1; CFA Francs 570/US\$1; Filipino Pesos 55/US\$1) per one-point difference in food security score.

found for DPC expenditure on meat, followed by DPC expenditure on dairy in Bolivia and the Philippines, and DPC expenditure on eggs in Bolivia and Burkina Faso. These findings suggest that those households facing food insecurity, even at moderate levels, might have a very poor dietary quality, characterized by the low intake of micronutrient-rich foods. In the case of DPC expenditure on fish, though, these were not different by food insecurity status, which is likely the result of the wide availability of fish in the Bolivian and Philippine settings, closely located to Titicaca Lake and the South China Sea, respectively. In Burkina Faso, expenditures in fish were very low, representing only 3% of the total DPC food expenditure.

Statistically significant negative correlations were also found with other food groups, such as oils and fats, vegetables and fruits, and even cereals and tubers, which are considered local staple foods. Despite the differences found in the Philippines with respect to the cereals group, when rice expenditures were examined separately, no differences were found among the 3 food insecurity categories. In regard to staple foods, significant differences were also found in DPC expenditures on roots and tubers in Bolivia, where they represented 13% of the DPC food expenditure. This fact is of concern because it suggests that severely food-insecure Bolivian households may have limited access even to potatoes, the main local staple food. In addition, Bolivian food-insecure households showed a significantly lower fruit expenditure than food-secure households, which suggests a lower dietary variety as food insecurity levels increase. In contrast with the other 2 settings, the Bolivian study site is characterized by high altitude and low soil fertility. As a result, the most commonly consumed fruits (citrus and bananas) are imported to the area, making them less affordable for poorer households.

Even though no differences were found in total fuel expenditures in any of the study settings, the consumption of less affordable types of cooking fuel (e.g., liquefied petroleum gas) was higher in the food-secure households. Conversely, the consumption of wood and charcoal was higher among food-insecure households when compared with food-secure households.

The findings in this study are consistent with other research using modified versions of the US HFSSM, which found

significant negative correlations of household food insecurity with food intake assessed by self-reported food inventory measurements (19–21,25,26,32). Nevertheless, the present study dealt with several limitations. First, in none of the study settings were enough time and resources available for a comprehensive qualitative assessment of the US HFSSM. As previously described, the primary feedback came from local interviewers, which was supplemented by 2 focus groups with CwE clients. Because the study objective was to test a relatively simple and uniform approach in multiple settings, the focus was only to refine the survey instrument so that it was understandable to respondents. Psychometric assessment of the modified US HFSSM versions can also be very helpful in assessing this tool's performance as a whole and for individual items. A Rasch scaling analysis conducted later (results not shown in this paper) showed that the Bolivian and Philippine US HFSSM versions had better psychometric characteristics than the US HFSSM version used in Burkina Faso (33). Those findings also showed that the US HFSSM had a poorer performance in the Burkina Faso rural sample than in the urban group, which was confirmed by the stronger correlations found in this urban subsample. No significant differences between the urban subsamples with the rural groups were found in Bolivia and Philippines. A second limitation in this study is the homogeneity of the selected samples, which mainly included low-income rural households with rather low educational level. An additional factor affecting the type of selected sample relates to the fact that two-thirds of the subjects were members of CwE programs, which intentionally aim to work with very poor population groups. The addition of about 100 CwE nonclient subjects may have helped to introduce more variation in the samples. Finally, the outcomes of the multiple linear regression model need to be interpreted taking into account that the raw FinSS used as the dependent variable does not reflect the actual interval for each unit increase in the score.

Regardless of the limitations mentioned above, the findings suggest that modified versions of the US HFSSM can be very useful in assessing the food insecurity status of low-income population groups. For practitioners, the food insecurity scale is a practical and cost-effective approach whose results correlate

well to expenditure estimates but that requires only a fraction of the cost to collect and analyze. It represents for CwE institutions and field workers an instrument that can be regularly applied to complement their efforts in evaluating the impact of their programs by adding a component that relates in a more direct way to their clientele's own food insecurity and hunger perception. The significant correlations found in this study between food expenditure and the modified versions of the US HFSSM in such a diversity of locations, which would imply a great deal of variation in the causes and consequences of household food insecurity among the 3 settings, seems to confirm the consistency and universality of the concepts that framed the construction of the US HFSSM. A more detailed assessment of each of the items in our modified US HFSSM versions is a next step for understanding their consistency across the countries in the study. In addition, other construct components of the food insecurity phenomenon need to be explored separately or in combination with the US HFSSM. As stated by other researchers, there seem to be a "core of the phenomenon common to all contexts that can be tapped for measurement purposes" (34).

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