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Food insecurity and household food supplies in rural Ecuador

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SUMMARY. The objective of this research is to assess the validity of a modified US Household Food Security Survey Module (HFSSM) through its correlation with food supply and demographic factors, and its fitness using Rasch model analysis in rural Ecuador. This study examines the relationship between household food insecurity and household food supplies in 52 Ecuadorian households. The sample was drawn from four rural communities participating in the project PLAN in Cantón Quijos. Questionnaires included a modified HFSSM, a household food shelf-inventory and demographic characteristics. Multiple ANOVA analysis resulted in statistically significant inverse relationships between household food insecurity and total food supply, as well as the supply of meat, vegetables, legumes, oils, and other food products (p=0.05). Rasch model measure values on the HFSSM illustrated food insecurity at different levels of severity. The majority of the items (>75%) presented adequate infit values. This study affirms that the proposed modified HFSSM may be useful to measure food insecurity and thus be used as a tool to monitor and evaluate programs aimed at improving quantity and variety of food items in rural Ecuador.
Key words: Food security, food supply, Rasch model, Ecuador.

RESUMEN. Inseguridad alimentaria y suministro de alimentos en hogares rurales de Ecuador. El objetivo de esta investigación es evaluar la validez de una escala doméstica de seguridad alimentaria modificada (HFSSM – en inglés: *Household Food Security Survey Module*) por medio de su correlación con el suministro de alimentos y características demográficas, así como su ajuste al modelo de Rasch en un área rural de Ecuador. En este estudio examinamos la relación entre la inseguridad alimentaria doméstica y el suministro de alimentos del hogar en 52 familias ecuatorianas. La muestra fue sacada de cuatro comunidades rurales participantes en el proyecto PLAN en el Cantón Quijos. Los cuestionarios aplicados incluyeron la HFSSM modificada, un inventario de despensa del hogar y características sociodemográficas. El análisis estadístico usando un modelo de ANOVA múltiple, mostró resultados inversamente significativos en la relación entre el nivel de seguridad alimentaria doméstica y el número total de alimentos disponibles, así como respecto a el suministro de carnes, verduras, legumbres, grasas y otros alimentos (p=0.05). Los valores de medida (*measure values*) de los insumos en la HFSSM usando el modelo Rasch muestran que la inseguridad alimentaria se presenta a diferentes niveles de severidad. La mayoría de las preguntas (>75%) presentaron valores de infit apropiados. Este estudio confirma que la HFSSM modificada puede ser útil para medir la inseguridad alimentaria y por eso puede ser usada como una herramienta para monitorear y evaluar programas enfocados en mejorar la cantidad y variedad de alimentos en el área rural de Ecuador.
Palabras clave: Seguridad alimentaria, suministro de alimentos, modelo Rasch, Ecuador.

INTRODUCTION

The conceptualization of food security incorporates "access by all people, at all times, to enough food for an active, healthy life (1, 2)." Food insecurity is a problem that affected over 800 million people worldwide in 2005, especially in rural areas in developing countries (3). However, these data do not take into account the large number of individuals suffering from "hidden hunger", which is characterized by vitamin and mineral deficiencies affecting over one third of children in some of the poorest regions (3, 4).

As a result of international collaboration efforts at the end of World War II, the 1948 Universal Declaration of Human Rights was adopted. Among other basic human rights, this document states that "everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food…" (5) In 1996, representatives from nearly all countries met at the World Food Summit in Rome, Italy reaffirming that the access to adequate, safe and nutritious food is an inherent human right throughout the world (6). At that meeting, the goal was established to cut the number of hungry individuals in half by the year 2015, but as opposed to a decrease, some regions have experienced lagging or worsening in the prevalence in hunger (3).

Several development organizations and government agencies are involved in hunger reduction efforts, where valid and inexpensive household food insecurity indicators are critical to monitor and evaluate the impact of the programs (7). The lack of adequate program monitoring and evaluation is one of the main limitations in evaluating numerous nutrition interventions in developing countries (8). Without the ability to determine the short-term and long-term effects of these programs, humanitarian agencies have limited ability to influence policy makers.

Because the most commonly used indicators to measure access to food are expensive and technically very difficult to manage, programmers need household food insecurity measurements that are simple to apply, low-cost, easy to evaluate and closely approximate the actual level of food insecurity in the home (9). The measurement of household food insecurity is critical in addressing the problem because it allows for the estimation of prevalence and better targeting of high risk population groups (8). Therefore, accurate information provided by these measurements permits the development of programs that work effectively to decrease the depth and breadth of food insecurity.

The construction of food security surveys must be well-grounded and based on in-depth studies. The results from the surveys need to coincide with empirical data and maintain consistency in response patterns, while giving an unbiased assessment (10). Precision and dependability in what is being measured must be reflective of what is actually occurring in the home. The Rasch model is a test which affirms this by investigating the unidimensionality and fitness of psychometric questionnaires (11). Criterion validity is measured by in-depth analysis comparing results against other variables such as social, economic and demographic factors already known to be related to food insecurity. These include income, employment, education and the use of food programs (10). For the last 15 years, questionnaire-based measures of hunger and food insecurity have been developed and validated according to specific parameters. In order to meet the needs of programmers, the United States Department of Agriculture (USDA) developed the HFSSM that takes into consideration the overall hunger experience and categorizes this phenomenon by its severity level (12). Current research in the United States has confirmed the validity of the HFSSM as an inexpensive, easy to use and analyze method for measuring household food insecurity (10, 13-18). With some exceptions, similar or modified HFSSM tools have not been tested consistently or exhaustively for validity outside of the US, but studies have never been done in to validate the HFSSM in rural Ecuador with individuals participating in a grassroots program (19-26).

MATERIALS AND METHODS

As a part of a larger study, PLAN (Planificación Local de la Agricultura y la Naturaleza- Community Planning for Sustainable Livestock-based Forested Ecosystems) researchers assessed household food insecurity in four rural Ecuadorian communities located in Canton, Quijos, Province of Napo. Convenience sampling was done to include all 54 households participating in PLAN located about 80 miles east of Quito, Ecuador's capital city. Demographic data regarding migration patterns, mothers' education, physical characteristics of the house, government aid, and community location were gathered. Household food supply at the time of the interview was estimated using an adapted Household Shelf Food Inventory Questionnaire used in previous studies in other Latin American countries (Appendix A, B) (20). The HFSSM, which consists of 15 statements plus three follow-up questions on frequency-of-occurrence, was translated into Spanish and then modified using focus groups for acceptability in the region (17, 18). For the purposes of this study, we excluded the three frequency-of-occurrence questions. The surveys were conducted by trained local interviewers.

Validity is a critical component in the evaluation of a survey and there are many different methods used to determine this characteristic of the tool. Criterion validity consists of the comparison of the survey tool to a gold standard previously determined to measure the phenomenon in question. In this study, criterion validity was established by comparing the modified HFSSM to household food stores at time of the interview. Fitness of the tool as well as severity level of the questions, were determined using Rasch model analysis.

Household food security status

To analyze the household food security data, each positive response was coded "1", whereas all negative responses were coded "0". A Food Security Score (FSS) was created from the sum of the positive responses to the items included in the HFSSM ranging from 0 to 15; the higher the FSS, the more food insecure the household. Originally the sample included 54 households, and two of them responded negatively to all of the questions, having therefore a FSS of zero. These two "fully" food secure families were removed from the subsequent analysis and the remaining families were divided into two categories of food insecurity status based on the number of positive answers (n=52). The following categorization is based on the difference in content of the questions, since initial HFSSM items relate to qualitative aspects of the available food, and more severe statements refer to quantitative decrease: 15-items HFSSM [Food insecure without hunger (FSS= 1-6), Food insecure with hunger (FSS = 7)].

In addition, based on research conducted in the US to generate a children's food security scale, food insecurity status was categorized separating the adult related questions in the HFSSM from the children related questions (27). This process resulted in two sub-modules: Adult Food Security Survey Sub-Module (AFSSM - 8 questions) and Children Food Security Survey Sub-Module (CFSSM - 7 questions). Only those households with children were included in the analysis of the CFSSM (n=41). These sub-modules were categorized as follows: AFSSM [Food insecure without hunger (FSS = 1-3); Food insecure with hunger (FSS = 4)]; CFSSM [Food insecure without hunger (FSS= 1-3); Food insecure with hunger (FSS = 4)].

Rasch model

Applying the one parameter logistic Rasch Model to the HFSSM dichotomous data provides a mathematical framework to data (28). The more food secure the individuals, the more likely they will respond negatively to easier questions. Food quality questions (questions 1 to 6) are more likely to be answered affirmatively than hunger questions (questions 7 to 15).

In the Rasch model, the "measure values" demonstrate the relative severity of each of the questions in correspondence to the actual food insecurity status of the interviewees (21). This means that a household with a relatively low food insecurity level (mildly food insecure) will have more 'difficulty' answering positively to the more severe questions than a household with higher food insecurity level (severely food insecure). Each item difficulty (household food insecurity severity level) and persons "ability" is estimated on a logit scale with has a degree of error associated with each of the estimates. Consequently, the ideal "measure value" would be a continuous positively ascending line showing that the questions increased in difficulty throughout the survey tool.

Item performance deviations such as infit values can be assessed to determine variation from expected fit to the Rasch Model. The infit values in the Rasch model, based on the comparison between observed and expected responses, are derived from a chi-squared test that gives more weight to unexpected answers closer to the actual household food insecurity status (29). The expected mean of the infit is one with a possible range from zero to positive infinity. Infit values higher than one signify a fit to the model with more variation than expected (29). Values below one signify a better than expected fit or less variation than the model predicts in the observed response pattern (29). The acceptable range of infit values is 0.7 to 1.3 for samples less than five hundred (29). Taking into account the small sample size in this study, and based on ranges used by other authors, a wider range to evaluate misfit was be applied to these data (0.6 – 1.4) (30).

Statistical analysis

Analysis was conducted using STATA for Windows, version 8.2 (StataCorp, College Station, Texas, USA). In order to determine criterion validity of the HFSSM, AFSSM, and CFSSM, food insecurity was initially correlated, in a bivariate mode, to the number of total food items and the total number of items in each of the following food groups: dairy, cereals, snacks, vegetables, fruit, legumes, beverages, oils, meats, animal products (including dairy, meat and eggs), condiments, and processed products (including processed beverages). Those groups with significant p-values ($p = 0.05$) in the bivariate analysis were then analyzed using multiple ANOVA models controlling for demographic characteristics of the household significantly associated with food insecurity (chi-squared test p-value = 0,05;): mothers' educational level, household size, community, food purchase patterns, age of interviewee, production and consumption of milk.

To perform Rasch Model analysis the software Winsteps 3.6 (Winsteps, Chicago, IL) was used. The Rasch Model was used to determine the fitness of the HFSSM (28) by application to all three scales: HFSSM, AFSSM, and CFSSM.

RESULTS

Demographics

There were 31 (59.6%) households experiencing food insecurity without hunger at the time of this interview, and 21 (40.4%) were in a situation of food insecurity with hunger. Descriptive statistics on the characteristics of the sampled households are presented in Table 1. Households were located in four neighboring communities with 94% interviewees being female head of household. Most of the participants had a middle school level of education and the majority could read and write (88.7%). The analysis of demographics uncovered correlations between food insecurity levels and characteristics of the mothers. Mothers' educational level correlated negatively with household food insecurity level for all households and households without children ($p<0.01$). As the number of years of school attendance increased the severity of food insecurity decreased. In addition, mothers' age correlated positively with food insecurity as measured by the AFSSM ($p<0.05$). As the mothers' age increased the severity of food insecurity increased. There were no statistically significant correlations between food insecurity status and household size, government assistance, house construction material, source of water supply, food cultivation, animal husbandry or milk production.

HFSSM

The percentage of affirmative responses to the HFSSM showed a decreasing trend as the severity of the question increased. In addition, there was a large decrease from 68.5% to 28.4% in the percentage of affirmative responses between 'no eating correct food' and 'adults skipped meals,' effectively dividing the questions into two groups (questions 1 through 6, and 7 through 15). This fits with the classification proposed earlier of two food insecurity categories divided according to decreased quality or quantity.

Food supply

Using all three food insecurity modules, HFSSM, AFSSM, and CFSSM, a statistically significant difference was found in the mean number of total food items between the food insecure households with and without hunger. Statistically significant differences in the number of food supplies between food insecure with hunger and without hunger were found using the HFSSM for the following food groups: meat,

vegetables, legumes, oils, processed products, beverages, snacks, and condiments (Table 2).

TABLE 1
Characteristics of the households (n= 54)

Characteristic	
Community [2]	
One	20.4 (11)
Two	7.4 (4)
Three	37.0 (20)
Four	35.2 (19)
Age [1]	45.4 (15.7)
Education [1]	6.3 (3.8)
Attended school [2]	87.0 (47)
Household size [1]	5.5 (2.3)
Total Foods [1]	55.9 (22.6)
Food Security Score (FSS) [1]	6.5 (3.7)
Food Security Level [2]	
Food Insecure without Hunger	59.6 (31)
Food Insecure with Hunger	40.4 (21)
Receive government aide [2]	59.3 (32)
Earthen floor [2]	7.4 (4)
House Wall Materials [2]	
Adobe	17.0 (9)
Wood	83.0 (44)
Water Sources [2]	
Indoor plumbing	13.0 (7)
Water from stream	18.5 (10)
Water from public water tank	66.7 (36)
Other	1.9 (1)
Gardens [2]	
Vegetables	59.3 (32)
Fruit trees	46.3 (25)
Corn	61.1 (33)
Beans	61.1 (33)
Animals [2]	92.6 (50)
Chicken	88.9 (48)
Cow	81.5 (44)
Hog	46.3 (25)
Duck	22.8 (15)
Milk production [2]	90.9 (40)

[1] Mean (Standard Deviation), [2] % (n)

TABLE 2
Number of food items by food insecurity status (n=52) [1, 2]

Food Group [3]	Food Insecurity Status (FI)		p-value
	FI without Hunger [4]	FI with Hunger [5]	
All Foods	63.71	39.17	0.003
Vegetables	11.29	6.72	0.001
Oils	2.79	2.11	0.003
Processed Products	5.44	2.5	0.01
Snacks	1.21	0.17	0.01
Beverages	4.62	2.94	0.02
Meat	2.97	1.56	0.03
Legumes	2.82	1.83	0.04
Condiments	5.09	3.72	0.06
Cereals	7.88	6	0.25
Fruit	7.21	4.83	0.25
Dairy	1.68	0.89	0.34

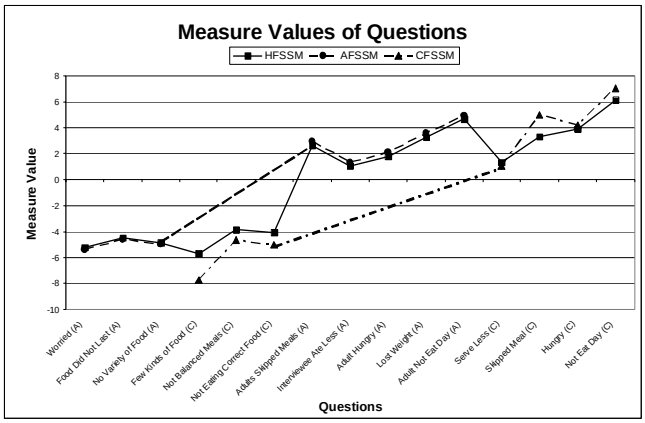
[1] Mean number of food items by food group.
[2] Multivariate ANOVA analysis of food items by household food insecurity status, adjusting for mothers education level, mothers age, number of individuals in home, purchase patterns, production of milk, and community.
[3] Dairy products: powdered milk, pasteurized milk, fresh cow milk, goat milk, cream, nata, yogurt, and cheese. Cereal products: cornflakes, wheat, oats, barley, roasted corn, tapioca, quinua, corn, bread, sweet bread, corn tortillas, corn flour, wheat flour, tortilla, tamales, noodles, rice, mote, pinol, milled corn, canguil, and barley flour. Vegetables: avocado, cauliflower, carrots, corn, gherkin pickles, papanabos, onions, garlic, broad beans, chilis, potatoes, sweet potatoes, sweet pumpkins, beets, cabbage, tomatoes, peppers, radishes, yucca, green leafy vegetables, tree tomatoes, red onions, celery, bell peppers, and mellocos. Legumes: beans, lentils, peas, nuts, coconut, tocte, garbanzo beans, peanuts, lima bean flour, and pea flour. Fruits: apple, pear, banana, plantain, berry, prickly pear, watermelon or melon, orange, grapefruit, mandarin orange, lemon or lime, mango, papaya, pineapple, babaco or chamburs, grape, strawberry, orito, little orange, guava, grenadine, taxos, passion fruit, cherry, plantain flour, blackberry, nogale, capuli, wild grape, and claudia. Oils and fats: butter, margarine, oil, lard, and vegetable oils. Beverages: coffee, medicinal herbs, tea, soda, beer, alcohol, juice, drink mix, and chocolate drink mix. Snack foods: saltines, cookies, cakes, chips, caramels, other cookies, and gelatin. Meats: beef, pork, sausage, giblets, chicken, fish, wild animals, sardines, and tuna fish. Condiments: mayonnaise, mustard, ketchup, salt, sugar, condiments, vinegar, squares of magi, vanilla, unrefined sugar, yeast, cinnamon, anis, and achiote. Processed foods: cornflakes, sweet bread, saltines, cookies, cakes, chips, caramels, other cookies, gelatin, sardines, tuna fish, squares of magi, soda, beer, alcohol, drink mix, chocolate drink mix and coffee.
[4] n=31
[5] n=21

Increased adult household food insecurity, as determined by the AFSSM, correlated with lower number of vegetables, beverages, snacks, oils, and processed products ($p= 0.05$). Children food insecurity derived from the CFSSM correlated with decreased number of vegetables, legumes, fruits, and oil ($p< 0.05$).

Rasch model

As the severity of a question increases, so does the measurement value among the three food insecurity modules. For all three scales (HFSSM, AFSSM, and CFSSM) the lines followed an increasing trend in 'measure values', with some variations in the pattern of response (Figure 1).

FIGURE 1
Rasch measure value of household food security (household, adult and child scales). (A) adult focused question. (C) child focused question



For the HFSSM, nearly the same value was given to the questions 'not balanced meals served to children' and 'children not eating correct foods.' Questions 'adults skipped meals,' 'adult not eat whole day' and 'serve less to children' did not follow the general upward trend. Within the AFSSM, 'Adults skipped meals' was the only question outside of the trend of increasing measurement values. The questions 'not balanced meals served to children' and 'children not eating correct foods' had nearly the same values in the CFSSM.

There was variation of the infit values for all 15-items from 0.36 to 1.55. We used a range of 0.6 to 1.4 for infit values resulting in eleven items within the acceptable parameters. The items outside of the range for the HFSSM included the following: 'children were given few kinds of food,' 'adults skipped meals,' 'interviewee ate less' and 'less food was served to children.'

DISCUSSION

The purpose of this study was to test an adapted version of the HFSSM for appropriateness in measuring household food insecurity in rural Ecuador. The overall pattern of affirmative responses to the HFSSM descended following the same patterns and empirical data in another location (29). This follows the conceptualization in the US that the HFSSM can be understood as a measure that quantifies a range of behaviors from least to most severe situations known to reflect food related stress (22). A negative association was found between the educational level of mothers and food insecurity status, consistent with results from Trinidad and Tobago (31). Criterion validity was established using correlations to household food supply and statistically significant differences were found in food supplies and household food security. Although differences in cereals and dairy products were not statistically significant, the trends followed the same direction as the others in the 15 question HFSSM (Table 2). The stronger correlations associated food groups with the 15 question HFSSM may be due to the larger total sample size (n=52) compared to the CFSSM, which included only the 41 households with children. Even though significant correlations were not found between food insecurity and other demographic and economic variables (i.e., household size, government assistance, house construction material, source of water supply, food cultivation, animal husbandry or milk production), this could be related to the small size and the low variability in the sample. Most of the households in the area where the study took place were farmer families, whose main income source was milk production. In addition, most of the families had at least some domestic animals, they practiced some kind of agricultural food production, the construction materials used in the houses were very similar, as well as the main sources of water. The size of the households did not vary by food insecurity status, with five to six family members in average. Since most of the families in this area have a low-income status, almost two thirds received governmental assistance, which did not allow for identifying statistically significant differences among them with regards to their food insecurity status.

The Rasch Model has been used extensively to confirm the validity of the HFSSM (31, 22). Measurement values from Rasch Modeling in the complete HFSSM, were almost identical in severity for questions 'not balanced meals served to children' and 'children not eating correct foods,' suggesting the questions are addressing the same level of household food insecurity (Figure 1). Question 'adults skipped meals' had a higher level of severity than the following two questions suggesting that it should be moved to after the question 'adult hungry' because it is related to a decrease in quantity of food as opposed to the former questions. 'Adult not eat whole day'

appears to fit better after the question 'children hungry,' which implies that in this region the children experience hunger and have decreased food available before the parents go without food for the entire day.

The AFSSM had only one point slightly outside of the expected position for 'adults skipped meals,' which confirms the idea of moving this question regarding amount of food after the two following questions regarding the quality of food. In the CFSSM, the questions 'not balanced meals served to children' and 'children not eating correct foods' where nearly the same as in the complete scale measure values once again demonstrating these questions may have the same conceptual severity for the interviewees and may be repetitive. An interesting variation found in the CFSSM was the higher severity for question 'children skipped meals' than 'children hungry' which warrants further investigation to determine which one is a coping strategy of households with more severe food insecurity. In this study we encountered no unusual behavior in the 'balanced food' question as previously reported (20, 25).

During the last five years, studies to validate the HFSSM or similar surveys have been conducted in Latin American countries: Brazil (20), Bolivia (21), Colombia (22), Mexico (23, 24), Venezuela (19, 32) and Trinidad and Tobago (25). Although different criterion variables and internal validity tests were frequently used in these studies, the results from our research in Ecuador matched their trends and confirmed the appropriateness of the HFSSM to determine food insecurity level of the household.

In Campinas, Brazil an adapted HFSSM was translated to Portuguese based on in-depth focus groups (20). Criterion validity of the tool was established using food intake and income strata based on minimum wages earned. These two variables were compared to food insecurity levels as opposed to household food supply which was used in this study in Ecuador. Food intake is more directly related to the actual nutrition level of individuals in the household but results were comparable to the interactions of food inventory and food insecurity in Ecuador. Researchers in Campinas found a dose-dependent relationship between food insecurity and income and food insecurity and food intake (20). Households at lower income stratus were less food likely to be food secure. As food intake decrease, the food insecurity of the household also decreased. This study had a larger sample size (n=125), and included both rural and urban areas (20).

In a study conducted in 2003 by Freedom from Hunger in Bolivia, investigators used food expenditure as a comparison to the adapted HFSSM (21). Food expenditure per capita was found to be significantly correlated to food insecurity levels. This was particularly evident in expenditure of total foods, animal source foods, fruits and vegetables for both moderately and severely food insecure households. These results demonstrated that the adapted HFSSM was appropriate for use in rural and urban settings in Bolivia (n=327) (21).

As with research in Ecuador, household food insecurity was compared to household food supply in Antioquia, Colombia using a regionally representative sample (n=1,624) (22). Researchers were primarily concerned with the internal validity which was established using Rasch modeling. The food insecurity score and food diversity of household food supply (total foods) showed an inverse correlation; as food insecurity increased, diversity of food decreased. The researchers asserted that an adapted HFSSM is appropriate for measuring food insecurity levels in the department of Antioquia (22).

Income strata, similar to the variable used in Brazil, and consumption were used as criterion variables in Mexico City, Mexico (23). This study demonstrated that household food insecurity was inversely correlated with household food consumption adding weight to the criterion validity of the HFSSM. Specifically, there was a decrease in fruit, fruit juices, vegetable, meats and dairy products as food insecurity increased. Food staples such as beans, eggs and tortillas were not associated with food insecurity in Mexico, whereas in Ecuador cereals, fruit, and dairy were not significantly associated. The difference in these food staples and their relation to food insecurity may be related to the nature of diets in different areas of the Latin America.

In Sierra de Manatlán, Jalisco, Mexico, researchers compared the variety of diet and food supply with levels of food insecurity (n=133). Variety of food in the diet was determined by three day food records. Researchers also found that as food insecurity increased the variety of diet decreased, as did the consumption of food (24). In this area there were a limited number of households that were food secure as was found in Ecuador, but even with the homogeneity in the population there were still differences between the food insecure groups with and without hunger.

Poor households in peri-urban Caracas, Venezuela were also used as a sampling population to test the HFSSM (n=238,155) (19, 32). Monthly income per person was positively associated with household food security (32). The less the individuals in the household earned, the more severe the mothers perceived their food insecurity. In addition, households with a greater number of children experienced higher levels of food insecurity (32). Food insecurity was also correlated with food diversity, as it was in Colombia. As food insecurity increased, the diversity of food decreased (19).

In the Caribbean islands of Trinidad and Tobago, researchers have evaluated the English version of the HFSSM for validity (n=3,858) (25). Adult and children items were divided and analyzed separately to determine calibrations using one parameter and two-parameter models to determine the fitness of the data. Researchers concluded that a one-

parameter model is generally sufficient to determine fitness of the HFSSM, as was the model used in our analysis (25). In relation to criterion validity of the HFSSM in Trinidad and Tobago, food insecurity was associated with monthly household income; as income increased, food insecurity decreased (25).

Our study in Ecuador confirmed our adapted version of the HFSSM is a viable option for determining household food insecurity in rural Ecuador. Comparisons of the HFSSM to household food inventory demonstrated the criterion validity. Rasch modeling affirmed the internal consistency of the questions in regards to severity. Additional research is needed with a larger, more heterogeneous population to confirm our findings on a larger scale.

Limitations of study

The small convenience sample size (n=52) was a limiting factor in this study, as was the homogeneity of the households. The similarity between the households made it difficult to find a strong variation between them, whereas a heterogeneous sample would enable a more universal picture of what is occurring in Ecuadorian households. Even though the households were very similar in their socioeconomic profile, statistically significant differences between the groups with or without hunger were still found, and the trends were still consistent with studies done in the US and other countries, adding strength to the HFSSM as a valid measure of food insecurity. In this study there were not enough fully food secure households (n=2; food security score=0) to include in the bivariate and multivariate statistical analysis. Both households had a total food inventory score (84 and 63), which was above the average (55.9). The interviewees also had an education level in years that was similar to the average or higher (6 and 12).

Another limiting factor for the results of this study was that only one criterion (household food inventory) was used to correlate to the HFSSM. Other indicators closely related to food insecurity must be added in future research to confirm that other aspects of this phenomenon are taken into consideration with the HFSSM.

Implications for research and practice

The adapted HFSSM is a suitable option as an inexpensive, simple to use tool to measure food insecurity in rural Ecuador. In the future, researchers throughout Latin America may be able to use an adapted HFSSM to measure levels of household food insecurity at local and national levels. Although there is no magic bullet to eliminate hunger and food insecurity, the HFSSM may play a role in teasing out possible causes. As the HFSSM continues to be validated in additional locations, it will be useful to target high nutrition risk groups to develop strategies for creating sustainable food systems. Another important use for this tool will be in the evaluation of programs set up to household food insecurity to determine their effectiveness, thus the HFSSM can play a critical part in policy planning in Latin America.

REFERENCES

1. Food a fundamental human right. Rome, Italy. Food and Agriculture Organization of the United Nations. 1996.
2. Anderson SA. Core indicators of nutritional state for difficult to sample populations. *J Nutr* 1990;120(1):1557S-1600S.
3. Food and Agriculture Organization of the United Nations. The state of food security in the world 2005: eradicating world hunger- key to achieving the millennium development goals. Rome, Italy. 2005. Available at: http://www.verticalfarm.com/pdf/FAO2005.pdf. Accessed May 5, 2006.
4. Ruel MT. Can food-based strategies help reduce vitamin A and iron deficiencies? Washington, D.C. *International food policy research institute.* December 2001.
5. All human rights for all. Fiftieth anniversary of the universal declaration of human rights. Geneva, Switzerland. United Nations High Commissioner for Human Rights. 1998. Available at: http://www.un.org/Overview/rights.html. Accessed July 11, 2005.
6. Food: a fundamental human right. Vaile delle Terme di Caracalla, 00100 Rome Italy. Food and Agriculture Organization of the United States. Available at: http://www.fao.org/ Accessed April 8, 2004.
7. Wolfe WS, Frongillo EA. Building household food security measurement tools from the ground up. *Food Nutr Bull.* 2001;22:5–12
8. Gillespie S, McLachlan M, Shrimpton R. Combating malnutrition - time to act. Washington, D.C. World Bank Health, Nutrition. *Population Peer Reviewed Series.* 2003.
9. Swindale A, Bilinsky P. Development of a universally applicable household food insecurity measurement tool: process, current status, and outstanding issues. *J Nutr.* 2006; 136: 1449S–1452S.
10. Frongillo EA. Validation of measures of food insecurity and hunger. *J Nutr.* 1999;129(2S Suppl):506S-509S.
11. Sapin C, Simeoni MC, El Khammar M, Antoniotti S, Auquier P. Reliability and validity of the VSP-A, a health-related quality of life instrument for ill and healthy adolescents. *J Adolesc Health.* 2005;36:327-36.
12. Radimer KL, Olson CM, Campbell CC. Development of indicators to assess hunger. *J Nutr.* 1990;120 Suppl 11:1544-8.
13. Derrickson JP, Fisher AG, Anderson JE. The core US Household Food Security Survey Module scale measure is valid and reliable when used with Asians and Pacific Islanders. *J Nutr.* 2000;130(11):2666-74.
14. Rose D. Economic determinants and dietary consequences of food insecurity in the United States. *J Nutr.* 1999;129(2S Suppl):517S-520S.
15. Kaiser LL, Melgar-Quiñonez HR, Lamp CL, Johns MC, Sutherlin JM, Harwood JO. Food security and nutritional outcomes of preschool-age Mexican-American children. *J Am Diet Assoc.* 2002;102(7):924-9.

16. Wolfe WS, Olson CM, Kendall A, Frongillo EA. Hunger and food insecurity in the elderly- its nature and measurement. *J Aging Health.* 1998;10(3):327-350.
17. Melgar-Quinonez H, Kaiser LL, Martin AC, Metz D, Olivares, A. Inseguridad alimentaria en latinos de California: observaciones de grupos focales. *Salud Pub Mex*. 2003;45(3):198-205.
18. Harrison GG, Stormer A, Herman DR, Winham DM. Development of a Spanish-language version of the U.S. household Household Food Security Survey Module. *J Nutr.* 2003;133(4):1192-7.
19. Lorenzana PA, Mercado C. Measuring household food security in poor Venezuelan households. *Public Health Nutr.* 2002;5(6A):851-7.
20. Pérez-Escamilla R, Segall-Corrêa AM, Maranha LK, Sampaio MFA, Marín-León L, Panigassi G. An adapted version of the U.S. department of agriculture food insecurity module is a valid tool for assessing household food insecurity in Campinas, Brazil. *J Nutr.* 2004;134:1923-1928.
21. Melgar-Quinonez HR, Zubieta AC, Mknelly B, Nteziyaremye A, Gerardo MF, Dunford C. Household food insecurity and food expenditure in Bolivia, Burkina Faso, and the Philippines. *J Nutr*. 2006;136:1431S-7S.
22. Álvarez M C, Montoya C, Estrada A, Melgar-Quiñonez H. Validación de escala de percepción de la seguridad alimentaria doméstica en Antioquia, Colombia. Submitted to *Salud Publica Mex.* 2006.
23. Pérez-Escamilla R, Parás P, Dolkar T, Melgar-Quiñonez H. The USDA food security module is a valid tool for assessing household food insecurity in Mexico City. *The Faseb Journal*. 2005;19(5)Abstract;748.4:A1350.
24. Melgar-Quiñonez, H., Zubieta A.C., Valdez E., Whitelaw B., Kaiser L. (2005) Desarrollo de un instrumento para monitorear inseguridad alimentaria en la Sierra de Manantlán, Jalisco. *Salud Publica Mex.* 47(6):413-422.
25. Gulliford MC, Nunes C, Rocke B. The 18 Household Food Security Survey items provide valid food security classifications for adults and children in the Caribbean. *BMC Public Health*. 2006; 8;6(1):263.
26. Gulliford MC, Mahabir D, Rocke B. Reliability and validity of a short form household food security scale in a Caribbean community. *BMC Public Health*. 2004; 6;4:22.
27. Nord M, Binkle G. Measuring children's food security in U.S. households, 1995-99. Washington, D.C. *Economic Research Service, US Department of Agriculture*. Available at: www.ers.usda.gov/publications/fanrr25 Accessed: Nov 8, 2005.
28. Nord M, Andrews M, Winicki J. Frequency and duration of food insecurity and hunger in US households. *J Nutr Educ Behav.* 2002;34(4):194-200.
29. Bond TG, Fox CM. *Applying the Rasch Model Fundamental Measurement in the Human Sciences.* Mahwah, New Jersey: Lawrence Erlbaum Associates; 2001.
30. Hwang JL, Nochajski SM, Linn RT, Yow-Wu B. The development of the School Function Assessment- Chinese version for cross-cultural use in Taiwan. *Occup Ther Int.* 2004;11(1):26-39.
31. Gulliford MC, Mahabir D, Rocke B. Food insecurity, food choices, and body mass index in adults: nutrition transition in Trinidad and Tobago. *Int J Epidemiol*. 2003 Aug;32(4):508-32.
32. Lorenzana PA, Sanjur D. Abbreviated measures of food sufficiency validly estimate the food security level of poor households: measuring household food security. *J Nutr.* 1999 Mar;129(3):687-92.

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