

Household food insecurity associated with stunting and underweight among preschool children in Antioquia, Colombia

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ABSTRACT

Objective. To assess criterion validity of a household food security scale through its associations with child health status in participants of the Colombian Plan for Improving Food and Nutrition in Antioquia (Mejoramiento Alimentario y Nutricional de Antioquia (MANA)).

Methods. A 12-item household food security survey (Colombian Household Food Security Scale, CHFSS) was applied to a cross-sectional stratified random sample of 2 784 low-income households with preschool children receiving MANA food supplements in Antioquia, Colombia. Anthropometrics and health status of the children were also assessed. Chi-square tests were used to initially compare child health status and household food security status. Logistic regression models were further developed to assess this relationship in bivariate and multiple regression models.

Results. Statistically significant associations were found between household food insecurity and diagnoses of children's diarrhea, respiratory infections, and parasitosis ($P < 0.0001$). The risk for child stunting and underweight increased in a dose-response way as food insecurity became more severe.

Conclusions. Our research establishes an important link between household food insecurity and child nutritional status in participants of a food assistance program. The results affirm the criterion validity of the CHFSS, establishing the proposed instrument as a valid measure for food insecurity with high-risk populations.

Key words

Food security, child preschool, child malnutrition, validity of tests, Colombia.

Food insecurity is defined as "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" (1). Food insecurity affects health and well-

being throughout the life cycle and has been associated with child dietary intake and weight status (2–4). Household food insecurity may be related to protein energy malnutrition evident in stunting, wasting, and underweight, which affects one-quarter of the world's children (5–7).

Food security is of great significance worldwide as governmental and non-governmental agencies rally to reach the United Nations' Millennium Development Goal of cutting hunger in half by the year 2015 (8). To meet this goal in Colombia, the regional government of Antioquia began the Plan for Improving Food and Nutrition in Antioquia,

Colombia (Mejoramiento Alimentario y Nutricional de Antioquia (MANA)) in 2002. This nutrition intervention targeted preschool-aged children in low-income households (9). In 2006, Colombian researchers spearheaded the first extensive evaluation of the food supplement component of MANA to the current nutritional and food security status of MANA participants (10).

Valid measures of food security form a critical component of monitoring the progress and achievement of the Millennium Development Goal. The measurement of food security allows governmental and development agencies to

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estimate the prevalence of this phenomenon, better target high-risk populations, and evaluate the impact of programs at the household level (11). With the use of a valid tool, organizations can appropriately channel resources to reduce epidemic levels of food insecurity and hunger. To our knowledge, this paper presents the first criterion validation research project on a household food security scale applied to participants of a food assistance program by comparing food insecurity measures with health conditions in children.

MATERIALS AND METHODS

Criterion validity of the Colombian Household Food Security Scale (CHFSS) was assessed using data collected May 2006 from a cross-sectional stratified random sample representative of the 200 000 MANA participants in the department of Antioquia, Colombia. Sample size was calculated by Colombian researchers using EpiStat[®] software. A maximal regional error of 0.05% resulted in a sample of 2 784 low-income households with preschool children. Thirty-six trained interviewers met with child caregivers at local hospitals to administer semistructured face-to-face questionnaires after a signed informed consent was collected. Data were reviewed on site by a fieldwork coordinator and confirmed or recollected as necessary. A secondary review was done as results were imputed into the computer, and 10% of the questionnaires were reviewed a third time. The ethics committee at the Faculty of Medicine at The University of Antioquia approved data collection, and the Institutional Review Board at The Ohio State University approved analysis of the resulting database.

Household demographics

The questionnaires included the following components in addition to the CHFSS: participation in other assistance programs, consumption of MANA powdered milk packets (25 grams (g) each), MANA crackers (30 g each), and grams of fortified vegetable flour (Bienestarina). Demographic variables consisted of area of residence (urban or rural), housing characteristics, age of parents and participating child, household size, number of siblings in the household, and previous month's income.

Anthropometrics

Child height was measured using a portable stadiometer sensitive to the nearest 0.1 centimeter (cm). Weights were obtained with a portable electronic scale (Tanita) sensitive to the nearest 100 g. Lengths of children from 6 to 23 months were measured with a portable aluminum infantometer designed for the study with a sensitivity of 0.1 cm. Three generally accepted anthropometric indices were used to approximate children's nutritional status: height-for-age Z-score (HAZ), weight-for-age Z-score (WAZ), and weight-for-height Z-score (WHZ) (12). Z-score was used to distinguish between normal and stunted or risk for stunted (HAZ < -1), underweight or risk for underweight (WAZ < -1), and wasted or risk for wasted (WHZ < -1) children for the logistic regression and chi-square tests.

Child health status

Caregivers were also asked if the target child had either diarrhea (defined as three or more liquid bowel movements within 24 hours) or a respiratory infection in the previous two weeks. Possible acute respiratory infections included rhinopharyngitis, common cold, ear or sinus infection, laryngitis, bronchitis, pharyngoamygdalitis, croup, bronchiolitis, and pneumonia. Blood samples were collected from the child to assess hemoglobin and ferritin concentrations. Hemoglobin was measured with HemoCue azidemethemoglobin techniques and ferritin was quantified with chemiluminescent immunoassays (13, 14). Anemia was established by using a cutoff of < 11 milligrams (mg) of hemoglobin per deciliter (dL) of blood. Fecal samples were collected from every child at the time of the interview and were assessed at the Intestinal Parasite Lab at the University of Antioquia, Department of Medicine. A classic formalin-ether concentration technique (Ritchie) was used to analyze the feces (15). Any type of parasite (helminthes, protozoan, or ameba) found in the child's stool resulted in a positive coding for parasites.

Household food security scale

For nearly 20 years, researchers have created and validated qualitative methods to measure food security experiences

in questionnaire format (16). One of the first modules developed for the Community Childhood Hunger Identification Project (CCHIP) was based on the Massachusetts Nutrition Survey (1983), in which researchers defined hunger as food insufficiency due to lack of resources (17). In 2003–2004, researchers in Antioquia, Colombia, conducted a validation study using this tool, the CHFSS, previously translated, modified, and applied in Venezuela (18).

The CHFSS consisted of 12 questions about the experiences of food insecurity as a result of financial constraint over the previous month. Each item was followed by a question on frequency of occurrence, which assessed how often a given condition occurred. A negative response to the initial item was coded as "0," and the follow-up questions were coded as rarely = 1, sometimes = 2, and always = 3. The sum of all responses gave a food security score ranging from 0 to 36, with 0 representing the most food secure and 36 the least. On the basis of this raw score, household food security status was categorized by using the following cut-off points: (1) households with a household food security score of 0 were considered food secure, (2) households with a score of 1–17 were labeled as mildly food insecure, (3) households with scores of 18–26 were categorized as moderately food insecure, and (4) households with scores of 27–36 were grouped into a severe food insecurity category (19).

Statistics

These data were analyzed by using Stata for Windows software version 8.2 (StataCorp, College Station, TX). Descriptive statistics were calculated for demographic, anthropometric, child's health, and food insecurity variables. The relation of child health outcomes to food insecurity was examined by using the Mantel-Haenszel chi-square test for ordered categorical variables. Logistic regression procedures were used in both the bivariate and multivariate analysis to examine risk of malnutrition by food insecurity level. We report results as significant at 95% confidence intervals (20).

RESULTS

Mean income the month before the interview was 259 785 Colombian pesos (US\$ 129.89) and average household size

TABLE 1. Descriptive statistics of low-income households with preschool children participating in 2006 evaluation of the food supplement component of the Plan for Improving Food and Nutrition in Antioquia (MANA) in Antioquia, Colombia (n = 2 784)

Characteristic ^a	No.	%
Urban area of residence	1 287	46.3
Food security status		
Food secure	1 343	48.2
Mildly food insecure	1 056	37.9
Moderately food insecure	280	10.1
Severely food insecure	105	3.8
Health status		
Respiratory infection ^b	1 605	57.7
Acute diarrhea ^b	631	22.7
Parasites ^b	1 460	70.8
Anemia ^b	194	7.0

^a Mean age, 41.1 ± 17.3 months; mean hemoglobin concentration, 12.9 ± 1.3 milligrams per deciliter; mean ferritin concentration, 28.5 ± 20.0 micrograms per liter.

^b Within two weeks before interview.

was 5.7, with a standard deviation of 2.4. Sample characteristics in Table 1 show that participating children had an average hemoglobin concentration of 12.9 mg/dL (anemia < 11 mg/dL) and an average ferritin level of 28.5 micrograms (µg) per liter (L) of blood (anemia < 12 µg/L). Most households had access to water (80.5%), sewage facilities (59.2%), and electricity (86.2%). Fewer than half the households were categorized as food secure (48.2%) and more than one-third were mildly food insecure (37.9%). One-tenth of the sample was categorized as a moderately food insecure household and 3.8% exhibited severe food insecurity. Most children had a positive diagnosis for parasites (70.8%) and reported respiratory infections within the two weeks before the interview (57.7%). Only 22.7% of the children had diarrhea within the same time frame, and only 7.0% were diagnosed as anemic.

Anthropometrics

Table 2 shows that most children presented normal HAZ (57.9%), WHZ (70.2%), and WAZ (62.5%). Missing data accounted for the loss of 62 children in the analysis. The prevalence of stunting or risk for stunting was 42.1%, while the prevalence of underweight or risk for underweight was 37.5%. The prevalence of wasting or risk for wasting was 18.7%. A small percentage of the sample were characterized as overweight (9.8%) or

TABLE 2. Anthropometrics of preschool children participating in 2006 evaluation of the food supplement component of the Plan for Improving Food and Nutrition in Antioquia (MANA) in Antioquia, Colombia (n = 2 722)

Anthropometric measure (Z-score)	No.	%
Height for age		
Risk of stunting (< -1 and -2)	845	31.0
Stunting (< -2)	265	9.7
Severe stunting (< -3)	38	1.4
Weight for height		
Overweight (+1 and +2)	266	9.8
Obese (> +2)	36	1.3
Risk of wasting (-1 to -2)	391	14.4
Wasted (-2)	80	2.9
Severely wasted (< -3)	37	1.4
Weight for age		
Risk of underweight (-1 and -2)	705	25.9
Underweight (< -2)	254	9.3
Severely underweight (< -3)	62	2.3

obese (1.3%) as measured by WAZ. When WHZ was used, even smaller percentages of the sample were overweight (4.2%) or obese (0.7%).

Household food security status

Household food security status was statistically significantly associated with child parasites, respiratory infections, and diarrhea (Table 3). Missing data for the following variables caused a decrease in sample: parasites (n = 6), diarrhea (n = 5), and respiratory infections (n = 3). Higher percentages of these illnesses were found in severely food insecure households.

Stunting or risk of stunting, as well as underweight or risk of underweight, showed a statistically significant inverse association with household food security status: the more food insecure the household, the higher the prevalence of stunted or risk of stunted and underweight or risk of underweight children. In contrast, wasting and risk of wasting did not show a significant association with food security status.

Covariates in a multiple logistic regression model included anemia, parasites, diarrhea, gender of head of household, area of residency, household size, father's age, mother's age, income, animals in the house, refugee status, high-risk area, sewage, water in house, electricity, water in kitchen, type of house, number of milk packets consumed per week, grams of Bienestarina consumed per week, and packets of crackers consumed per week (Table 4). Approximately one-half of the sample (n = 1 299) was lost in the model because of missing item responses. Following a dose-response pattern, children in food insecure households (mild, moderate, and severe) showed a statistically significantly higher risk for stunting or risk of stunting in the multiple logistic regression model compared with children in food secure households (P < 0.05). Children living in moderately and severely food insecure households also showed statistically significantly higher risks for underweight or risk of underweight than those living in food secure households (p < 0.05).

TABLE 3. Bivariate associations between potential risk factors and various levels of food security of low-income households with preschool children participating in the 2006 evaluation of the food supplement component of the Plan for Improving Food and Nutrition in Antioquia (MANA) in Antioquia, Colombia

	Food secure		Mild food insecurity		Moderate food insecurity		Severe food insecurity		P value
	No.	%	No.	%	No.	%	No.	%	
Stunting or risk of stunting ^a	498	38.0	450	43.4	136	49.5	64	63.4	< 0.0001
Underweight or risk of underweight ^a	453	34.6	399	38.5	115	41.8	54	53.5	< 0.0001
Wasting or risk of wasting ^a	248	18.9	192	18.5	47	17.1	21	20.8	0.84
Parasites ^b	652	66.7	577	72.6	164	77.4	67	82.7	< 0.0001
Acute diarrhea ^c	245	18.3	257	24.4	91	32.5	38	36.2	< 0.0001
Respiratory infection ^d	703	52.4	659	62.5	173	61.8	70	66.7	< 0.0001

^a n = 2 722.

^b n = 2 062.

^c n = 2 779.

^d n = 2 781.

TABLE 4. Probability of stunting and underweight in preschool children from low-income households participating in 2006 evaluation of the food supplement component of the Plan for Improving Food and Nutrition in Antioquia (MANA) in Antioquia, Colombia (n = 1 485)

	No.	%	Odds ratio (95% CI) ^a	Adjusted odds ratio (95% CI) ^b
Stunting				
Food secure	498	38.0	1.00 (reference)	1.00 (reference)
Mild food insecurity	450	43.4	1.25 (1.06, 1.48)	1.28 (1.00, 1.63)
Moderate food insecurity	136	49.5	1.60 (1.23, 2.07)	1.58 (1.08, 2.31)
Severe food insecurity	64	63.4	2.82 (1.85, 4.29)	2.65 (1.37, 5.14)
Underweight				
Food secure	453	34.58	1.00 (reference)	1.00 (reference)
Mild food insecurity	399	38.51	1.18 (1.00, 1.40)	1.11 (0.87, 1.42)
Moderate food insecurity	115	41.82	1.36 (1.04, 1.77)	1.47 (1.01, 2.15)
Severe food insecurity	54	53.47	2.17 (1.45, 3.27)	1.89 (1.00, 3.55)

^a CI = confidence interval.

^b Multivariate logistic regression adjusted for anemia, parasites, diarrhea, gender of head of household, area of residency, household size, father's age, mother's age, income, animals in the house, refugee status, high-risk area, sewage, water in house, electricity, water in kitchen, type of house, number of milk packets, grams of Bienestarina, and packets of crackers.

DISCUSSION

The purpose of this study was to test an adapted version of the CHFSS for appropriateness in measuring household food insecurity of MANA participants in Antioquia, Colombia. This validation research provides nutrition interventions worldwide with a tool that can be adapted to their specific evaluation needs. The broader implications of this study address the need for measures of food insecurity for nutrition interventions in the developing world. A novel outcome of this study includes the quantification of child stunting and underweight by food security status within a food assistance population when adjusted for associated covariates. An unexpected result of this study is that both child stunting or risk of stunting and underweight or risk of underweight status were significantly associated with household food insecurity, but wasting was not.

In Bogota, Colombia, food insecure children were almost three times as likely to be underweight as food secure children, while stunting was not significantly associated with food security when controlling for covariates (21). The prevalence of food insecurity in Bogota was 24% higher than the rates in the MANA sample. This large difference may be associated with differences in the tool applied in the two settings. Whereas researchers in Antioquia applied a locally adapted tool derived from the CCHIP instrument for our study, in Bo-

gota researchers applied the U.S. Household Food Security Survey Module. The latter contains 16 items, some of which are different from those included in the CHFSS. In addition, the children sampled in Bogota were not the subject of a food assistance intervention like the one administered to Antioquia children through MANA.

In comparison, in Guapi, Colombia, food insecurity status showed a positive association with both stunting and wasting of Afro-Colombian children (6). The differences in the association of wasting with food insecurity may be the result of differences in the recall time of the questionnaires used in the studies or in the definitions of wasting. The Guapi survey used a recall time of six months, and the Antioquia study asked the caregivers about the situation in the previous one month. The difference in associations observed may indicate that participation in the MANA food supplement program played a role in protecting the children against wasting.

In our sample, the highest proportions of stunted, underweight, and wasted children were found in the most food insecure households. Likewise, in Pakistan, household food insecurity was statistically significantly associated with child stunting (7). Conversely, in Korea, households with mildly food insecure and hungry children had the largest proportion of overweight children (4). This difference could be due to the small subsample of overweight or obese children

in our study, which is one of the limitations of our results.

The high prevalence of children with parasites in this study is consistent with research in Mexico, where more than half the school children had intestinal parasitic infections and polyparasitism (22). One limitation to our research is the lack of information on which specific parasitic infections were diagnosed. Such data would have enabled us to add to the model only parasites known to compromise nutritional status. Nevertheless, the presence of any parasite indicates poor housing, sanitation, water supplies, health care, education, and personal earnings (23). Another limitation of this study is that the data on illnesses were reported by the caregivers. Nevertheless, the questions were specific and interviewers explained the symptoms of the illness conditions that constituted a response as positive.

This research presents an important comparison of household food security status and child nutritional status of participants of a food assistance program in Colombia. Our findings affirm the criterion validity of the CHFSS with this high-risk population. Consequently, this tool may be of great use to other food assistance programs regardless of country or continent. The implications of this study are critical for governmental and nongovernmental agencies throughout the world that need valid, easy to apply, and inexpensive tools to measure the household food security status of high-risk populations. As different institutions assess household food insecurity to determine prevalence and vulnerability, as well as to evaluate the impact of their interventions, a measurement tool with validity in diverse settings allows for comparability of the data. Future studies are needed to evaluate the proposed food insecurity instrument at different points in time before, during, and after intervention projects are carried out to determine whether this tool represents a reliable option to assess nutrition interventions.

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RESUMEN

Inseguridad alimentaria en los hogares asociada con el retraso del crecimiento y el bajo peso en niños preescolares de Antioquia, Colombia

Objetivo. Evaluar la validez de una escala de seguridad alimentaria en hogares mediante su asociación con el estado de salud de niños participantes en el plan colombiano Mejoramiento Alimentario y Nutricional de Antioquia (MANA).

Métodos. Se aplicó una encuesta de seguridad alimentaria en hogares (CHFSS), compuesta por 12 preguntas, a una muestra transversal estratificada y aleatoria de 2 784 hogares de bajos ingresos con niños preescolares que recibían suplementos alimenticios del programa MANA en Antioquia, Colombia. Se evaluó el estado de salud y antropométrico de los niños. Se comparó el estado de salud de los niños y de seguridad alimentaria de los hogares mediante la prueba de la ji al cuadrado. Se elaboraron modelos de regresión logística para evaluar esa relación mediante regresiones bifactoriales y multifactoriales.

Resultados. Se encontraron asociaciones estadísticamente significativas entre la inseguridad alimentaria de los hogares y el diagnóstico de diarrea, infecciones respiratorias y parasitosis en los niños ($P < 0,0001$). El riesgo de retraso del crecimiento y bajo peso en los niños se incrementó según una relación dosis-respuesta a medida que se agravaba la inseguridad alimentaria.

Conclusiones. Se estableció un vínculo importante entre la inseguridad alimentaria de los hogares y el estado nutricional de los niños participantes en un programa de asistencia alimentaria. Estos resultados confirman la validez del CHFSS, por lo que este instrumento es válido para evaluar la inseguridad alimentaria en poblaciones en alto riesgo.

Palabras clave

Seguridad alimentaria, preescolar, trastornos de nutrición del niño, validez de las pruebas, Colombia.