January 2016

Food Insecurity In San Pedro, Ecuador: The Association Of Food Insecurity With Dietary Diversity And Bmi

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Food insecurity, dietary diversity and BMI in San Pedro, Ecuador

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A Thesis Presented to the Faculty of the Yale School of Public Health in Partial Fulfillment of the Requirements for the Degree of Master of Public Health

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April 2016

Abstract

Background: Limited research has examined the association between food insecurity and both dietary diversity and body mass index (BMI) in rural, Ecuador.

Methods: A cross-sectional analysis was conducted on a sample of 237 patients and family members visiting a primary care community clinic. To determine food security level, the Escala Latinoamericana y Caribeña de Seguridad Alimentaria (ELCSA) was employed. Outcome was measured using the Household Dietary Diversity Score (HDDS) and BMI was deduced using measured height and weight. These measures were then evaluated in their associations with food security level, adjusting for wealth stratum for the HDDS variable.

Results: As severity of food insecurity increased, the prevalence of normal weight decreased and the prevalence of overweight increased. However, these findings did not reach statistical significance (p=0.316). A statistically significant association was found between HFI and HDDS: as severity of food insecurity increased, low HDDS increased substantially from 18.2% to 54.7%, while high HDDS decreased from 63.7% to 22.7% ($p < 0.001$). Fruit, meat and milk consumption decreased as household food insecurity worsened ($p = 0.035$, $p = 0.009$, and $p = 0.003$, respectively).

Conclusions: Future studies should follow the impacts of food insecurity on both dietary diversity and BMI given the ongoing nutrition transition in Ecuador.

Introduction

Over the past several decades, developing countries have been undergoing a rapid nutrition transition that has led to a shift toward reliance on highly processed foods (1). These changes are of great concern given the strong association between the consumption of processed foods that are high in fat and sugar and obesity, which increases the risk of chronic diseases such as diabetes, hypertension, heart disease and a number of cancers (2, 3). However, the reasons for the increase in obesity are not completely understood, as in some countries obesity is associated with wealth and hence more food-abundant environments, while in other countries obesity is associated with poverty and hence limited availability of high quality food (4). Thus, it may be that food insecurity leads to the consumption of obesity promoting foods.

Food insecurity, the limited or uncertain availability of acquiring nutritionally adequate and safe foods in socially acceptable ways, has been postulated to be a factor in the increasing rates of overweight and obesity (5, 6). A study conducted among U.S. adults found that those who experienced food insecurity had 32 percent greater odds of being obese compared with adults living in food secure homes (7). In fact, this relationship has been consistent among women in the US, Europe and Australia, all high-income countries (8). However, in Latin America, the association between food insecurity and obesity remain mixed in evidence. While in Brazil food insecurity has been associated with excessive weight, in Colombia, food insecurity has been associated with underweight and not overweight or obesity (9-11). Given that the nutrition transition is underway in Latin America and that obesity rates are climbing, it is important to understand additional factors that are associated with obesity (12, 13).

As with BMI, food insecurity may also influence individuals' diet diversity. Dietary diversity is the measure of number of foods or food groups consumed over a given time period. Achieving a diverse and nutritious diet seems to be a problem that is reflected in the high rates of obesity in many Latin American countries (14). Although higher dietary diversity increases the consumption of essential micronutrients such as fiber and vitamin C, higher dietary diversity may also be linked with increased energy consumption and hence high BMI (15, 16). However, few studies have looked at this association and hence the linkages between food insecurity and dietary diversity, and therefore the potential impact on BMI, remain unclear (17).

Given the impact that obesity can have on health, it is important to understand the relationship between food insecurity and both dietary diversity and BMI. Furthermore, the assessment of dietary diversity, a proxy for diet quality, is an important source of information for analysis of dietary issues arising due to the nutrition transition. Ecuador provides a unique environment for carrying out this research study as the country is currently undergoing a nutrition transition and is experiencing increasing rates of overweight and obesity (18). Yet, to date, little is known about household-level food insecurity in this middle-income country where about a quarter of the population lives in poverty (19). Hence, the purpose of this study is to examine the association between food insecurity and both BMI and diet diversity. To our knowledge, this is the first study that has explored these associations in Ecuador.

Methods

Study/population/sample

The study was carried out in the Santa Elena province of Ecuador. Santa Elena became its own province in 2007, making it the most recently added of the 24 provinces (20). According to the recent census, the total population of this province is 308,693, with the majority living in rural areas (21).

A cross-sectional study design was employed using quantitative methods. The sample (N=247) consisted of patients and family members 18 years or older who visited a community clinic that offers primary care for both children and adults; only one member per family was interviewed. Persons who were pregnant or had appointments due to an illness were excluded because these conditions often affect the foods consumed (22). Participants were recruited face-to-face in the clinic waiting room. Consenting individuals were interviewed by one of three trained Spanish speaking interviewers from June to August 2015. The protocols for this cross-sectional study were approved by the Yale University Institutional Review Board. The clinic did not have its own IRB and hence the director and owner of the clinic delegated the approval to Yale's IRB.

Measures

Participants responded to an interviewer-administered survey that contained items from several established survey instruments. The main independent variables were household food insecurity and demographic and socio-economic covariates were also assessed. The main outcome variables included were BMI and Household Dietary Diversity Score (HDDS).

Covariates

Household characteristics were captured by the survey and included family size, household composition (homes with children or no children), wealth stratum, financial stress, drinking water source and sanitation facilities. Family size included everyone who resided within the respondents' home.

Wealth stratum was computed using an adapted version of items in the Latin American Public Opinion Project questionnaire that asks participants about household appliances and possessions and domestic assistance (23, 24). These included: electricity, refrigerator, washing machine, radio, microwave oven, computer, internet, television/flat panel TV, landline/residential telephone, cellular phone, car, motorcycle, agricultural land and domestic helper. An additive count of possessions was made such that homes received one point for each possession. Hence, the maximum score for wealth stratum was 14; the scores ranged from 0 to 12 across households. Wealth stratum was trichotomized according to its distribution such that 25% of the sample fell in the low and upper end of the distribution and 50% of the sample fell in the middle of the distribution. Household wealth stratum was divided into high (6-12 possessions), medium (5 possessions) and low (0-4 possessions) wealth stratum.

Financial stress was assessed using a question from the Public Opinion and Foreign Policy survey administered in Brazil, Columbia, Ecuador, Mexico and Peru (25). Participants were asked whether they believed that with the total family income they 'can cover expenses and

save', 'can just cover expenses without major difficulties,' 'cannot cover expenses and have difficulties,' 'cannot cover expenses and have major difficulties,' 'don't know' or 'no answer/refused to answer' (25). Financial stress was re-categorized such that it became a three level variable: 'can cover expenses' and 'save and can just cover expenses without major difficulties' were merged into one category while 'cannot cover expenses and have difficulties' and 'cannot cover expenses and have major difficulties' remained as their own categories.

Drinking water and sanitation were assessed according to WHO/UNICEF guidelines; drinking water source was dichotomized into improved or unimproved sources of drinking water (26). Unimproved source of water included tanker-truck.

Facilities were also dichotomized into improved and unimproved facilities (26). Improved facilities are sanitation facilities that are able to hygienically separate human excreta from human contact (26). In this sample, households were deemed to have improved facilities if they used sanitation facilities that had flush toilets, a piped sewer system or a pit latrine with slab; households were deemed to have unimproved facilities if they had a pit latrine without a slab, used a bush or field or had no facilities.

Participants' characteristics included age, gender, and education level. Age was measured as a continuous variable and gender as a dichotomous variable (male or female). Education was stratified into a three-level categorical variable: ≤6 years of education, 7-12 years of education or 13 or more years of education.

Food insecurity

Food security status was measured using the Escala Latinoamericana y Caribeña de Seguridad Alimentaria (ELCSA) (27). The ELCSA, a previously validated tool, consists of 15 questions administered to a household respondent: the first eight questions inquire about the food security status of adults and the next seven inquire about the food security status of children/youth less than 18 years (28). In homes with no children or youth, only the first eight questions were administered. Response options for each question include yes, no, don't know or refuse to answer and the reference time period for all questions is 3 months. ELCSA scoring guidelines were used to classify households into one of the four established food security categories: food secure, mildly food insecure, moderately food insecure or severely food insecure, with the mild and moderate categories combined for the analysis. For households with children, cut-off points were: food secure (0), mildly food insecure (1-5), moderately food insecure (6-10) and severely food insecure (11-15) (27). In households without children, the cutoff points were: food secure (0), mildly food insecure (1-3), moderately food insecure (4-6) and severely food insecure (7-8) (27). The food insecurity scale showed acceptable internal consistency as Cronbach's α for ELCSA for the entire sample when combining the 8 adult household items was 0.83; Cronbach's α for households with children (15 questions) was 0.92 and for households without children (8 questions) was 0.79, respectively.

Anthropometric measures

Height and weight were measured according to Centers for Disease Control and Prevention (CDC) recommendations (29). Height was measured to the nearest $1/8^{th}$ inch with a measuring tape. Weight was measured to the nearest 0.1 pound using a digital scale. The scale was calibrated daily with standardized weights and recalibrated any time the scale was moved;

scales were switched out with a new but identical model if they did not measure the correct weight. BMI was calculated using the National Institutes of Health BMI calculator with underweight defined as a BMI <18.5, normal weight as BMI between 18.5-24.9, overweight as BMI between 25-29.9 and obesity as BMI ≥30 (30).

Dietary Diversity Score

Household Dietary Diversity Score (HDDS) was assessed using the guidelines established by the Food and Nutrition Technical Assistance (FANTA) Project (31). The number of different food groups consumed was calculated by asking participants to report household food consumption using a 24 hour recall; participants were asked to describe all the ingredients in the food they had eaten. Foods consumed were then grouped into the following 12 food groups used to calculate HDDS: cereals, roots and tubers, vegetables, fruits, meat and poultry, eggs, fish and seafood, pulses/legumes/nuts, milk and milk products, oils/fats, sugar and other such as fruit juices and soda; the cereals group was divided into a whole grain and refined grain subgroup. The overall HDDS was computed by summing the number of food groups from which at least one food was consumed the previous day. The amounts of each food type consumed were not assessed. HDDS was trichotomized according to its distribution such that 25% of the sample fell in the low and upper end of the distribution and 50% of the sample fell in the middle of the distribution. HDDS was divided into low (≤ 8 food groups), medium (9 food groups) and high (≥ 10 food groups) categories.

Statistical analyses

Of the 247 participants who took part in the study, 237 were included in the analysis; because small sample sizes may produce unreliable associations, the underweight group (n=6) was excluded from analyses, resulting in three BMI groups. Four participants with missing information for BMI were also excluded.

First, chi square analysis and t tests were used to compare categorical and continuous variables, respectively across household food insecurity (HFI) categories. Secondly, unadjusted associations between HFI and both BMI and HDDS were conducted, followed by adjusted associations between HFI and HDDS. Prior to conducting the adjusted analyses, wealth stratum and financial stress and drinking water and sanitation facilities were assessed for multi-collinearity, and were included in the model as there was no evidence of multicollinearity among them. The variables that were significant in the bivariate analyses and that were included in the model were: age, wealth stratum, financial stress and education. Nonsignificant interaction terms with a p-value greater than 0.10 were removed to create the most parsimonious model that includes wealth stratum. The results were expressed as odds ratio and the corresponding 95% confidence interval. Findings were considered to be statistically significant if the 95% CI excluded the value of one.

To explore dietary diversity further, count and proportions for food groups by level of HFI were also analyzed using $\chi 2$ tests or Fisher's exact test as appropriate.

Data were analyzed using SAS statistical software version 9.3 (SAS Institute Inc., Cary, NC, USA). Statistical significance was set at $p< 0.05$.

Results

Table 1 summarizes the associations between household characteristics and HFI levels. Of the 243 subjects, 14% were men and 86% were women. Subjects who were food secure made up 4.9% of the sample. At the bivariate level, age, education, wealth stratum and financial stress were associated with HFI. As severity of food insecurity increased, the respondents' mean age increased and education level decreased. Likewise, as the severity of food insecurity increased, wealth stratum decreased and income stress increased. Household size, household composition, drinking water source and sanitation facilities were not statistically significant across the four levels of food security.

Table 2 shows the prevalence of BMI categories (normal, overweight and obese) and HDDS by HFI levels. As severity of food insecurity increased, the prevalence of normal weight decreased and the prevalence of overweight increased. Additionally, the level of obesity decreased. However, these findings did not reach statistical significance and hence no further multivariate analysis was done. However, a statistically significant association was found between HDDS and HFI: as severity of food insecurity increased, low HDDS increased substantially from 18.2% to 54.7%, while high HDDS decreased from 63.7% to 22.7%. These findings were confirmed in the unadjusted and adjusted analysis of FI and HDDS (Table 3). Respondents from households that were severely food insecure had 6.06 times the odds of having low HDDS category compared with households that were food secure. The corresponding OR for households that were mildly/moderately food insecure was 1.75, although this association did not reach statistical significance. In the multivariable model that adjusted for age, financial stress and education, respondents living in households with mild/moderate food insecurity had 50% higher odds of being in the low HDDS category compared with food secure homes, although this association did not reach statistical significance (adjusted OR = 1.50, 95% CI 0.45, 5.00). The corresponding OR for severely food insecure homes was 4.33 (95% CI 1.20, 15.61).

Table 4 presents the food groups consumed by HFI level as reported by participants during the 24 hour recall. The majority of households consumed cereals, roots and tubers, vegetables, oils, sweets and an item from the food group "other." Statistical difference existed in the consumption of fruits, meat and milk across HFI levels; fruit, meat and milk consumption decreased as HFI worsened. Similarly, as HFI worsened, legumes and/or nuts consumption also decreased, although this difference was marginally significant ($p = 0.062$).

Discussion

In this cross-sectional study, we investigated the association between household food insecurity and both BMI and HDDS among adults living in rural Ecuador. At the community level, food insecurity and overweight and obesity were common. At the household level, age, wealth stratum, financial stress and education were associated with food security status. The main findings from the present study are that severely food insecure households in rural Ecuador 1) did not show any significant association with BMI levels and 2) were 4.33 times more likely to have low dietary diversity than their food secure counterparts.

Contrary to previous studies conducted in high-income countries, the present study found no significant association between food insecurity and overweight and obesity. Other studies conducted in Latin America, specifically among women in Colombia and men and women in Trinidad and Tobago, found that food insecurity was associated with underweight and not

overweight or obesity (10, 32). Hence our findings are consistent with the conclusions drawn in other Latin American countries. Yet, it is important to note that our findings are suggestive of a possible food insecurity-obesity association: as severity of food insecurity increased, the prevalence of normal weight decreased and the prevalence of overweight increased, although these findings did not reach statistical significance Hence, this may be why the Brazilian findings differ from our conclusions; researchers found that mild and severe food insecurity are associated with obesity among women (33). Thus it may be that Ecuador will eventually mirror the food insecurity-obesity pattern observed in high income countries and upper middle income countries such as Brazil. Future studies are needed to further explore the relationship between food insecurity and obesity as Ecuador continues to advance with its nutrition transition.

Very few studies have specifically addressed the association between food insecurity and dietary diversity (34). The studies that have examined this association have focused mostly on Mexican and Hispanic households in the U.S. Two studies of Hispanic children in the U.S. reported no association between food insecurity and intake of most food groups, although one reported lower meat consumption among food-insecure youth (35, 36). In contrast, one study in Mexico seeking to validate an experience-based food security scale found that food insecurity was associated with low dietary variety (37). Similarly, one study conducted in Tehran, Iran found similar results (38). Hence, the present study adds to the evidence showing an inverse association between food insecurity and dietary diversity in a different region and context of Latin America.

To further explore the relationship between food insecurity status and dietary diversity, additional analyses were carried out. Fruit, meat and milk consumption decreased as HFI worsened. Furthermore, legumes and/or nuts consumption also decreased as HFI worsened. This is not surprising, as food insecurity may limit the variety of foods available. In fact, during the validation of the USDA food insecurity module in Brazil, researchers found that the likelihood of consumption of fruits, tuber vegetables and meat was zero among households that were severely food insecure (39). Furthermore, that study also found that milk, dairy products, juices, candy and soft drink consumption also decreased as the severity of food insecurity increased (39). In the Trinidad and Tobago study, researchers found that food insecure households were less likely to consume fruits, or green vegetables or salads (32). In the Tehran study, low dietary diversity was associated with lower fruit consumption (38). Hence, dietary diversity appears to be negatively associated with household food insecurity. Thus, our study supports the hypothesis that reliance on low-cost energy dense food groups resulting from low food insecurity may be a risk factor for overweight and obesity.

Several limitations should be considered when evaluating the findings of this study. Cross-sectional methods were used to determine the association between food insecurity and both HDDS and BMI, hence no causal inferences can be made. Furthermore, the generalizability of this study is limited because samples were drawn from patients attending a clinic in a rural part of Ecuador and most participants were women. Additionally, HDDS may have substantial measurement error as we relied on a recall to determine the foods consumed.

To our knowledge, this study is the first to date that looks at the association between food insecurity and both dietary diversity and BMI. Our study suggests that food insecurity is negatively associated with dietary diversity and that food insecurity may be associated with higher obesity rates, although this association did not reach statistical significance due to insufficient statistical power. The two findings in the present study have important implications for addressing food insecurity in Ecuador; understanding how the dietary quality is affected for

households at different levels of food insecurity can help Ecuador understand how people cope in the face of food insecurity. Therefore, it can inform effective, targeted nutrition programs and policies that seek to tackle poor nutrition in the country. Future studies should follow the impacts of food insecurity on both dietary diversity and BMI given the ongoing nutrition transition in Ecuador; it will be important to monitor the direction of the association between food insecurity and BMI as this relationship continues to evolve over time.

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Table 1 Household characteristics by food security status among men and women in Santa Elena, Ecuador

Variable	All (n = 237)	Food Security Status				P*
		Food Secure (n = 11)	Mildly Food Insecure (n = 76)	Moderately Food Insecure (n = 75)	Severely Food Insecure (n = 75)	
SES/Demographics						
Age (years), mean ± SD	36.4 ± 13.0	30.1 ± 12.8	32.8 ± 12.6	38.1 ± 12.6	39.2 ± 12.9	0.004
Gender, n (%)						0.777
Male	34 (14.4)	2 (18.2)	10 (13.2)	13 (17.3)	9 (12.0)	
Female	203 (85.7)	9 (81.8)	66 (86.8)	62 (82.7)	66 (88.0)	
Household Size, mean ± SD	6.0 ± 2.2	5.7 ± 2.0	5.7 ± 2.3	5.9 ± 2.2	6.3 ± 2.2	0.366
Household Composition						0.838
Households with no children	20 (8.4)	1 (9.1)	5 (6.6)	8 (10.7)	6 (8.0)	
Households with children <18	217 (91.6)	10 (90.9)	71 (93.4)	67 (89.3)	69 (92.0)	
Education, n (%)						<0.001
≤ 6 years	154 (65.0)	5 (45.5)	38 (50.0)	54 (72.0)	57 (76.0)	
7 – 12 years	70 (29.5)	4 (36.4)	30 (39.5)	18 (24.0)	18 (24.0)	
≥13 years	13 (5.5)	2 (18.2)	8 (10.5)	3 (4.0)	0 (0.0)	
Wealth Stratum (household asset), n (%)						<0.001
1 (lowest)	63 (26.6)	2 (18.2)	22 (29.0)	18 (24.0)	21 (28.0)	
2	109 (46.0)	3 (27.3)	27 (35.5)	31 (41.3)	48 (64.0)	
3 (highest)	65 (27.4)	6 (54.6)	27 (35.5)	26 (34.7)	6 (8.0)	
Income Stress, n (%)						<0.001
Sufficient and can save/ no great difficulties	37 (15.7)	4 (36.4)	18 (24.0)	11 (14.9)	4 (5.3)	
Not sufficient and difficult	108 (46.0)	6 (54.6)	40 (53.3)	37 (50.0)	25 (33.3)	
Not sufficient and great difficulties	90 (38.3)	1 (9.1)	17 (22.7)	26 (35.1)	46 (61.3)	
Drinking water source						0.116
Improved source of drinking water[a]	227 (96.2)	11 (100.0)	76 (100.0)	71 (94.7)	69 (93.2)	
Unimproved source of drinking water (Tanker-truck)	9 (3.8)	0 (0.0)	0 (0.0)	4 (5.3)	5 (6.8)	
Sanitation, n (%)						0.406
Improved facilities[b]	215 (90.7)	11 (100.0)	70 (92.1)	69 (92.0)	65 (86.7)	
Unimproved facilities[c]	22 (9.3)	0 (0.0)	6 (7.9)	6 (8.0)	10 (13.3)	

*Numbers may not sum to totals due to missing data and column percentages may not sum to 100% due to rounding

[a] Includes piped water into dwelling and bottled water

[b] Includes flush/pour to piped sewer system, flush/pour to septic tank, pit latrine with slab

[c] Includes pit latrine without slab and no facilities/bush or field

Table 2 BMI and HDDS by food security status among men and women in Santa Elena, Ecuador

Variable		All (n = 237)	Food Security Status			p*
			Food Secure (n = 11)	Mildly/Moderately Food Insecure (n = 151)	Severely Food Insecure (n = 75)	
BMI						0.316
	Normal	96 (40.5)	6 (54.6)	64 (42.4)	26 (34.7)	
	Overweight	105 (44.3)	3 (27.3)	62 (41.1)	40 (53.3)	
	Obese	36 (15.2)	2 (18.2)	25 (16.6)	9 (12.0)	
HDDS						<0.001
	1 (lowest)	82 (34.6)	2 (18.2)	39 (25.8)	41 (54.7)	
	2	68 (28.7)	2 (18.2)	49 (32.5)	17 (22.7)	
	3 (highest)	87 (36.7)	7 (63.6)	63 (41.7)	17 (22.7)	

Table 3 Ordered logistic regression predicting decreasing HDDS among men and women in Ecuador (N=237)

	Food Security Status				
	Food Secure	Mildly/Moderately Food Insecure OR (95% CI)	p	Severe Food Insecurity OR (95% CI)	p
Unadjusted	1.00	1.75 (0.53, 5.80)	0.359	6.06 (1.73, 21.28)	0.005
Adjusted	1.00	1.50 (0.45, 5.00)	0.512	4.33 (1.20, 15.61)	0.025

*Adjusted for wealth stratum.

Table 4 Food group intake by level of food security status among men and women in Santa Elena, Ecuador

		Food Security Status			
Food Group	All (n = 237)	Food Secure (n = 11)	Mildly/Moderately Food Insecure (n = 151)	Severely Food Insecure (n = 75)	p
Cereals	233 (98.3)	11 (100.0)	150 (99.3)	72 (96.0)	0.263
Whole Grains	48 (20.3)	3 (27.3)	29 (19.2)	16 (21.3)	0.782
Refined Grains	233 (98.3)	11 (100.0)	150 (99.3)	72 (96.0)	0.263
Roots and Tubers	214 (90.3)	11 (100.0)	138 (91.4)	65 (86.7)	0.284
Vegetables	214 (90.3)	10 (90.9)	138 (91.4)	66 (88.0)	0.718
Fruits[a]	117 (49.4)	7 (63.6)	82 (54.3)	28 (37.3)	0.035
Meat	162 (68.4)	8 (72.7)	113 (74.8)	41 (54.7)	0.009
Eggs	86 (36.3)	3 (27.3)	59 (39.1)	24 (32.0)	0.475
Fish	179 (75.5)	8 (72.7)	115 (76.2)	56 (74.7)	0.947
Legumes and/or nuts	55 (23.2)	5 (45.5)	38 (25.2)	12 (16.0)	0.062
Milk	172 (72.6)	11 (100.0)	116 (76.8)	45 (60.0)	0.003
Oils	228 (96.2)	11 (100.0)	146 (96.7)	71 (94.7)	0.666
Sweets	234 (98.7)	11 (100.0)	150 (99.3)	73 (97.3)	0.356
Other[b]	228 (96.2)	11 (100.0)	146 (96.7)	71 (94.7)	0.666

[a]Excludes fruit juices

[b]Includes sodas, fruit juices, coffee