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M. Margaret Weigel & Maria Mercedes Armijos

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Food Insufficiency in the Households of Reproductive-Age Ecuadorian Women: Association with Food and Nutritional Status Indicators

M. MARGARET WEIGEL

Departments of Public Health Sciences and Human Immunology, Nutrition, and Disease Research Laboratory, University of Texas at El Paso, El Paso, Texas, USA; Biomedical Center of the Central University of Ecuador, Quito, Ecuador; and Prometeo Program, National Secretary of Higher Education, Science, Technology and Innovation, Quito, Ecuador

MARIA MERCEDES ARMIJOS

Department of Sociology and Anthropology, University of Texas at El Paso, El Paso, Texas, USA

*Data from a nationally representative survey of Ecuadorian households with reproductive-aged women (*n *= 10,784) were used to analyze the prevalence of household food insufficiency (HFI) and its association with sociodemographic characteristics, food acquisition and expenditure patterns, dietary diversity, and anthropometric indicators. Fifteen percent of households had food insufficiency and 15% had marginal food sufficiency. HFI was associated with poverty-linked indicators. Marginally food sufficient households reported social and economic capital than food which appeared protective against HFI. Food insufficiency was associated with reduced household acquisition/expenditures on high quality protein and micronutrient-rich food sources. HFI was not associated with adult or adolescent female overweight/obesity but was associated with short adult stature (< 1.45 m). The ongoing nutrition transition in Ecuador is expected to continue to modify population food security, diet, and nutrition. Systematic surveillance of household level food security is needed to inform recent food-related policies and programs implemented by the Ecuadorian government.*

Address correspondence to M. Margaret Weigel, PhD, Department of Public Health Sciences, College of Health Sciences, University of Texas at El Paso, 500 West University Ave., El Paso, Texas 79968, USA. E-mail: mmweigel@utep.edu

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Food security, an important nutrition and health determinant, 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 healthy life" (FAO 1996). Improving the food security situations of households is a globally important public health challenge. Although some progress has been made toward improving the food security status of many populations, 870 million persons worldwide are estimated to currently lack sufficient food to meet their basic dietary energy and protein requirements (FAO 2012) and two billion suffer from micronutrient deficiencies (Muthaya et al. 2013; Nordin, Boyle, and Kemmer 2013). Most of these food insecure persons live in low- and middle-income country households (FAO 2012).

At the household level, food insecurity has been defined as, "the limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" (Anderson 1999). It occurs when households are unable to produce, purchase or otherwise access foods needed for a socially acceptable and nutritious diet or when household management of food and other resources is sub-optimal (WHO 2010).

Household food insufficiency, the focus of the present analysis, results from involuntary reductions in food intake because of inadequate income and other economic and social capital (NRC 2005). It has been operationally defined as when a household sometimes or often did not get enough food to eat (Chavez, Telleen, and Kim 2007). Food insufficiency and the broader concept of food insecurity have both been used in the literature to describe the food situation of households. Both concepts and the instruments developed to measure them describe the quantitative compromises that affect food availability and adequacy but food insecurity also captures the psychological, social, cultural and other qualitative dimensions of food deprivation experienced by households (Coleman-Jensen, Nord, and Andrews 2012; IOM 2011). Examples of commonly used household food insecurity measurement tools include the U.S. Household Food Security Survey Module (HFSSM) and language-adapted and other modified versions of the HFSSM, the Radimer/Cornell food security questionnaire, the Household Food Insecurity and Access Scale, and the Household Hunger Scale, among others (Jones et al. 2013).

Although low income plays a major role, other poverty-linked factors (e.g., education, ethnicity, household size, rurality, social-welfare assistance) also can influence household food access, vulnerability, and resilience in the

management of insufficient food supplies. Some at-risk households may able to temporarily cope by juggling their resources or altering expenses, but the options of others may be more limited causing them to experience episodic or chronic food insufficiency (Maxwell and Smith 1992). Households who have poorer access to social networks, social safety nets, and other resources that could potentially help them to weather economic shocks also may have increased vulnerability (Maxwell and Smith 1992).

Mild–moderate chronic household food insufficiency and insecurity have been linked to suboptimal indicators of nutritional status in some U.S. and Canadian groups including low fruit/vegetable consumption, low micronutrient intake, and low micronutrient blood levels (Ivers and Cullen 2011) or higher obesogenic food intake (Seligman, Laraia, and Kushel 2010; Ivers and Cullen 2011). Mild-moderate episodic or cyclical food insecurity has been hypothesized to promote weight gain and obesity through one or more complementary mechanisms. These include the purchase of cheaper, high-calorie, micronutrient-poor items by households, recurring "feast or famine" cycles which lower basal metabolism, and/or promote unhealthy eating behaviors, and chronic anxiety over insecure food supplies which causes increased stress hormone production, altered metabolism and weight gain (Drenowski 2009; Drewnowski and Specter 2004; Franklin et al. 2012; IOM 2011). However, the evidence in support of "food insecurity-obesity hypothesis" is mixed at best for U.S. and Canadian women (Franklin et al. 2012; IOM 2011; Ivers and Cullen 2011; Larson and Story 2011). It is also equivocal in the few studies published on this topic in Latin American and Caribbean country populations (Gulliford, Mahabir, and Rocke 2003; Hackett, Melgar-Quiñonez, and Uribe 2008; Isanaka, Mora-Plazas, and Lopez-Arana 2007; Velásquez-Melendez et al. 2011).

Little is known about household-level food insufficiency or insecurity in Ecuador, a middle-income country where 40% of the population lives in poverty and 5% in extreme poverty (UNDP 2010). Similar to many of its Latin American neighbors, Ecuador is currently undergoing nutritional and epidemiological transition. Sedentary lifestyles are becoming more frequent and traditional food patterns are increasingly being replaced by energy-dense processed convenience and fast foods (Friere et al. 2013). The population prevalence of overweight and obesity has been steadily rising over the past decade especially among adult women (Friere et al. 2013). At the same time, iron, vitamin A, zinc and other micronutrient deficiencies remain common especially among reproductive-aged women and children (Friere et al. 2013) as does the prevalence of child and adolescent growth stunting (Friere et al. 2013; PAHO 2011) and short stature in adult women (PAHO 2011). Although infectious diseases are still prevalent, diabetes, hypertension, cardiovascular disease and other obesity-related chronic conditions now rank among the top causes of adult morbidity and mortality (MSP 2012).

Published reports on household-level food insufficiency or food insecurity in Ecuador are restricted to an ethnographic study conducted in a rural highland Afro-Ecuadorian community (Moreno-Black and Guerrón-Montero 2005) and two small surveys carried out in rural highland indigenous (Weigel et al. 2012) and rural lowland mestizo communities (Hackett et al. 2007). Their findings suggested that household food insufficiency/insecurity was common in these rural communities (Hackett et al. 2007; Moreno-Black and Guerrón-Montero 2005; Weigel et al. 2012). In addition, food insecurity was associated with low household food stores (Hackett et al. 2007) and low dietary diversity (Weigel et al. 2012) but not adult overweight or obesity (Weigel et al. 2012). However, it is uncertain whether these limited findings also apply to other households (e.g., urban) and little else is known about the magnitude, characteristics, and food and nutrition context of household food insufficiency/insecurity in Ecuador.

The present study analyzed data from the most recent *Encuesta Demografica de Salud Materna e Infantil 2004* survey to investigate household food insufficiency (HFI) in a large, nationally representative sample of Ecuadorian households containing reproductive age (15–49 years) women (CEPAR 2005b). The analysis examined HFI prevalence, its sociodemographic correlates, the economic strategies used by households to deal with difficulty in paying for food and the intra-household food allocation strategies they employed to stretch available food once HFI occurred. It also investigated the association of HFI with household food acquisition, food expenditures, and dietary diversity patterns. Finally, the study explored whether HFI was associated with anthropometric indicators of nutritional status (i.e., overweight/obesity, short stature), in women of child-bearing age.

The study of food insufficiency in the households of reproductive age women is especially important because of their key roles in the production, preparation, and distribution of foods as well as caregivers and keepers of food, nutrition, and health knowledge with their family units (Ivers and Cullen 2011). Women who live in food insufficient households are also more vulnerable for poorer nutrition, health, and pregnancy outcomes (FAO 2012; Ivers and Cullen 2011). In addition, female-headed households, especially those with children, are more likely to live in poverty and to experience food deprivation (FAO 2012).

METHODS

Survey Design and Sampling

The *Encuesta Demografica de Salud Materna e Infantil 2004* (ENDEMAIN 2004) survey was conducted by the *Centro de Estudios de Población y Desarrollo Social* (CEPAR) with technical assistance from the Centers

for Disease Control and Prevention (CDC). The survey design, sampling, response rate, and methodology have been described previously (CEPAR 2005a, 2005b). Briefly, the survey used a probabilistic, multistage design to collect data from a nationally representative sample of 29,908 Ecuadorian households containing at least one reproductive-age woman (15–49 years) in 15 provinces and two regions of the country. Data collection took place from July–November 2004. The survey used the 2001 Ecuadorian National Census as the sampling frame for selecting households within census sectors. The survey had a 78% response rate. For logistical reasons, the ENDEMAIN 2004 survey administered separate questionnaires to two different randomly selected sub-samples (CEPAR 2005a, 2005b). The current analysis used data from the *Mujer de Edad Fértil* or MEF subsample which collected sociodemographic, nutrition and health data from one reproductive-aged female respondent (15–49 years) living in each household. Of the 10,814 households included in this sub-sample, 30 lacked data on food sufficiency status resulting in a final sample of 10,784 households for the present analyses.

Study Measures

Household food sufficiency status

In this study, household food insufficiency was narrowly defined as restricted household food stores due to economic constraints. The female respondents were asked if their household had experienced difficulty in paying for food during the past two weeks. They were also questioned as to whether their household had sufficient food to feed all its members during the same time period. Respondents who reported that their households had experienced difficulty in paying for food during the past two weeks and also noted that they lacked sufficient food to feed all family members during the same time period were classified as “food insufficient”. Those who reported they had experienced difficulty in paying for food but had enough food to feed all household members in the prior two-week period were classified as “marginally food sufficient.” Respondents who reported that their households had not experienced difficulty in paying for food and that they had enough food to feed all their members during the previous two weeks were classified as “food sufficient”.

The household food insufficiency measure contained in the ENDEMAIN 2004 survey is similar to that used by prior authors who reported it as closely associated with reduced household food expenditures and poorer nutrition and health outcomes (Alaimo et al. 1998; Chavez et al. 2007; Mazur, Marquis, and Jensen 2003; Rose and Oliveira 1997; Vozoris and Tarasuk 2003). The inclusion of the question on household difficulty in paying for

food strengthens the HFI measure used in the study because it explicitly includes the dimension of insufficient economic resources.

The ENDEMAIN 2004 survey asked only those 3,245 respondents who reported that their household had experienced difficulty in paying for food during the prior two weeks (i.e., households classified as food insufficient and marginally food sufficient), to identify, from a list of fixed responses, which economic coping strategies they had used to manage this situation. The responses included on the list were: had borrowed money from a family member or a friend, had obtained store credit to buy food, had stopped purchasing certain foods, had used personal savings to pay for food, had sold an animal to obtain cash, or had charged food on a credit card. The survey then asked only the respondents from the 1,657 food insufficient households to identify, from a fixed list, which food allocation strategies they had used to stretch their food supply during the prior 2-week period. The fixed responses provided by the survey were: (1) had reduced the number of daily meals served to the household, (2) had reduced the size of meals (food quantity) size for all household members, (3) had reduced the size of meals only for adults, (4) had reduced the size of meals only for children, or (5) had used another unspecified strategy.

Sociodemographic characteristics

The household and female respondent sociodemographic covariates analyzed in the present study were selected because of their previously reported associations with household food insufficiency/food insecurity in prior studies and their availability in the ENDEMAIN 2004 survey database. These included income (Alaimo et al. 1998; Alvarez-Uribe, Estrada-Restrepo, and Fonseca-Centeno 2010; Bauer et al 2012; Coleman-Jensen et al. 2012; Hackett, Melgar-Quiñonez, and Taylor 2010; Kim et al. 2011; Laraia et al. 2006; Seligman et al. 2010; Shariff and Khor 2005;), women's employment status (Kim et al. 2011; Pardilla et al. 2013; Shariff and Khor 2005; Sorsdahl, Slopen, and Siefert 2011), women's education (Alaimo et al. 1998; Laraia et al. 2006; Pardilla et al. 2013; Seligman et al. 2010; Shariff and Khor 2005; Sorsdahl et al. 2011; Velásquez-Melendez et al. 2011), ethnicity (Alaimo et al. 1998; Coleman-Jensen et al. 2012; Guilliford, Mahabir, and Rocke 2003; Laraia et al. 2006; Seligman et al. 2010; Sorsdahl et al. 2011; Velásquez-Melendez et al. 2011), household size (Alaimo et al. 1998; Hackett et al. 2010; Shariff and Khor 2005), rurality (Hackett et al. 2010; Sorsdahl et al. 2011; Velásquez-Melendez et al. 2011), and household participation in social welfare programs (Bauer, Widome, and Himes 2012; Hackett et al. 2010; Kim et al. 2011).

Household food acquisition and expenditure

The ENDEMAIN 2004 survey selected a random subsample of 2622 (24%) of reproductive age female respondents from the *Mujer de Edad Fértil*

(MEF) subsample for the purpose of collecting detailed information on their household food acquisition and expenditure patterns during the prior two weeks. This included all foods purchased and/or obtained by other means for household consumption (e.g., barter, gift, payment, grown by family, obtained from the family-owned business). The fixed list of common Ecuadorian foods provided in the ENDEMAIN 2004 survey were classified into 12 major groups based on Food and Agriculture Organization (2010) criteria: cereals, meats, eggs, milk/milk products, legumes/nuts/seeds, oils/fats, vegetables, fruits, fish/other seafood, white tubers/roots, sweets, and spices/condiments/beverages. Individual foods with very low response rates (< 20 total positive responses identifying the specific food item) were excluded from the analyses.

The specific foods included in the 12 groups which were used in the present analyses were: (1) *Cereal group*: Polished rice, bread, oats, noodles, and wheat flour; (2) *Meat group*: Beef cuts with bone in, boneless beef cuts, ground beef, pork/lamb, chicken pieces, whole chicken without feathers, cold cuts, hotdogs, and organ meats; (3) *Fish and seafood group*: Fresh fish, canned tuna/sardines, and shrimp; (4) *Egg group*: Chicken eggs; (5) *Milk and milk product group*: Pasteurized milk, raw milk, cheese, and yogurt; (6) *Legumes, nuts, and seeds group*: Fresh beans, dried beans, lentils, fava beans, and green peas; (7) *Oils and fats group*: Cooking oil, margarine, butter, and vegetable shortening; (8) *Vegetable group*: Chard, cabbage, cauliflower, broccoli, bell peppers, lettuce, tomatoes, fresh corn, beets, carrots, avocado, garlic, spring onions, and red onions; (9) *Fruit group*: Bananas, limes, apples, tangerines, cantaloupe, blackberries, passion fruit, orange, naranjilla [*Solanum quitensis*], papaya, pineapple, tree tomato, watermelon, and grapes; (10) *White tubers and roots group*: Potatoes, cassava, mellocos, green (ripe) plantains, and yellow (ripe) plantains; (11) *Sweets group*: White sugar, brown sugar, sweetened soft drinks, and cookies; and (12) *Spices, condiments, and beverages group*: Salt, coffee, carbonated mineral water, and non-carbonated mineral water.

The average number of different items from each food group obtained by households during the past two weeks for their consumption was used to analyze food acquisition patterns. The average amount of money (or equivalent price) spent on the items from the 12 major food groups was used for the analysis of food expenditure patterns. Food expenditures were expressed in U.S. dollars, the official national currency adopted by Ecuador in 2000. Dietary diversity reflects the ability of a household to access a variety of foods (FAO 2010). In this study, dietary diversity was defined as the number of key foods rich in iron and vitamin A acquired by households for their consumption in the prior two week period. Food and Agriculture Organization (2010) guidelines were used to classify key foods rich in retinol (i.e., organ meats, egg yolks, milk/milk products), retinol precursor carotenoids (i.e., dark leafy green vegetables, certain tubers and fruits), and heme iron (i.e., flesh meats, fish/seafood, organ meats).

Anthropometric indicators

Complete weight (kg) and standing height (cm) measurements were obtained by the trained study anthropometrists on a total of 3,731 female adult (20–49 years) and 336 adolescent respondents (15–19 years). These measurements were used to calculate body mass index (BMI): weight (kg)/height (m^2) and BMI categories for the female adult (WHO 2010) and adolescent respondents (WHO 2007). The height measurements also were used to identify short statured women (i.e., < 145 cm) (PAHO 2011). The analysis of short stature was restricted to respondents aged 20 years or older in order to exclude adolescents who had not yet achieved their final adult height (PAHO 2011).

Data Analysis

The data were analyzed using IBM-SPSS, version 20 (Armonk, NY: IBM Corp.) A survey-provided complex samples weighting factor was applied to compensate for the sampling design and differences in inter-regional response rates (CEPAR 2005a, 2005b). This factor is inversely proportional to a woman's probability of selection and dependent on the number of women in the household and regional, province and census sector population size. Descriptive data are presented as number (%) or mean ± SE. Initial bivariate analyses were used to explore the study questions of interest using cross-tabulation with X^2 for categorical variables or one-way analysis of variance for continuous variables. The respondent and household characteristics identified in the initial analyses as associated with household food sufficiency status were investigated using multinomial logistic regression. These data are presented in the tables as unadjusted and adjusted prevalence ratio estimates with 95% confidence intervals. This method also was used to examine the association of HFI with BMI categories. Modified Poisson regression with robust variance estimation was employed to compare the economic coping strategies of food insufficient versus marginally sufficient households and in analyses examining the association of HFI with short adult female stature. Between-group differences in food acquisition (no. of different food items), food expenditures (dollar cost of food items), and dietary diversity (no. of micronutrient-rich foods) were analyzed with analysis of covariance. Differences of $p < .05$ were considered significant.

RESULTS

Household Food Insufficiency Prevalence and Sociodemographic Correlates

One-sixth (15.4%; 1,657) of the 10,784 Ecuadorian households were classified as food insufficient. Another one-sixth of the households (14.7%; 1,588) were

identified with marginal food sufficiency. Table 1 compares household and respondent sociodemographic characteristics by food sufficiency status. The unadjusted analysis results indicated that HFI prevalence was significantly increased among lower income quintile households, rural residents, families with > 5 members, households who participated in governmental social safety net assistance programs, ethnic minorities, and those characterized by low female respondent education. In contrast, HFI prevalence was reduced in households where the female respondent was actively employed.

Table 1 also shows the results of the multivariate analysis which adjusted for the other variables in the model. It confirmed the previously identified associations of HFI with income quintile, rurality, government assistance, and respondent education, respondent employment status and Afro-Ecuadorian ethnicity. However, the contributions of household size and indigenous ethnicity to HFI were no longer evident and were dropped from the model.

Coping Strategies

Figure 1 compares the economic coping strategies identified by respondents from the 3245 households who reported they had difficulty in paying for food in the past 2-week period. As it shows, two most frequently identified were that they had purchased food on store credit or they had ceased buying certain food items. The results of the bivariate analyses indicated that food insufficient households were more likely than their marginally food sufficient counterparts to report that they had borrowed money from a family member, had used their savings, or had used a credit card to purchase food. These results were confirmed in the subsequent multivariate analysis which controlled for covariates (figure 1). However, no statistically significant between-group differences were identified with respect to the four other household strategies.

The survey also asked the respondents from 1,657 food insufficient households to identify which intra-household food rationing strategy their families might had used to stretch their food supplies during the past two weeks. The strategies that they most frequently identified were that they had served fewer daily meals (52%) or had reduced the size of meals for all household members (39%). Six percent reported that they had decreased adult meal size. Only 8 (< 1%) of the 1,340 households with minor children indicated that they had been forced to reduce their meal size.

Household Food Acquisition and Expenditure Patterns

Table 2 displays the results of the bivariate analyses which examined the association of HFI with household food acquisition patterns in during the previous two weeks. Food insufficient households reported acquiring a fewer

TABLE 1 Association of Household and Respondent Characteristics with Household Food-sufficiency Status (n = 10,784)[a]

	Food-sufficient households (n = 7539) n (%)	Marginally food-sufficient households (n = 1,588) n (%)	Food-insufficient households (n= 1657) n (%)	Marginally food-sufficient households		Food-insufficient households	
				Unadjusted PR (95% CI)[c]	Adjusted PR (95% CI)[b, c]	Unadjusted PR[c] (95% CI)	Adjusted PR (95% CI)[b, c]
Household income quintile							
Lowest quintile	1,426 (18.9)	415 (26.1)	764 (46.1)	3.08 (2.52, 3.77)*	2.26 (1.79, 2.86)*	10.6 (8.33, 13.4)*	6.13 (4.69, 8.03)*
Lowest middle quintile	1,530 (20.3)	393 (24.7)	393 (23.7)	2.60 (2.13, 3.17)*	2.02 (1.62, 2.52)*	4.75 (3.72, 6.06)*	3.10 (2.37, 4.03)*
Middle quintile	1,496 (19.8)	354 (22.3)	263 (15.9)	2.55 (1.92, 2.88)*	1.99 (1.60, 2.47)*	3.18 (2.46, 4.10)*	2.84 (1.79, 3.06)*
Highest middle quintile	1,587 (21.1)	271 (17.1)	151 (9.1)	1.68 (1.36, 2.07)*	1.51 (1.21, 1.87)*	1.70 (1.29, 2.23)*	1.40 (1.06, 1.86) **
Highest quintile	1,500 (19.9)	155 (9.8)	86 (5.2)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Household size							
$\geq$ 5 persons	2,028 (26.9)	507 (31.9)	693 (41.8)	1.28 (1.14, 1.44)*	1.00 (0.88, 1.14)	1.96 (1.76, 2.19)*	1.10 (0.97, 1.25)
< 5 persons	5,511 (73.1)	1081 (68.1)	964 958.2)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Household participation in governmental social safety net program							
Yes	2,770 (36.9)	794 (50.1)	953 (57.8)	1.73 (1.55, 1.93)*	1.43 (1.29, 1.61)*	2.37 (2.12. 2.64)*	1.40 (1.24, 1.58)*
No	4,240 (63.1)	790 (49.9)	695 (42.2)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Ethnicity							
Indigenous	697 (67.1)	120 (11.5)	222 (21.4)	0.82 (0.67, 1.00)	0.64 (0.52, 0.79)*	1.62 (1.37, 1.90)*	0.96 (0.80, 1.14)
Afro-Ecuadorian	242 (63.0)	56 (14.6)	86 (22.4)	1.04 (0.81, 1.47)	0.93 (0.69, 1.26)	1.78 (1.39, 2.30)*	1.41 (1.08, 1.84) ***
Mestizo/other	6,600 (70.5)	1412 (15.1)	1349 (14.4)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Respondent education							
0–6 years	3,002 (39.8)	754 (47.5)	1008 (60.8)	2.08 (1.74, 2.49)*	1.36 (1.11, 1.67)†	4.94 (3.98, 6.14)*	2.02 (1.58, 2.58)*
7–12 years	3,138 (41.6)	663 (41.8)	551 (33.3)	1.72 (1.44, 2.06)*	1.33 (1.10, 1.61)†	2.49 (1.99, 3.11)*	1.55 (1.22, 1.97)*
Postsecondary college/ technical training	1,399 (18.6)	171 (10.8)	98 (5.9)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Location of residence							
Rural area	3,886 (53.1)	783 (49.6)	710 (43.0)	1.92 (1.62, 2.27) † †	1.12 (0.99, 1.27)	3.59 (2.90, 4.44)*	1.30 (1.14, 1.48)*
Urban area	3,426 (46.9)	797 (50.4)	941 (57.0)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Respondent employment status							
Currently employed	3,651 (53.1)	698 (44.0)	691 (41.7)	0.84 (0.75, 0.94) † ††	0.98 (0.85, 1.06)	0.77 (0.69, 0.86)*	0.80 (0.71, 0.92)*
Not employed	3,888 (51.6)	890 (56.0)	966 (58.3)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)

[a]Sample weights applied.

[b]Adjusted for other model covariates.

[c]Prevalence ratio.

*p = .0001, **p = .02, ***p = .012, †p = .03, ††p = .006, †††p = .002.

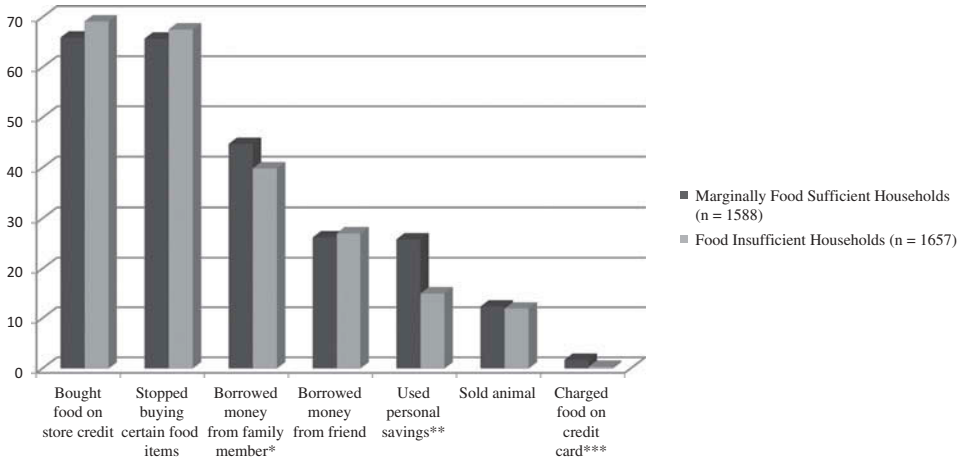

FIGURE 1 Comparison of the economic coping strategies of marginally food sufficient versus food insufficient households who reported difficulty in paying for food in past 2-week period. *Note*. Sample weights applied; multivariate analyses controlled for household income quintile, household size, residence location, participation in governmental social safety net program, ethnicity, respondent education, and respondent employment status.
$^{*}p = .004$; $^{**}p = .001$; $^{***}p = .001$.

mean number of items from 11 of the 12 major food groups compared to their food sufficient or marginally food sufficient counterparts and they also acquired a fewer overall number of foods. These results were confirmed in the multivariate analyses with the exception of the sweets group which was only marginally associated with household food sufficiency status after controlling for the model covariates.

Table 2 also shows the findings from the analyses which compared the acquisition of micronutrient-rich foods during the past two-week period by household food sufficiency status. Both the bivariate and multivariate analysis results indicated that food insufficient households appeared to have less diverse diets than their more food sufficient counterparts as reflected by the average number of foods they reported having acquired which were rich sources of retinol, retinol precursor carotenoids and heme-iron.

Table 3 indicates that food insufficient households reported spending significantly less money during the prior two weeks, on average, to acquire 11 of the 12 major food groups compared to their more food sufficient counterparts. The one exception was their expenditures on white tubers/roots foods which were comparable to the other two groups. The multivariate analysis results confirmed that although food insufficient households reported spending less on meat, fish/seafood, vegetables, fruits, and cereal purchases, their expenditures on other groups were similar comparable to more food sufficient households after adjustment for covariates (table 3). The multivariate analysis also confirmed that food insufficient

TABLE 2 Comparison of Average Number of Foods Reported Acquired for Household Consumption During the Past Two Weeks by Household Food-sufficiency Status[a]

	Food-sufficient households (n = 1,801)		Marginally food-sufficient households (n = 401)		Food-insufficient households (n = 420)		ANOVA p value	ANCOVA p value[c]
	Mean ± SE	Adj mean[b]	Mean ± SE	Adj mean[b]	Mean ± SE	Adj mean[b]		
Food groups								
Cereals	3.29 ± 0.03	3.31	3.44 ± 0.07	3.43	3.21 ± 0.06	3.17	.037	.02
Meats	4.15 ± 0.05	4.06	4.05 ± 0.10	4.16	3.29 ± 0.09	3.64	.0001	.0001
Eggs	0.81 ± 0.01	0.81	0.86 ± 0.20	0.86	0.77 ± 0.02	0.78	.004	.02
Milk and milk products	1.15 ± 0.02	1.15	1.11 ± 0.04	1.12	0.92 ± 0.04	0.97	.0001	.0001
Legumes, nuts, and seeds	2.38 ± 0.04	2.34	2.23 ± 0.08	2.26	1.83 ± 0.07	1.99	.0001	.0001
Oils and fats	1.24 ± 0.02	1.24	1.19 ± 0.04	1.19	1.09 ± 0.03	1.10	.0001	.002
Vegetables	7.70 ± 0.08	7.61	7.20 ± 0.17	7.31	6.44 ± 0.17	6.93	.0001	.002
Fruits	5.32 ± 0.07	5.17	4.72 ± 0.16	4.93	3.37 ± 0.15	4.08	.0001	.0001
White tubers and roots	2.47 ± 0.03	2.48	2.56 ± 0.07	2.58	2.25 ± 0.06	2.28	.002	.004
Sweets	3.05 ± 0.03	3.04	2.93 ± 0.07	2.93	2.81 ± 0.06	2.87	.002	.05
Spices, condiments, and beverages	3.01 ± 0.03	3.02	3.10 ± 0.06	3.08	2.98 ± 0.06	2.98	.37	.50
Fish and seafood	1.34 ± 0.02	1.34	1.29 ± 0.05	1.33	1.12 ± 0.04	1.20	.0001	.020
Total number of food items	35.9 ± 0.30	35.5	34.67 ± 0.64	35.2	30.07 ± 0.62	31.98	.0001	.0001
Micronutrient-rich foods								
Vitamin A foods								
Plant sources[d]	2.50 ± 0.04	2.43	2.17 ± 0.09	2.29	1.64 ± 0.09	2.02	.0001	.0001
Animal sources[e]	1.75 ± 0.03	1.73	1.72 ± 0.05	1.75	1.42 ± 0.05	1.55	.0001	.009
Heme-iron foods[f]	11.0 ± 0.12	10.8	10.7 ± 0.25	11.0	8.82 ± 0.24	9.7	.0001	.0001

Note. Food items contained in each of the 12 food groups: (1) *Cereals*: Polished rice, bread, oats, noodles, wheat flour; (2) *Meats:* Beef cuts with bone in, boneless beef cuts, ground beef, pork/lamb, chicken pieces, whole chicken w/o feathers, cold cuts, hotdogs, organ meats; (3) *Fish and seafood:* Fresh fish, canned tuna/sardines, shrimp; (4) *Eggs*: chicken eggs; (5) *Milk and milk products*: Pasteurized milk, raw milk, cheese, yogurt; (6) *Legumes, nuts, and seeds*: Fresh beans, dried beans, lentils, fava beans, green peas; (7) *Oils and fats*: Cooking oil, margarine, butter, vegetable shortening; (8) *Vegetables*: Chard, cabbage, cauliflower, broccoli, bell peppers, lettuce, tomatoes, fresh corn, beets, carrots, avocado, garlic, spring onions, red onions; (9) *Fruits*: Bananas, limes, apples, tangerines, cantaloupe, blackberries, passion fruit, orange, naranjilla [*Solanum quitensis*], papaya, pineapple, tree tomato, watermelon, grapes; (10) *White tubers and roots*: Potatoes, cassava, mellocos, green (ripe) plantains, yellow (ripe) plantains; (11) *Sweets*: White sugar, brown sugar, soft drinks, cookies; and (12) *Spices, condiments, and beverages*: Salt, coffee, carbonated mineral water, non-carbonated mineral water.

[a]Sample weights applied.

[b]Adjusted mean.

[c]Multivariate analyses controlled for household income quintile, household size, residence location, participation in governmental social safety net program, ethnicity, respondent education, and respondent employment status.

[d]Retinol precursor carotenoid key foods: Dark leafy green vegetables, other vegetables, tubers, vitamin A-rich fruits.[61]

[e]Retinol key foods: Organ meats, Egg yolks, milk/milk products.[61]

[f]Heme-iron key foods: Flesh meats, fish/seafood, organ meats.[61]

TABLE 3 Comparison of Reported Average Household Expenditures (in U.S. dollars) on Foods for Household Consumption During Prior Two-week Period, by Household Food-sufficiency Status[a]

	Food-sufficient households (n = 1,801)		Marginally food-sufficient households (n = 401)		Food-insufficient households (n = 420)			
	Mean ± SE (US$)	Adj mean[b] (US$)	Mean ± SE (US$)	Adj mean[b] (US$)	Mean ± SE (US$)	Adj mean[b] (US$)	ANOVA p value	ANCOVA p value[c]
Food groups								
Cereals	7.28 ± 0.24	7.27	6.13 ± 0.52	6.04	5.34 ± 0.50	5.59	.001	.005
Meats	7.73 ± 0.16	7.39	6.26 ± 0.34	6.72	4.32 ± 0.33	5.80	.0001	.0001
Eggs	0.72 ± 0.02	0.69	0.63 ± 0.04	0.68	0.56 ± 0.04	0.69	.001	.95
Milk and milk products	1.33 ± 0.04	1.30	1.13 ± 0.09	1.21	0.91 ± 0.09	1.11	.0001	.20
Legumes, nuts, and seeds	2.10 ± 0.04	2.06	1.94 ± 0.09	1.98	1.86 ± 0.08	2.04	.019	.70
Oils and fats	1.67 ± 0.04	1.66	1.56 ± 0.08	1.57	1.43 ± 0.08	1.48	.025	.10
Vegetables	3.75 ± 0.06	3.63	3.14 ± 0.14	3.28	2.68 ± 0.13	3.20	.0001	.004
Fruits	4.11 ± 0.09	3.87	3.16 ± 0.19	3.45	2.00 ± 0.18	2.97	.0001	.001
White tubers and roots	2.47 ± 0.07	2.38	2.58 ± 0.15	2.69	2.24 ± 0.14	2.50	.21	.20
Sweets	3.03 ± 0.17	2.91	2.82 ± 0.25	2.93	2.07 ± 0.24	2.48	.001	.30
Spices, condiments, and beverages	1.06 ± 0.03	1.00	0.96 ± 0.06	1.02	0.68 ± 0.06	0.88	.0001	.10
Fish and seafood	2.99 ± 0.09	2.88	2.00 ± 0.19	2.19	1.55 ± 0.18	2.06	.0001	.0001
Total household food expenditure	38.03 ± 0.60	36.86	32.31 ± 1.29	33.68	25.34 ± 1.24	30.50	.0001	.0001

Note. Food items contained in each of the 12 food groups: (1) *Cereals*: Polished rice, bread, oats, noodles, wheat flour; (2) *Meats*: Beef cuts with bone in, boneless beef cuts, ground beef, pork/lamb, chicken pieces, whole chicken w/o feathers, cold cuts, hotdogs, organ meats; (3) *Fish and seafood*: Fresh fish, canned tuna/sardines, shrimp; (4) *Eggs*: Chicken eggs; (5) *Milk and milk products*: Pasteurized milk, raw milk, cheese, yogurt; (6) *Legumes, nuts and seeds*: Fresh beans, dried beans, lentils, fava beans, green peas; (7) *Oils and fats*: Cooking oil, margarine, butter, vegetable shortening; (8) *Vegetables*: Chard, cabbage, cauliflower, broccoli, bell peppers, lettuce, tomatoes, fresh corn, beets, carrots, avocado, garlic, spring onions, red onions; (9) *Fruits*: Bananas, limes, apples, tangerines, cantaloupe, blackberries, passion fruit, orange, naranjilla [*Solanum quitensis*], papaya, pineapple, tree tomato, watermelon, grapes; (10) *White tubers and roots*: Potatoes, cassava, mellocos, green (ripe) plantains, yellow (ripe) plantains); (11) *Sweets*: White sugar, brown sugar, soft drinks, cookies; and (12) *Spices, condiments, and beverages*: Salt, coffee, carbonated mineral water, non-carbonated mineral water.

[a]Sample weights applied.

[b]Adjusted mean.

[c]Multivariate analyses controlled for household income quintile, household size, residence location, participation in governmental social safety net program, ethnicity, respondent education, and respondent employment status.

households still expended significantly fewer dollars overall on all household food purchases made compared to those with better food sufficiency status (table 3).

Anthropometric Indicators

No statistically significant differences were identified regarding the respective age- and ethnicity-adjusted average body mass index (BMI) of either female adult (26.2 vs. 26.1 vs. 26.3; $p = .61$) or adolescent respondents (24.3 vs. 24.2 vs. 24.2; $p = .83$) from food insufficient, food sufficient, and marginally food sufficient households. Based on their BMIs, close to 60% of the adult female respondents were classified as overweight (42%) or obese (16%); 30% of female adolescents were overweight and 8% were obese. However, as table 4 shows, no statistically significant differences were identified between HFI and overweight or obesity for the adult or adolescent female respondents in the bivariate and multivariate analyses.

The average height of the adult female respondents ($\geq$ 20 years) was 1.51 $\pm$ 0.06 m (range: 1.2–1.8 m); 15% were identified with short stature ($<$ 1.45 m). The bivariate analysis results indicated that the prevalence of short stature was significantly increased among women living in food insufficient compared to other households, results which were confirmed in the multivariate analysis which controlled for age and ethnicity (table 4).

DISCUSSION

This study is the first to investigate household food insufficiency (HFI) in a nationally representative sample, in this case, households containing one or more women of child-bearing age. One of every six Ecuadorian households who participated in the national survey indicated that they had lacked sufficient food to meet their basic needs during the prior 2-week period. The prevalence of HFI fell midway between the 4%–9% estimated for households in high-income countries (Alaimo et al. 1998; Radimer et al. 1997; Vozoris and Tarasuk 2003) and the 22%–38% reported for low-income sub-Saharan African countries (Leyna, Mnyika, and Mmbaga 2007; Weiser et al. 2007). It is noted that estimates for HFI, a more severe level of food insecurity, tend to be lower than those reported for food insecurity as they only measure the adequacy and availability of household food supplies and not the qualitative compromises that constitute the broader food security experience (Coleman-Jensen 2012; Bauer et al. 2012; Hackett et al. 2010; IOM 2011; Kim et al. 2011; Maxwell and Smith 1992).

In contrast to what has been posited by the "food insecurity-obesity hypothesis," no statistically significant associations were identified between household food security status and the prevalence of female adult or

TABLE 4 Comparison of Anthropometric Indicators of Nutritional Status for Female Respondents (15–49 years) by Household Food-sufficiency Status[a]

	Food-sufficient households *n* (%)	Marginally food-sufficient households *n* (%)	Food-insufficient households *n* (%)	Marginally food-sufficient households		Food-insufficient households	
				Unadjusted PR (95% CI)[b]	Adjusted PR (95% C.I.)[b,c]	Unadjusted PR (95% CI)[b]	Adjusted PR (95% C.I.)[b,c]
Adolescent BMI (kg)[d,e]							
Overweight[f]	74 (31.1)	11 (30.6)	18 (29.0)	0.94 (0.43, 2.03)	0.98 (0.45, 2.14)	0.66 (0.15, 3.04)	0.64 (0.14, 2.98)
Obese[f]	19 (8.0)	2 (5.6)	7 (11.3)	0.95 (0.51, 1.76)	0.94 (0.50, 1.76)	0.95 (0.43, 2.03)	1.32 (0.51, 3.41)
Adult BMI (kg)[d,g]							
Overweight (BMI 25–29.9)	1,056 (42.9)	255 (41.1)	265 (41.3)	0.95 (0.78, 1.16)	0.92 (0.76, 1.20)	1.10 (0.86, 1.42)	1.03 (0.80, 1.34)
Obese (BMI $\geq$ 30)	394 (16.0)	110 (17.7)	99 (15.4)	0.92 (0.76, 1.11)	0.87 (0.72, 1.06)	0.92 (0.71, 1.18)	0.85 (0.65, 1.10)
Adult stature (m)[h,i]							
Short stature (< 1.45 m)	314 (12.6)	99 (15.7)	139 (21.4)	1.24 (1.01, 1.53)**	1.25 (1.01, 1.53)**	1.70 (1.42, 2.03)*	1.70 (1.42, 2.03)*

[a]Sample weights applied.
[b]PR (prevalence ratio) with 95% confidence intervals (CI).
[c]Analyses controlled for maternal age and ethnicity.
[d]Reference category: Normal weight/underweight.
[e]$n = 344$ (adolescents 15–19 y).
[f]Overweight: >+1 SD (equivalent to BMI 25 kg/m^2 at 19 y)[63]; Obese: >+2 SD (equivalent to BMI 30 kg/m^2 at 19 y).[63]
[g]$n = 3{,}775$ (adult women 20–49 y).
[h]Reference category: Height $\geq$ 1.45 m.
[i]$n = 3{,}777$.
*$p = .04$; **$p = .0001$.

adolescent overweight or obesity. This finding is consistent with those reported for some populations in North America (IOM 2011; Franklin et al. 2012; Ivers and Cullen; Larson and Story 2011) and others in Colombia and Trinidad and Tobago (Gulliford et al. 2003; Hackett et al. 2008; Isanaka et al. 2007) but differs from two recent Brazilian reports (Velásquez-Melendez et al. 2011; Schlüssel et al. 2013).

One of the mechanisms proposed in the "food insecurity-obesity hypothesis" is that food deprivation promotes the purchase of energy-dense foods for household consumption (Drenowski 2009). However, in the present study, food insufficient households were either less likely or did not differ from each other regarding their acquisition of and expenditures on high-calorie items from the sweets and oils/fats food groups. These findings are generally consistent with several reports from Colombia indicating that food insufficient/insecure households were less likely to purchase and consume high-calorie foods such as sugar, cooking oils/fats and fried foods (Hackett et al. 2008; Isanaka et al. 2007), candies (Alvarez-Uribe et al. 2010), and sweetened soft drinks (Alvarez-Uribe et al. 2010; Isanaka et al. 2007). Future prospective cohort studies are needed to further explore the relationship among household food insecurity, dietary patterns, and overweight/obesity as Ecuador continues to undergo nutrition transition. Indeed, findings from a recent (2011–2013) national health and nutrition survey indicate that the consumption of energy-dense snack, convenience, and fast foods is increasing in Ecuador as is the prevalence of adult female overweight/obesity (Friere et al. 2013).

In the present survey, HFI was inversely associated with the number of different food items acquired by households and the amount of money they spent on protein- and micronutrient-rich meats, fish/seafood, fruits and vegetables. This means that food insufficient households were restricted to a more monotonous and less socially acceptable diet compared to other households who were able to afford a more varied diet with higher nutritional value. These results concur with the findings from two small rural Ecuadorian studies (Hackett et al. 2007; Weigel et al. 2012), and those from several other Latin American and Caribbean (Alvarez-Uribe et al. 2010; Guilliford et al. 2003; Hackett et al. 2008; Isanaka et al. 2007) and North American groups (Ivers and Cullen 2011; Rose and Oliveira 1997; Seligman et al. 2010). The poorer access of food insufficient households to key foods high in important micronutrients such as vitamin A and heme iron is particularly noteworthy given the high prevalence of low serum retinol levels reported for young children (17.1%) and iron-deficiency anemia among reproductive-aged women (15%) and young children (25.7%) in Ecuador. These key micronutrients play important roles in immunity, development and physical growth.

The prevalence of child growth stunting and short adult female stature in Ecuador are among the highest reported for Latin America and the Caribbean populations (PAHO 2011). The prevalence of short stature among

the adult women from food insufficient homes in the present study was 1.7 times greater than their food sufficient counterparts. This finding suggests but does not prove that these short women may have experienced chronic under-nutrition due to food deprivation and/or infection during critical prenatal, childhood, and adolescent growth periods. This is important because short maternal stature is associated not only with an increased risk for adverse reproductive outcomes but also decreased work capacity and reduced lifetime economic productivity. The latter limits the ability of mothers to provide income, food, care, and other resources for households (PAHO 2011). In addition, it has intergenerational effects since the offspring of short mothers are more likely to grow up stunted themselves and produce stunted children, a condition which is also associated with future obesity (FAO 2012).

Although Ecuador is self-sufficient in major food commodities, long-standing economic and social structural inequalities restrict the access of low-income and other vulnerable groups to nutritious food (WFP 2011). Low income adversely affects a household's ability to purchase, produce, or otherwise acquire sufficient foods for a healthy diet and it limits their flexibility in responding to food shortages. In this study, household food insufficiency was inversely associated with household income quintile, a finding consistent with prior studies describing HFI or food insecurity in high-, middle- and low-income populations worldwide (Alaimo et al. 1998; Alvarez-Uribe et al. 2010; Bauer et al. 2012; Coleman-Jensen et al. 2012; Hackett et al. 2010; Kim et al. 2011; Laraia et al. 2006; Seligman et al. 2010; Shariff and Khor 2005). The findings also concur with studies conducted in diverse populations linking HFI with other poverty indicators including rural residence (Hackett et al. 2010; Sorsdahl et al. 2011; Velásquez-Melendez et al. 2011), minority ethnicity (Alaimo et al. 1998; Coleman-Jensen et al. 2012; Seligman et al. 2010; Sorsdahl et al. 2011; Velásquez-Melendez et al. 2011), and large household size (Alaimo et al. 1998; Shariff and Khor 2005). In this study, household participation in governmental food, nutrition, cash assistance, or other social safety net programs was not associated with better food sufficiency status, ostensibly because benefit levels offered at the time were too low to make a significant difference. Also consistent with prior reports, female educational achievement (Alaimo et al. 1998; Laraia et al. 2006; Pardilla et al. 2013; Seligman et al. 2010; Sorsdahl et al. 2011; Velásquez-Melendez et al. 2011) and outside employment (Kim et al. 2011; Pardilla et al. 2013; Shariff and Khor 2005; Sorsdahl et al. 2011) were inversely associated with HFI. This is important since female education and employment status are potentially modifiable factors. Higher education and employment are both associated with better financial and health literacy as well as the ability to control and manage household income, food, and other resources. In addition, outside employment has the potential to expand the size of women's social networks, potentially providing them with increased social support and individuals on whom they may be able to rely on for small loans/gifts of food

and money in times of need. These findings suggest the need for changes in policy and better program supports for women to higher education, technical training and employment opportunities could work to increase their financial security and the food security of their households.

The study findings also revealed that although both food insufficient and marginally food sufficient households relied on similar coping strategies to help them manage difficulty in paying for food, the latter appeared to enjoy better access to social and financial capital (e.g., family members who loaned them money, personal savings, credit cards) which appeared to have helped them to remain food sufficient. However, it is also possible that marginally food sufficient households could have used other strategies to avoid food insufficiency that were not covered in the list of responses provided by the survey. Potential examples include starting a home business, sending family members to eat or live in the homes of kin or fictive kin (e.g., *padrinos*) and harvesting wild plants and animals. These and other possibilities should be further explored in future studies due to their potential to contribute to household food security status.

This study had some potential limitations. For example, the ENDEMAIN 2004 survey data may have underestimated HFI prevalence in Ecuador because it focused on the households of reproductive aged women. It did not include certain households who may be vulnerable to HFI such as older women, elderly couples or widowers who live alone. In addition, the cross-sectional survey design did not allow for establishment of temporal or causal effects and HFI assessment was limited to the prior 2-week period which may not be necessarily be representative of a household's usual food situation. Since overweight/ obesity and growth stunting also develop over a long period of time, we were forced to make certain assumptions about past household food sufficiency status. Prospective cohort studies are needed to simultaneously track HFI and anthropometric indicators over time in order to confirm the above associations identified in the present study.

Although most of the covariates reported for household food insecurity in prior studies also tracked for the food insufficiency measure in the present study, they are not directly comparable. Household food insufficiency is a more restrictive measure than food insecurity since it does not assess anxiety or concern over not having enough food. Thus, it does not measure the qualitative compromises experienced by food insecure households (Coleman-Jensen et al. 2012). Another potential limitation is that the survey used household-level food acquisition and expenditures as proxy indicators for food consumption and dietary diversity. Future studies should directly measure individual food intake and nutrient status since the intra-household food distribution often varies by age, gender, reproductive status, and other characteristics. Furthermore, the ENDEMAIN 2004 survey relied on fixed responses from respondents regarding their economic and food allocation coping strategies and these were restricted to only food insufficient

and/or marginally food sufficient households. Thus, it was not possible to explore potential alternative or positive deviance practices used by food sufficient households which could have been responsible for their better food sufficiency status. Future studies should employ in-depth interviews, focus groups, or other qualitative techniques to explore this important issue in detail.

In conclusion, the study findings support the notion that structural inequalities reduce the food access of impoverished and otherwise marginalized Ecuadorian households. The tendency toward decreasing levels of physical activity and sedentarism in the Ecuadorian population coupled with the increasing consumption of micronutrient poor energy-dense, processed, convenience, and fast foods linked to the nutrition transition is expected to continue to modify the experience of reproductive-aged women and their households regarding HFI, obesity, and obesity-related chronic diseases. Studies are needed to revisit this issue since significant changes in law, policy, and programs have occurred in recent years that may have affected the food security status of the population. The new 2008 Ecuadorian constitution laid the legal and policy framework for food sovereignty, food security, and a number of other important social protections in a new national development plan (WFP 2011). Within this framework, a new umbrella program has consolidated various initiatives in an effort to improve the coordination and effectiveness of the country's food, nutrition, and other social safety net programs for low-income households (WFP 2011). These include the popular conditional cash transfer program *(Bono de Desarrollo Humano)*, school feeding program, integral nutrition program (*Alimentate Ecuador*), and unconditional cash transfer program for the elderly (*Pension para Adultos Mayores*), and a public works employment program (*Mi Primer Empleo*), among others (World Bank 2014).

Ecuador tripled its spending on social safety net programs from 2005–2010 from 0.5% to 1.8% of the national GDP (World Bank 2014). It is anticipated that with the planned 2016 elimination of governmental fuel subsidies, which currently average $3.8 billion annually (7% of GDP), the savings will be reinvested in social safety nets, education, and other public services." It is recommended that some of this reinvestment be focused on safety net policy supports and programs that focus on improving the food security status of reproductive-aged women and their families through improved education, employment opportunities, and nutrition and financial literacy. It is also recommended that a national food security surveillance system be implemented that is linked to household health and nutrition surveys. The systematic measurement of household-level food security status is important to better understand its impact on diet, nutrition, and health, it allows for the better targeting of high risk groups, provides evidence for policy making, and the monitoring and evaluation of the effectiveness of food, nutrition, and other social safety net programs.

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