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Dietary Associations of Household Food Insecurity Among Children of Mexican Descent: Results of a Binational Study

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Abstract

Background/objective—Children of Mexican descent frequently experience household food insecurity both in the United States (US) and Mexico, however, little is known about the associations of food insecurity with dietary intake. This study aimed to understand the level of perceived food insecurity and its association with dietary intake among children of Mexican descent residing in the US and Mexico.

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Design—This cross-sectional study utilized data from a 2006 binational study of five-year-old children of Mexican descent living in migrant communities in California (CA) and Mexico (MX).

Methods—In CA, children were 301 participants from the CHAMACOS study, a longitudinal birth cohort in a Mexican immigrant community. MX children (n=301) were participants in the Proyecto Mariposa study, which was designed to capture a sample of women and their children living in Mexico who closely resembled the CA sample, yet who never migrated to the US. Household food insecurity was measured using the US Department of Agriculture Food Security Scale and dietary intake was assessed with food frequency questionnaires. Analysis of variance was used to examine unadjusted and adjusted differences in total energy, nutrient intake, and consumption of food groups by household food security status.

Results—Approximately 39% of the CA mothers and 75% of the MX mothers reported low or very low food security in the last 12 months (p<0.01). Children in the US, experiencing food insecurity consumed more fat, saturated fat, sweets and fried snacks than children not experiencing food insecurity. In contrast, in Mexico food insecurity was associated with *lower* intake of total carbohydrates, dairy and vitamin B6.

Conclusions—Programs and policies addressing food insecurity in the US and Mexico may need to take steps to address dietary intake among children in households experiencing food insecurity, possibly through education and programs to increase resources to obtain healthy foods.

Keywords

Food insecurity; dietary intake; children; Mexican immigrants

Introduction

Household food insecurity, defined as, "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire foods in a socially acceptable way (1)," is more likely to affect low-income, minority groups in the United States (US) (2–8). According to the 2007 Current Population Survey of US Households, 11.1% of all households in the US were classified as food insecure whereas 20.1% of Hispanics reported food insecurity (9). Studies of Mexican immigrants and Hispanic farmworkers living in the US have observed even higher prevalences of food insecurity ranging from 30% to 80% (2, 3, 5–8). In addition, evidence suggests that Mexicans in the US emigrate from areas of high food insecurity (10, 11). A study of Mexico City school children found that 41% experienced food insecurity (10) while a study of mothers of preschool-age children from rural Jalisco found that almost all (97%) experienced food insecurity (11).

Despite the high prevalence of food insecurity in Mexican households on both sides of the border, few studies have examined whether food insecurity is associated with dietary intake among children of Mexican descent on either side of the border. Two studies of Hispanic children in the US, ranging in age from four to 16 years, reported no association of food insecurity and total energy or macronutrient intake, percentage of energy intake from fat and other macronutrients, or intake of most food groups (12, 13), though one reported lower meat consumption among food-insecure youth (12). The only study to focus exclusively on younger Mexican-American children (three to six years) found that, after controlling for acculturation, children in severely food insecure households were less likely to meet the US Food Guide Pyramid recommended servings of grains, vegetables, fruit, milk and meat than other children (14). In Mexico, a study of nine- and ten-year-old children in Mexico City (n=769) found that food insecurity was associated with higher intake of sweets and fried snacks (10). In contrast, a study of mothers with preschool children in rural areas of the state of Jalisco, Mexico found that food insecurity was associated with lower household inventories of all food groups examined (11).

Although families are likely to experience food insecurity on both sides of the border, the foods they choose to eat given limited resources are likely to be different as a result of the diverse food environments in each country. Drawing upon data from a binational study of young children of Mexican descent living in migrant communities in California and Mexico, this study tested the hypothesis that food insecurity would affect dietary intake differently in the US and Mexico. Specifically, that food insecurity would be associated with increased dietary intake, particularly in the form of food of minimal nutritional value in the US, and overall decreased macronutrient and micronutrient intake in Mexico. Nutrition programs and policies in the US and Mexico can benefit from understanding similarities and differences in the level of perceived food insecurity and its association with dietary intake on both sides of the border due to continuous US-Mexico migration and the binational nature of the Mexican migrant population.

Methods

Study Design and Participants

This binational study was comprised of two cross-sectional samples of five-year-old children and their mothers. The California (CA) sample included Mexican-born mothers and their children from the Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) longitudinal birth cohort study. Data from the five-year follow-up visit was used for the present analysis. The CHAMACOS study has been described elsewhere (15, 16). Briefly, a convenience sample of pregnant women was recruited between 1999 and 2000 in Salinas, CA from prenatal clinics that served a predominantly low-income, Spanish-speaking population. Women were eligible for the study if they were: less than 20 weeks gestation, 18 years or older, Medi-Cal eligible, fluent in English or Spanish, and planning to deliver in the local hospital. Approximately 53% of eligible women screened agreed to take part in this multi-year study. Of the 601 women initially enrolled in CHAMACOS, 458 Mexican-born mothers were followed through delivery of a live birth that survived the neonatal period. Three hundred and five follow-up interviews were completed when the children were five years old. Four mother-child pairs were excluded due to implausible energy intakes (< 80% of each child’s Basal Metabolic Rate (17)) for a final CA sample size of 301.

In Mexico, a convenience sample of women and children was recruited through local government community health clinics from families that received a federal conditional cash transfer program (Oportunidades). All Oportunidades beneficiaries receive cash transfers, health care services and heath and nutrition education as well as nutrition supplementation during critical periods (pregnancy, lactation and early childhood). Because Mexican-born women in the CA sample were most commonly from the states of Michoacán (24%), Guanajuato (20%), and Jalisco (12%) recruitment for the MX sample was from high-migration communities in these three states. Municipalities were considered high-migration if, as of the most recent Mexican census in 2005, 10% or more of the male population in the majority of towns and districts in the municipality were residing in the US (18). Recruitment was done in this way to capture a sample of women and their children living in Mexico that closely resembled the CA sample and had similar access to health care and education.

Women and their five-year-old children were eligible to participate if: the child was approximately five years old (59 months to 66 months); the mother was 23 years or older (at least 18 when child was born); the mother and child were currently receiving the Oportunidades benefits; the mother and child lived exclusively in Mexico and had never migrated to the US for longer than one month (other family members could have migrated); and the mother spoke fluent Spanish. Over 95% of the eligible mothers agreed to participate (n=317). Sixteen mother-child pairs with implausible energy intakes (< 80% of each child's Basal Metabolic Rate (17)) were excluded for a final MX sample size of 301.

The sample size for the CHAMCOS cohort was originally determined to examine pesticide exposure and neurodevelopmental outcomes. A similar number of women were recruited in Mexico and the sample size was deemed large enough for this analysis to detect differences between groups in kilocalories and macronutrients. The Institutional Review Boards at UC Berkeley and the Mexican National Institute of Health approved the study.

Measures

Interviewers for the CHAMACOS and Proyecto Mariposa studies were trained in the same study protocols, including interview administration, anthropometry and food frequency questionnaires. Interviewers conducted repeated administrations of the study protocol until results were reliable. They conducted face-to-face interviews and anthropometric measurements from 2005 to 2006. Written informed consent was obtained from all participants.

Dietary intake—Two different food frequency questionnaires (FFQ) were used to determine children's energy, nutrient and food group intakes to allow for the differences in customs and availability of foods in the US and Mexico. In CA, the Harvard Service Food Frequency Questionnaire for Hispanic children was used (19). In MX, a FFQ developed by the Division of Nutritional Epidemiology at the Mexican National Institute of Public Health was used (20). Overall, these two instruments were very similar with slight variations to account for the differing food environments. Both instruments had identical structures whereby interviewers asked mothers how many times the child ate a certain item in the last month, and women could respond in times per day, times per week or times per month and serving size was not specified. Overall the CA instrument had 96 total items and the MX instrument had 93 total items. The two instruments covered the same food groups in the same order and included the same number of foods within each food group. The two instruments were different in some of the specific food items that were included within each food group. In total, 16 food items on the CA FFQ were not included on the MX FFQ. Interviewers in CA and MX, who received identical training, administered the FFQ's to mothers.

Total energy, macronutrients, micronutrients and the following ten foods and food categories: vegetables; fruit; bread, cereals and grains (including tortillas); tortillas (alone); beans; dairy; meat; sweetened beverages; fast food; and sweets and fried snacks were examined. These categories were chosen because they were similar to food groups in the US Department of Agriculture (USDA) Food Guide Pyramid (21) and the Mexican nutrition guide known as the "Plate of Good Eating" (22). Additionally, sweetened beverages, fast food, sweets and fried snacks were included due to their possible connection with childhood overweight and tortillas and beans because of their importance for the Mexican diet.

Energy and nutrient intake from the two different FFQs were estimated using a specifically designed program for each country. Both programs were based on the USDA Nutrient database with additional information from local databases. The database used for the CA sample was a specifically designed program (harvardsffq.041206, April 12, 2006, Harvard University, Boston, MA), which uses the USDA Nutrient Database for Standard Reference and supplemented with additional food composition references, journals and manufacturers (23–25). In MX, a program designed by the Nutritional Epidemiology Department at the Mexican National Institute of Public Health, which is based on the USDA Nutrient Database for Standard Reference and supplemented with information form the Food Composition Tables from the Mexican National Institute of Nutrition, as well as others was used (26–28). In both cases, the nutrient calculations were based on the frequency chosen on the questionnaire multiplied by the portion size of the food. Missing values were imputed from similar foods when appropriate. All foods are summed to get the nutrient totals. Portion sizes for each country were based on national data (29, 30).

Household food insecurity—Household food insecurity was measured using the USDA Household Food Security Scale (FSS), Spanish Version (6-item Short Form) in both locations (31, 32). The FSS assesses three components of food insecurity during the last 12 months: 1) perception that quantity and quality of food are insufficient; 2) coping mechanisms such as reducing food intake or skipping meals; and 3) experiencing hunger due to lack of resources. Households were classified as experiencing food security, low food security or very low food security according to USDA guidelines (31). This instrument has been used with several Mexican immigrant populations in the US (2, 3, 5, 7, 8) and it has been shown to be a useful tool for assessing food insecurity in Mexico as well (11).

Covariates—Covariates were selected *a priori* because of their importance in describing the socio-demographic characteristics of the sample or because of their possible association with household food insecurity (3, 33) and included mother's marital status, mother's education level, mother's current work status, father's education level, father's current work status, household size and household socioeconomic status (SES). In addition, whether the parents were farmworkers, if the family received food assistance and mother's time spent in the US were examined in the CA sample and family migration experience was examined in the MX sample. A different SES measure, relative to each sample, was used in CA and MX.

In CA, SES was measured using a continuous measure of per capita household income divided into tertiles. In MX, a developing country setting where self-reported household income may not accurately capture household socioeconomic status (34), a principal component analysis was used to summarize housing characteristics, such as type of floor, level of sanitation and household assets, such as appliances and cars as proxy measures for SES. The first principal component was retained (35) and divided into tertiles.

Mother's length of residence in the US was used as a proxy for acculturation in the CA sample given that all women were foreign-born and the majority were monolingual Spanish-speaking (36). In CA, women receiving Supplemental Nutrition Program for Women, Infant and Children coupons or food stamps were classified as receiving food assistance. In the MX sample, it was not necessary to include a variable for food assistance because all families were receiving cash transfers, which are intended to improve resources for food as part of the Oportunidades program. To determine the extent to which the mother and child may have been affected by migration to the US in the MX study, women were asked if the child's father or the current head of household or any other close family member, including her grandparents, parents, siblings or other children had migrated to the US for work and if any of them were currently residing in the US.

Statistical Analysis

Sociodemographic characteristics of households that reported food security, low food security and very low food security were compared using Pearson's Chi-square tests and Fisher's exact tests in the case of small cell sizes separately for the CA and MX samples. To describe children's diet, children's median, 25th and 75th percentiles (interquartile range) of energy and nutrient intakes well as their consumption of the food groups were calculated. Medians were calculated instead of means due to the skewed distributions of the majority of the dietary outcomes.

Analysis of Variance (ANOVA) and Tukey's HSD post hoc test for pairwise comparisons, which takes into account multiple comparisons, were used to examine unadjusted differences in total energy, nutrient intake, and consumption of food groups by household food security status. To satisfy the ANOVA assumption of normally distributed dependent variables, diet variables were transformed to approximate the normal distribution using the Box-Cox power transformation method (37). Because the interaction term for household food security and sample (CA vs. MX) was significant in models for each dietary outcome ($p<0.05$), except for the model for vegetables ($p=0.29$), the results are presented stratified by sample.

To examine whether food security status was associated with dietary intake independent of potential confounders, each ANOVA model was repeated including variables for SES and maternal education level. In addition, for the CA sample, a variable to indicate if the mother was currently working in farmwork and if the family was receiving food assistance was included. These covariates were either associated with food security status in this study or have been shown to be associated in the literature (3, 33). Mother's length of residence in the US was not included as a covariate because it was not significantly associated with food security status or dietary intake in the CA sample. Statistical analyses were conducted using

STATA (version 10.0 for Windows, 2006, StataCorp, College Station, TX). A p-value of ≤ 0.05 was considered statistically significant for all analyses.

Results

As seen in Figure 1, approximately 39% of the CA mothers and 75% of the MX mothers reported that their households had experienced low or very low food security in the last 12 months (p<0.01). One tenth of the CA mothers and almost a third of MX mothers reported very low food security (p<0.01). As expected, households classified in the low and very low food security groups were more likely to be in the lowest SES tertile in both samples (p≥ 0.01) (Table 1). No differences in household food security according other demographic characteristics were observed.

Macronutrient and Micronutrient Intake

CA children from households in the low and very low food security groups were found to have higher energy (p=0.03) and fat intakes (p=0.02) compared to children from food secure households (Table 2) in the unadjusted analysis. After controlling for SES, maternal education, mother's farmworker status, and food assistance, the association of household food insecurity and total energy intake was reduced to non-significant (p=0.07), while the associations with fat and saturated fat remained significant (p<0.05). No differences in intake of other vitamins and minerals according to food security status were found (p>0.05).

In contrast to the CA sample, MX children from households with very low food security consumed *fewer* calories (median 1357 kcals vs. 1631 kcals p=0.03) and carbohydrates (median 220 g vs. 249 g p=0.02) than children from food secure households (Table 3). After controlling for SES and maternal education, the association with energy intake was reduced to non-significant (p=0.09) and the association with carbohydrate intake persisted (p=0.05). Additionally, intake of vitamin B6 was lower among children from food insecure households (adjusted ANOVA p=0.05).

Food Groups

CA children had similar intakes of vegetables, fruits, grains, tortillas, beans, dairy, sweetened beverages, and fast food across all levels of household food insecurity (Table 4). However, food insecurity was associated with more frequent consumption of sweets and fried snacks, with mothers in the low and very low food security groups reporting intakes of 2.5 and 2.3 times per day, respectively, compared to 1.9 times per day for the food secure group (p<0.01). This association remained significant after controlling for SES, maternal education, mother's farmworker status, and food assistance (p<0.01). The low food security group reported the highest (adjusted ANOVA p=0.04) consumption of meat (0.9 times/day) compared to those in the very low food security (0.6 times/day) and food secure groups (0.7 times/day).

Unadjusted ANOVA tests indicated that children from food secure households in MX had higher intakes of fruits (1.7 times/day vs. 1.2 times/day p=0.05), meat (1.0 times/day vs. 0.7 times/day p=0.04) and dairy (2.1 times/day vs. 1.1 times/day p=0.01) than children in the low and very low food security groups (Table 4). Additionally, children in the very low food security groups consumed more beans than children in the low food security group (6 times/day vs. 4 times/day $p<0.01$). After controlling for covariates, the associations between food security status and fruit and meat were reduced to non-significant ($p\leq 0.10$) but the associations with dairy ($p=0.05$) and beans ($p=0.01$) persisted.

Discussion

In this binational study of children of Mexican descent residing in migrant communities in Mexico and California, the prevalence of food insecurity was much higher in households in Mexico compared to California (75% vs. 39%) using the 6-item FSS. The prevalence of food insecurity in the California sample was higher than the US national estimate of 19.5 % for Hispanics (4), likely because the sample was comprised primarily of low-income farmworker families. However, the estimate was lower than other studies of migrant farmworkers and other Hispanic immigrants that also used the FSS (2, 3, 5, 7, 8). For example, a survey of primarily Mexican farmworkers in North Carolina (n=102) found that 47% of households were classified as food insecure using the 18-item FSS (3) and the California Women's Health Survey found that 62% of Mexico-born women reported food insecurity in the last 12 months using the 6-item FSS (5). Additionally, although an association of food security and acculturation has been shown in other studies of Mexican-Americans (8, 14), food insecurity was not associated with maternal years of residence in the US in the California sample. This is likely due to homogeneity of this Mexican-born, Spanish-speaking sample of mothers.

Compared to studies in Mexico, the estimate of food insecurity prevalence for the Mexico sample (75%) was higher than the estimate from a study of school-age children in Mexico City (41%) of low and middle socioeconomic level (10) and lower than a study of mothers of preschool-age children from small rural communities in Jalisco (97%) (11).

According to this study, children in California experiencing food insecurity consumed more fat and saturated fat than children not experiencing food insecurity and these higher intakes persisted after controlling for covariates. Total energy was also higher in children experiencing low or very low food security in the unadjusted analysis. Other studies examining energy intake have either found that food insecurity or food insufficiency is associated with lower energy intakes (13, 38) or no difference in energy intake (12, 39, 40). It is possible that higher energy and fat intakes in this study were due to consumption of low-cost, energy-dense foods as food insecurity was associated with increased consumption of sweets and fried snacks. It could also be partially due to higher meat consumption, at least among the low food security group. Further analysis of the meat consumption patterns revealed that the higher meat consumption in the low food security group was due primarily to a higher consumption of fried chicken. Research has shown that sweet and high-fat foods are more affordable than foods consistent with a "healthy diet" such as fruits, vegetables, lean meat and whole grains (41). Consumption of sweet and high-fat foods may put children at increased risk for childhood overweight. Previous research with adult women and some studies of children have found that household food insecurity is associated with increased weight (33, 42–44). Researchers have hypothesized that reliance on low-cost, energy dense foods may be one possible mechanism for this association (33, 39, 43, 44).

In contrast to the findings for the California sample, in Mexico food insecurity was associated with *lower* intake of total carbohydrates, dairy and vitamin B6, after adjusting for covariates. Total energy, fruit and meat intake were also lower in children from low food secure households in the unadjusted analysis, however, it appeared that controlling for markers of socioeconomic status attenuated these associations. These finding were consistent with the study hypothesis. However, contrary to the study hypothesis, food insecurity was not associated with decreased intake of the majority of micronutrients. All children included in the Mexico sample were in the lowest 20th percentile of income in Mexico and it is possible that at this low end of the SES spectrum, food insecurity is not an important determinant of micronutrient intake. Beans were the only food consumed more frequently in the very low food secure group compared to the other groups, likely due to their low cost.

Only two other studies have assessed household food insecurity and diet in Mexico and the results have been inconsistent. The previously mentioned study of mothers in rural areas of Jalisco did not examine dietary intake but found that household food insecurity was significantly associated with lower household inventories of foods of animal origin, dairy, processed foods, foods high in added sugar, fruits and vegetables (11). While, Ortiz-Hernandez et al (2007) reported that severe food insecurity in Mexico City children was associated with higher intakes of sweet bread, snacks, fried pork skin, ice cream, peanuts, candy and sodas (10). These disparate findings may be related to differences in food availability in Mexico City compared to smaller cities as well as the purchasing power and food choices of the poor.

The association of food insecurity and lower nutrient and food group intake in Mexico may help to understand the findings of higher sweet and fried snack intake among Mexican immigrants in California. Prior to immigrating to California, Mexican immigrant parents may have experienced similar levels and effects of food insecurity as was observed in the Mexican sample of the present study. It is possible that Mexican immigrant parents in the US overcompensate for previous experiences of food insecurity in Mexico by providing their children with packaged foods that are commonly high in fat, readily available and inexpensive in the US (41) but which they did not have in Mexico (45). This could have important implications for health education and nutritional counseling among food insecure Mexican immigrant households in the US. Future research should examine how past experiences of food insecurity among parents affects children's dietary intake and child feeding strategies, especially in the context of migration.

This study had several limitations. Diet was assessed using Food Frequency Questionnaires (FFQ), which attempt to gather usual dietary intake over a specific period of time by asking about a list of core foods. Critics have pointed out that FFQ's are difficult for participants to answer, limited in detail about portion size and food preparation, and ineffective in gathering information about mixed dishes such as stews or casseroles (46, 47). However, FFQs are still the instrument of choice for epidemiologic studies because of their ability to capture long-term diet as opposed to intake on a few specific dates and their usefulness for ranking participants (48). Secondly, slightly different FFQs in California and Mexico were used, making it difficult to directly compare energy and nutrient intakes between the two samples.

At the same time, using FFQs and nutrient databases specific to each country allowed us to address dietary differences according to food security status within each sample with greater accuracy. Finally, the generalizability of this study is limited because the samples were drawn from one low-income farmworker community in California and low-income Oportunidades recipients in Mexico.

Conclusions

These findings have important implications for nutrition programs and policy addressing food insecurity in both countries. Among children of Mexican immigrants in California, food insecurity was associated with a dietary intake that may encourage childhood overweight. Consequently, programs such as the Supplemental Nutrition Program for Women, Infant and Children and the Food Stamp program may need to take steps to improve the quality, quantity and accessibility of healthy foods for children experiencing food insecurity. These programs could include parent education, outreach with local businesses to improve accessibility of healthy foods in areas where food insecure children live as well as policies and programs aimed at decreasing intake of sweets and fried snacks among food insecure children. In Mexico, programs to address food insecurity, such as the national social welfare program, Oportunidades, should take into consideration that food insecurity could lead to increases in energy, fat, sweets and fried snacks among Mexicans as we have shown among Mexican immigrant children in California. This is especially important given Mexico's transitioning epidemiologic and nutritional profile to one more similar to the US, including increasing trends in childhood overweight. Future research in Mexico should follow the impacts of food insecurity on dietary intake among children given the current nutritional transition.

Bibliography

1. Anderson S. Core indicators of nutritional state for difficult-to-sample populations. Journal of Nutrition. 1990; 121:1559–1600.
2. Kasper J, Gupta SK, Tran P, Cook JT, Meyers AF. Hunger in legal immigrants in California, Texas, and Illinois. Am J Public Health. 2000; 90:1629–1633. [PubMed: 11030002]
3. Quandt SA, Arcury TA, Early J, Tapia J, Davis JD. Household food security among migrant and seasonal latino farmworkers in North Carolina. Public Health Rep. 2004; 119:568–576. [PubMed: 15504448]
4. Nord, M.; Andrews, M.; Carlson, S. Household Food Security in the United States, 2006. Economic Research Service, US Department of Agriculture; 2007.
5. Kaiser L, Baumrind N, Dumbauld S. Who is food-insecure in California? Findings from the California Women's Health Survey, 2004. Public Health Nutr. 2007; 10:574–581. [PubMed: 17381928]
6. Chavez N, Telleen S, Kim YO. Food insufficiency in urban Latino families. J Immigr Minor Health. 2007; 9:197–204. [PubMed: 17295051]
7. Kersey M, Geppert J, Cutts DB. Hunger in young children of Mexican immigrant families. Public Health Nutr. 2007; 10:390–395. [PubMed: 17362535]
8. Weigel MM, Armijos RX, Hall YP, Ramirez Y, Orozco R. The household food insecurity and health outcomes of U.S.-Mexico border migrant and seasonal farmworkers. J Immigr Minor Health. 2007; 9:157–169. [PubMed: 17245658]
9. Nord, M.; Andrews, M.; Carlson, S. Household Food Security in the United States, 2007. Economic Research Service, US Department of Agriculture; 2008.

10. Ortiz-Hernandez L, Acosta-Gutierrez M, Nunez-Perez A, Peralta-Fonseca N, Ruiz-Gomez Y. En escolares de la Ciudad de Mexico la insecuridad alimentaria se asocio positivamente con el sobrepeso. Revista de Investigacion Clinica. 2007; 59:32–41. [PubMed: 17569298]
11. Melgar-Quinonez H, Zubieta A, Valdez E, Whitelaw B, Kaiser L. Validacion de un instrumento para vigilar la inseguridad alimentaria en la Sierra de Manantlan, Jalisco. Salud Publica de Mexico. 2005; 47:413–422. [PubMed: 16983986]
12. Matheson DM, Varady J, Varady A, Killen JD. Household food security and nutritional status of Hispanic children in the fifth grade. Am J Clin Nutr. 2002; 76:210–217. [PubMed: 12081837]
13. Mazur RE, Marquis GS, Jensen HH. Diet and food insufficiency among Hispanic youths: acculturation and socioeconomic factors in the third National Health and Nutrition Examination Survey. Am J Clin Nutr. 2003; 78:1120–1127. [PubMed: 14668273]
14. Kaiser LL, Melgar-Quinonez HR, Lamp CL, Johns MC, Sutherlin JM, Harwood JO. Food security and nutritional outcomes of preschool-age Mexican-American children. J Am Diet Assoc. 2002; 102:924–929. [PubMed: 12146552]
15. Eskenazi B, Gladstone EA, Berkowitz GS, Drew CH, Faustman EM, Holland NT, Lanphear B, Meisel SJ, Perera FP, Rauh VA, Sweeney A, Whyatt RM, Yolton K. Methodologic and logistic issues in conducting longitudinal birth cohort studies: lessons learned from the Centers for Children's Environmental Health and Disease Prevention Research. Environ Health Perspect. 2005; 113:1419–1429. [PubMed: 16203258]
16. Eskenazi B, Harley K, Bradman A, Weltzien E, Jewell NP, Barr DB, Furlong CE, Holland NT. Association of in utero organophosphate pesticide exposure and fetal growth and length of gestation in an agricultural population. Environ Health Perspect. 2004; 112:1116–1124. [PubMed: 15238287]
17. Schofield W. Predicting basal metabolic rate, new standards and review of previous work. Human Nutrition: Clinical Nutrition. 1995; 39C:5–41.
18. INEGI. [Accessed July 1, 2008, 2008] Conteo de poblacion y vivienda 2005 [Population and Housing Census 2005]. 2005. http://www.inegi.gob.mx/inegi/default.aspx?s=est&c=10202
19. Stein AD, Shea S, Basch CE, Contento IR, Zybert P. Consistency of the Willett semiquantitative food frequency questionnaire and 24-hour dietary recalls in estimating nutrient intakes of preschool children. Am J Epidemiol. 1992; 135:667–677. [PubMed: 1580243]
20. Diaz Montiel, J. Validacion de un cuestionario de frecuencia de consumo de alimentos para ninos en edad preescolar. Cuernavaca, Mexico: Nutritional Epidemiology, Instituto Nacional de Salud Publica (National Institute of Public Health; 2004.
21. United States Department of Health and Human Services and United States Departmetn of Agriculture. Dietary Guidelines for Americans. Washington DC: 2005.
22. Secretaria de Salud (Secretary of Health). El Plato del Buen Comer (The Plate of Good Eating). 2006
23. US Department of Agriculture ARS. USDA National Nutrient Database for Standard Reference, Release. 2007; 20
24. Paul, A. McCance and Widdowson's The Composition of Foods. 4th ed.. London: H.M. Stationery Office; 1976.
25. Holland, B.; Welch, A.; Unwin, I.; Buss, D.; Paul, A. McCance and Widdowson's The Composition of Foods. 5th ed.. Cambridge: Royal Chemical Society and Ministry of Agriculture, Fisheries and Food; 1991.
26. Food and Agriculture Organization of the United Nations. Tabla de Composicion de Alimentos de America Latina. 2000.
27. Bourges Rodriguez, H.; Morales de Leon, J.; Camacho Parra, M.; Escobedo Olea, G. Tablas de Composicion de Alimentos. Subdireccion de Nutricion Experimental y Ciencia de los Alimentos, Instituto Nacional de la Nutricion Salvador Zubiran; 1996.
28. Munoz de Chavez M, Antonio Roldan J, Ledesma J, Mendoza E, Chavez A, Perez-Gil F, Hernandez S, Chaparro A. Tablas de Valor Nutritivo de los Alimentos de Mayor Consumo en Mexico. 1996
29. US Department of Agriculture. Continuing Survey of Food Intakes by Individuals. Low-income women 19–50 years of age and their children 1–5 years. Hyattsville, MD: 1987.

30. Rivera, JA.; Shamah, T.; Villapando, S.; Gonzalez, T.; Hernandez, B.; Sepulveda Amor, J. Encuesta Nacional de Nutricion (National Nutrition Survey). Cuernavaca, Morelos, Mexico: Instituto Nacional de Salud Publica (National Institute of Public Health; 1999.
31. Bickel, G.; Nord, M.; Price, C.; Hamilton, W.; Cook, J. Guide to Measuring Household Food Security. United States Department of Agriculture Food and Nutrition Service, Office of Analysis, Nutrition, and Evaluation; 2000.
32. Harrison GG, Stormer A, Herman DR, Winham DM. Development of a spanish-language version of the U.S. household food security survey module. J Nutr. 2003; 133:1192–1197. [PubMed: 12672942]
33. Dinour LM, Bergen D, Yeh MC. The food insecurity-obesity paradox: a review of the literature and the role food stamps may play. J Am Diet Assoc. 2007; 107:1952–1961. [PubMed: 17964316]
34. Falkingham, J.; Namazie, C. Measuring health and poverty: a review of approaches to identifying the poor. London: Department for International Development Health Systems Resource Centre; 2002.
35. Vyas S, Kumaranayake L. Constructing socio-economic status indices: how to use principal components analysis. Health Policy Plan. 2006; 21:459–468. [PubMed: 17030551]
36. Arcia E, Skinner M, Bailey D, Correa V. Models of acculturation and health behaviors among Latino immigrants to the US. Soc Sci Med. 2001; 53:41–53. [PubMed: 11386307]
37. Millns H, Woodward M, Bolton-Smith C. Is it necessary to transform nutrient variables prior to statistical analyses? Am J Epidemiol. 1995; 141:251–262. [PubMed: 7840099]
38. Rose D, Oliveira V. Nutrient intakes of individuals from food-insufficient households in the United States. Am J Public Health. 1997; 87:1956–1961. [PubMed: 9431283]
39. Casey PH, Simpson PM, Gossett JM, Bogle ML, Champagne CM, Connell C, Harsha D, McCabe-Sellers B, Robbins JM, Stuff JE, Weber J. The association of child and household food insecurity with childhood overweight status. Pediatrics. 2006; 118:e1406–e1413. [PubMed: 17079542]
40. Rose D. Economic determinants and dietary consequences of food insecurity in the United States. J Nutr. 1999; 129:517S–520S. [PubMed: 10064321]
41. Drewnowski A, Darmon N. Food choices and diet costs: an economic analysis. J Nutr. 2005; 135:900–904. [PubMed: 15795456]
42. Casey PH, Szeto K, Lensing S, Bogle M, Weber J. Children in food-insufficient, low-income families: prevalence, health, and nutrition status. Arch Pediatr Adolesc Med. 2001; 155:508–514. [PubMed: 11296080]
43. Dietz WH. Does hunger cause obesity? Pediatrics. 1995; 95:766–767. [PubMed: 7724321]
44. Alaimo K, Olson CM, Frongillo EA Jr. Food insufficiency and American school-aged children's cognitive, academic, and psychosocial development. Pediatrics. 2001; 108:44–53. [PubMed: 11433053]
45. Kuyper EM, Espinosa-Hall G, Lamp CL, Martin AC, Metz DL, Smith D, Townsend MS, Kaiser LL. Development of a tool to assess past food insecurity of immigrant latino mothers. J Nutr Educ Behav. 2006; 38:378–382. [PubMed: 17142195]
46. Brown D. Do food frequency questionnaires have too many limitations? J Am Diet Assoc. 2006; 106:1541–1542. [PubMed: 17000185]
47. Briefel RR, Flegal KM, Winn DM, Loria CM, Johnson CL, Sempos CT. Assessing the nation's diet: limitations of the food frequency questionnaire. J Am Diet Assoc. 1992; 92:959–962. [PubMed: 1640039]
48. Willet, W. Nutritional Epidemiology. New York: Oxford University Press; 1998.

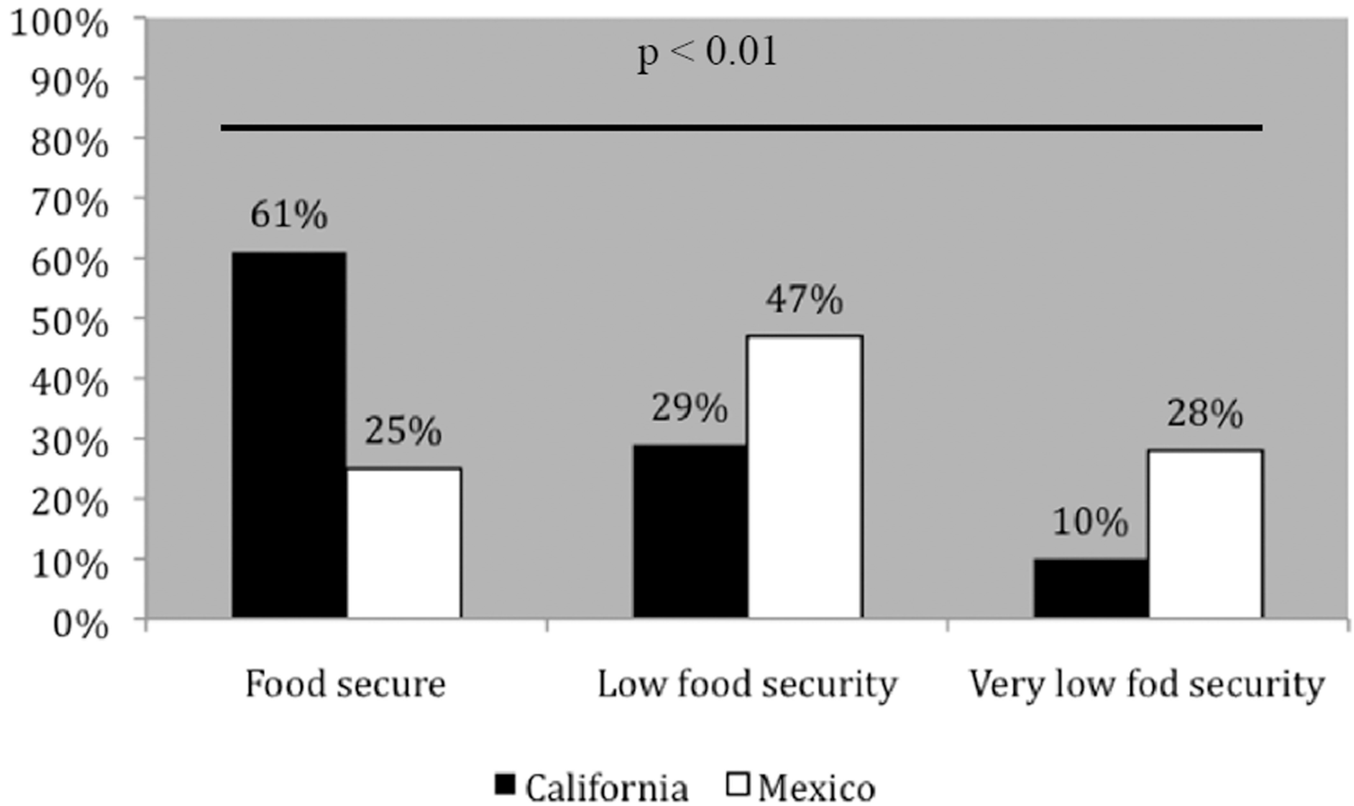

Figure 1.
Household food security status for households with five-year-old children in California (Salinas, CA) and Mexico (Guanajuato, Jalisco, and Michoacán, Mexico) 2006.

Table 1

Selected socio-demographic characteristics of participants by food security status, CHAMACOS (Salinas, CA) and Proyecto Mariposa (Guanajuato, Jalisco, and Michoacán, Mexico) 2006.

Characteristic	CHAMACOS (n=301)					Proyecto Mariposa (n=301)				
	Total	Food secure	Low food security	Very low food security		Total	Food secure	Low food security	Very low food security	
	n (%)	n (%)	n (%)	n (%)	p-value[a]	n (%)	n (%)	n (%)	n (%)	p-value[a]
Married or living as married					0.61					0.96
No	33 (11.0)	20 (10.8)	10 (11.4)	5 (16.1)		20 (6.6)	5 (6.3)	11 (7.4)	5 (5.6)	
Yes	268 (89.0)	166 (89.3)	78 (88.6)	26 (83.9)		281 (93.4)	74 (93.7)	138 (92.6)	84 (94.4)	
Mother's education					0.06					0.86
Elementary or less	151 (50.2)	88 (47.3)	48 (54.6)	18 (58.1)		207 (68.8)	51 (64.6)	103 (69.1)	63 (70.8)	
Middle or high school	105 (34.9)	62 (33.3)	32 (36.4)	12 (38.7)		88 (29.2)	27 (34.2)	43 (28.9)	24 (27.0)	
High school graduate or more	45 (15.0)	36 (19.4)	8 (9.1)	1 (3.2)		6 (2.0)	1 (1.3)	3 (2.0)	2 (2.3)	
Mother currently works					0.41					0.87
No	177 (58.8)	44 (37.6)	32 (46.4)	10 (47.6)		193 (64.1)	52 (65.8)	96 (64.4)	55 (61.8)	
Yes	124 (41.2)	73 (62.4)	37 (53.6)	11 (52.4)		108 (35.9)	27 (34.2)	53 (35.6)	34 (38.2)	
Father's education					0.12					0.17
Elementary or less	141 (53.6)	82 (48.0)	46 (63.9)	16 (66.7)		198 (68.0)	46 (59.7)	98 (68.5)	64 (74.4)	
Middle or high school	95 (36.1)	71 (41.5)	19 (26.4)	6 (25.0)		91 (31.3)	31 (40.3)	44 (30.8)	21 (24.4)	
High school graduate or more	27 (10.3)	18 (10.5)	7 (9.7)	2 (8.3)		2 (0.7)		1 (0.7)	1 (1.2)	
Father currently works					0.83					0.41
No	79 (26.3)	33 (19.8)	13 (16.5)	6 (20.7)		31 (11.0)	2 (2.8)	6 (4.6)	6 (7.7)	
Yes	221 (73.7)	134 (80.2)	66 (83.5)	23 (79.3)		251 (89.0)	69 (97.2)	124 (95.4)	72 (92.3)	
Socioeocnomic status					0.01					<0.01
Low	138 (46.0)	73 (39.3)	50 (56.8)	18 (60.0)		96 (32.1)	17 (21.5)	45 (30.6)	43 (48.3)	
Medium	66 (22.0)	42 (22.6)	16 (18.2)	8 (26.7)		102 (34.1)	25 (31.7)	51 (34.7)	29 (32.6)	
High	96 (32.0)	71 (38.2)	22 (25.0)	4 (13.3)		101 (33.8)	37 (46.8)	51 (34.7)	17 (19.1)	
Household size					0.71					0.40
4 members or fewer	122 (40.5)	80 (43.5)	32 (37.2)	10 (32.3)		54 (17.9)	16 (21.1)	23 (15.9)	15 (18.8)	
5–6 members	143 (47.5)	82 (44.6)	44 (51.2)	17 (54.8)		151 (50.2)	35 (46.1)	81 (55.9)	35 (43.8)	
7 members or more	36 (12.0)	22 (12.0)	10 (11.6)	4 (12.9)		96 (31.9)	25 (32.9)	41 (28.3)	30 (37.5)	

Characteristic	CHAMACOS (n=301)					Proyecto Mariposa (n=301)				
	Total	Food secure	Low food security	Very low food security		Total	Food secure	Low food security	Very low food security	
	n (%)	n (%)	n (%)	n (%)	p-value[a]	n (%)	n (%)	n (%)	n (%)	p-value[a]
Mother's years in the US					0.42					
5–10 years	157 (52.2)	104 (55.9)	40 (45.5)	16 (51.6)						
11–15 years	91 (30.2)	53 (28.5)	28 (31.8)	11 (35.5)						
16+	53 (17.6)	29 (15.6)	20 (22.7)	4 (12.9)						
Mother currently farmworker					0.09					
No	239 (79.4)	155 (83.3)	64 (72.7)	23 (74.2)						
Yes	62 (20.6)	31 (16.7)	24 (27.3)	8 (25.8)						
Father currently farmworker					0.22					
No	139 (46.2)	94 (50.5)	36 (40.9)	12 (38.7)						
Yes	162 (53.8)	92 (49.5)	52 (59.1)	19 (61.3)						
Receive food assistance					0.60					
No	60 (19.9)	37 (20.1)	15 (17.4)	8 (25.8)						
Yes	241 (80.1)	147 (79.9)	71 (82.6)	23 (74.2)						
Family member currently in US[b]										0.13
No						132 (43.9)	30 (38.0)	64 (43.0)	47 (52.8)	
Yes						169 (56.2)	49 (62.0)	85 (57.1)	42 (47.2)	

[a] p-value from Chi-square test or Fisher’s Exact test in cases of small sample size; p-value of ≤ 0.05 considered significant

[b] Family member includes child's father or the current head of household and the mother's grandparents, parents, siblings, or other children

Table 2

Median and interquartile range (IQR)[a] of energy and nutrient intake according to food security level among children in CHAMACOS (Salinas, CA) 2006

Nutrient	Total n=301		Food Security Status: Food secure		Food Security Status: Low food security		Food Security Status: Very low food security		ANOVA[b] p-value	Adjusted ANOVA[c] p-value
	Median	(IQR)	Median	(IQR)	Median	(IQR)	Median	(IQR)		
Energy (kilocalories)	1961.4	(1584.1, 2380.4)	1897.3	(1540.8, 2280.0)	2114.2	(1754.3, 2559.0)	2042.4	(1431.4, 2489.1)	0.03	0.07
Fat (g)	65.1	(50.4, 80.3)	61.0	(48.7, 74.2)	68.2	(56.7, 84.6)	71.5	(47.0, 87.4)	0.02	0.03
Saturated fat (g)	24.3	(18.8, 30.2)	23.3	(17.9, 27.9)	26.3	(20.3, 32.3)	27.6	(19.2, 35.3)	0.02	0.03
Carbohydrate (g)	284.1	(221.6, 355.3)	275.8	(217.0, 351.0)	309.2	(249.9, 373.1)	291.7	(209.3, 323.4)	0.06	0.12
Protein (g)	68.4	(56.3, 86.4)	66.9	(55.1, 84.5)	73.0	(63.3, 88.1)	68.2	(50.5, 88.3)	0.06	0.08
Fiber (g)	19.9	(15.0, 26.8)	19.5	(15.1, 24.9)	22.1	(15.6, 29.0)	18.7	(13.4, 28.6)	0.15	0.28
Cholesterol (mg)	232.3	(192.8, 289.0)	227.3	(184.6, 281.7)	243.6	(204.4, 301.7)	223.2	(201.5, 288.1)	0.10	0.18
Sodium (g)	2.8	(2.1, 3.5)	2.6	(2.1, 3.4)	2.9	(2.3, 3.6)	2.9	(2.1, 3.6)	0.09	0.17
Vitamin A (µg)	988.4	(741.8, 1286.1)	981.1	(770.4, 1281.6)	1020.1	(745.4, 1315.7)	931.7	(693.7, 1209.0)	0.61	0.70
Vitamin E (mg)	5.1	(4.1, 6.7)	5.1	(4.0, 6.2)	5.2	(4.4, 7.6)	5.2	(4.1, 7.2)	0.07	0.09
Vitamin C (mg)	113.3	(68.2, 180.0)	111.3	(67.9, 175.5)	118.2	(64.2, 183.7)	115.9	(72.8, 179.1)	0.63	0.61
Vitamin B6 (mg)	1.8	(1.5, 2.3)	1.8	(1.4, 2.2)	1.8	(1.5, 2.4)	1.6	(1.4, 2.3)	0.12	0.16
Vitamin D (µg)	266.0	(211.4, 322.8)	265.2	(211.6, 312.5)	274.6	(215.3, 343.7)	260.3	(158.3, 306.2)	0.14	0.13
Folate (µg)	491.7	(387.4, 626.5)	483.4	(382.8, 601.6)	512.7 *	(398.7, 646.0)	520.1 *	(331.5, 632.0)	0.21	0.26
Vitamin B12 (µg)	5.4	(4.1, 6.7)	5.4	(4.3, 6.5)	5.8	(4.0, 7.4)	5.0	(3.7, 6.2)	0.08	0.08
Calcium (mg)	1127.4	(903.4, 1351.9)	1094.4	(900.6, 1329.2)	1143.6	(953.0, 1520.9)	1126.4	(905.9, 1312.2)	0.15	0.16
Magnesium (mg)	278.9	(223.2, 344.6)	268.3	(213.5, 334.0)	287.0	(236.3, 364.7)	267.6	(220.0, 358.6)	0.09	0.13
Potassium (mg)	3.1	(2.5, 3.9)	3.0	(2.4, 3.8)	3.5	(2.6, 4.1)	3.0	(2.4, 3.8)	0.06	0.11
Iron (mg)	16.0	(11.2, 19.7)	15.5	(11.2, 19.0)	17.3	(11.1, 21.1)	15.4	(11.9, 19.5)	0.35	0.46
Zinc (mg)	12.3	(9.7, 15.3)	11.9	(9.8, 14.6)	13.6	(9.8, 16.5)	11.9	(9.4, 14.7)	0.20	0.24
Thiamin (mg)	1.5	(1.2, 1.8)	1.5	(1.2, 1.8)	1.6	(1.3, 1.9)	1.5	(1.2, 1.9)	0.07	0.11
Riboflavin (mg)	2.5	(1.9, 2.9)	2.4	(1.9, 2.8)	2.5	(2.0, 3.1)	2.4	(1.9, 2.8)	0.19	0.20
Phosphorus (mg)	1500.1	(1231.6, 1850.8)	1473.1	(1202.1, 1779.8)	1616.5	(1341.7, 1938.9)	1415.7	(1193.3, 1859.9)	0.09	0.13

[a] Median and IQR's are presented due to the skewed distributions of the nutrients

[b] Groups with the same symbol (*) are significantly different according to the post hoc Tukey HSD test of pairwise comparisons; p-value of ≤ 0.05 considered significant

[c]Adjusted for socioeconomic status, maternal education, receiving food assistance and mother currently working in farmworker

Table 3

Median and interquartile range (IQR)[a] or energy and nutrient intake according to food security level among children in Mexico (Guanajuato, Jalisco, Michoacán) 2006

Nutrient	Total n=301		Food Security Status: Food secure		Food Security Status: Low food security		Food Security Status: Very low food security		ANOVA[b]	Adjusted ANOVA[c]
	Median	(IQR)	Median	(IQR)	Median	(IQR)	Median	(IQR)	p-value	p-value
Energy (kilocalories)	1517.2	(1190.39, 1920.0)	1631.7 †	(1389.2, 2074.7)	1521.9	(1187.0, 1901.8)	1356.6 †	(1120.2, 1707.1)	0.03	0.09
Fat (g)	41.5	(31.86, 53.9)	45.5	(34.9, 58.2)	41.5	(30.6, 54.8)	39.3	(29.4, 49.7)	0.15	0.34
Saturated fat (g)	10.7	(7.84, 15.1)	12.2	(8.7, 16.4)	11.1	(7.6, 15.3)	9.8	(7.3, 14.0)	0.21	0.54
Carbohydrate (g)	248.7	(196.77, 315.3)	277.3	(219.3, 338.6)	244.2	(196.8, 309.0)	219.6	(174.6, 290.7)	0.02	0.05
Protein (g)	42.9	(31.73, 56.3)	44.4	(37.3, 60.2)	42.7	(30.9, 56.1)	39.2	(28.4, 51.4)	0.09	0.23
Fiber (g)	15.1	(11.97, 19.8)	16.4	(12.7, 21.8)	14.8	(11.6, 19.6)	14.1	(11.5, 19.3)	0.13	0.12
Cholesterol (mg)	136.8	(98.87, 194.1)	142.0	(98.0, 198.6)	132.9	(90.4, 190.8)	139.2	(112.0, 209.0)	0.40	0.39
Sodium (g)	0.7	(0.52, 1.0)	0.8	(0.6, 0.9)	0.7	(0.5, 1.0)	0.7	(0.5, 1.0)	0.30	0.27
Vitamin A (µg)	338.5	(217.86, 644.9)	389.8	(245.3, 683.4)	314.9	(217.3, 630.5)	336.6	(198.1, 635.9)	0.56	0.72
Vitamin E (mg)	5.3	(3.8, 7.1)	5.7	(3.9, 7.6)	5.1	(3.5, 6.8)	5.7	(4.4, 7.3)	0.33	0.26
Vitamin C (mg)	74.7	(47.47, 109.8)	84.5	(54.8, 118.9)	71.6	(48.4, 107.9)	69.0	(45.2, 95.3)	0.24	0.43
Vitamin B6 (mg)	1.1	(0.8, 1.5)	1.2 † ‡	(1.0, 1.7)	1.0 †	(0.9, 1.4)	1.0 ‡	(0.7, 1.5)	0.02	0.05
Vitamin D (µg)	10.9	(0.01 42.6)	10.9	(0.01 23.5)	10.7	(0.01 42.6)	11.0	(7.4 63.6)	0.84	0.70
Folate (µg)	224.4	(175.13, 299.8)	233.6	(181.4, 324.6)	217.5	(176.9, 291.9)	218.1	(158.4, 286.7)	0.41	0.55
Vitamin B12 (µg)	2.0	(1.2, 3.6)	2.1	(1.5, 4.0)	1.9	(1.1, 3.5)	1.9	(1.1, 3.5)	0.41	0.65
Calcium (mg)	663.9	(444.65, 1010.9)	751.3	(579.4, 1111.7)	653.5	(417.1, 1010.9)	583.5	(410.0, 853.8)	0.12	0.32
Magnesium (mg)	229.9	(171.8, 290.6)	245.3	(189.8, 325.7)	233.4	(175.5, 283.5)	211.8	(157.3, 288.6)	0.10	0.21
Potassium (mg)	1.8	(1.3, 2.5)	2.0	(1.6, 2.7)	1.8	(1.3, 2.5)	1.7	(1.2, 2.3)	0.22	0.27
Iron (mg)	10.8	(8.09, 14.8)	11.7	(8.7, 16.2)	10.8	(8.3, 14.8)	10.0	(7.3, 13.7)	0.17	0.23
Zinc (mg)	6.3	(0.00 9.0)	6.8	(0.01 9.3)	6.4	(0.00 8.8)	5.9	(4.0 9.5)	0.33	0.60
Thiamin (mg)	1.1	(0.00 1.6)	1.2	(0.00 1.8)	1.2	(0.00 1.6)	1.1	(0.8 1.5)	0.35	0.56
Riboflavin (mg)	1.3	(0.00 1.8)	1.3	(0.00 1.8)	1.3	(0.00 1.8)	1.2	(0.9 1.8)	0.33	0.61
Phosphorus (mg)	865.6	(0.64 1185.2)	958.4	(0.75 1336.3)	853.8	(0.61 1161.7)	760.1	(605.2 1130.3)	0.13	0.26

[a]Median and IQR's are presented due to the skewed distributions of the nutrients

[b]Groups with the same symbol (†or ‡) are significantly different according to the post hoc Tukey HSD test of pairwise comparisons; p-value of ≤ 0.05 considered significant

[c]Adjusted for socioeconomic status and maternal education

Table 4

Median and interaquartile range (IQR)[a] of consumption of selected food groups and foods among children according to food security level in CHAMACOS (Salinas, CA) and Mexico (Guanajuato, Jalisco, Michoacán) 2006

Food group	Food Security Status						ANOVA[b]	Adjusted ANOVA[c]
	Food secure		Low food security		Very low food security			
	Median	(IQR)	Median	(IQR)	Median	(IQR)	p-value	p-value
California n = 301								
Vegetables/day	2.3	(1.4, 3.5)	2.7	(1.9, 3.8)	2.6	(0.8, 3.9)	0.43	0.43
Fruits/day	2.8	(2.0, 4.3)	3.2	(2.1, 4.7)	2.4	(1.6, 3.9)	0.61	0.75
Grains/day[d]	5.1	(3.5, 6.6)	5.2	(4.1, 6.7)	4.3	(2.9, 6.8)	0.32	0.45
Tortillas/day	1.0	(0.4, 2.5)	1.0	(0.4, 2.5)	1.0	(0.4, 2.5)	0.66	0.39
Beans/day	3.0	(3.0, 7.0)	4.3	(3.0, 7.0)	3.0	(3.0, 7.0)	0.12	0.19
Meat/day[e]	0.7	(0.4, 1.1)	0.9	(0.6, 1.5)	0.6	(0.4, 1.1)	0.02	0.04
Dairy/day	3.4	(2.4, 4.7)	3.8	(3.1, 5.4)	3.1	(2.0, 3.9)	0.18	0.11
Sweetened beverages/day[f]	1.6	(0.9, 2.9)	1.4	(1.0, 2.9)	1.6	(0.9, 3.5)	0.62	0.66
Fast food/week	1.0	(0.5, 1.0)	1.0	(0.5, 1.0)	1.0	(0.5, 1.0)	0.47	0.49
Sweets and fried snacks/day	1.9 *	(1.1, 2.9)	2.5 *	(1.6, 3.9)	2.3	(1.1, 4.3)	<0.01	<0.01
Mexico n = 301								
Vegetables/day	2.8	(1.9, 4.2)	2.5	(1.7, 3.8)	2.9	(1.6, 4.1)	0.35	0.34
Fruits/day	1.7 *	(1.0, 2.6)	1.4	(0.9, 2.1)	1.2 *	(0.7, 2.1)	0.05	0.10
Grains/day[d]	5.8	(4.5, 7.9)	5.9	(4.6, 7.4)	5.3	(4.0, 7.4)	0.17	0.10
Tortillas/day	4.0	(3.0, 6.0)	4.0	(3.0, 5.4)	3.0	(3.0, 5.8)	0.48	0.39
Beans/day	6.0	(3.5, 7.8)	4.0 *	(3.0, 6.5)	6.0 *	(4.0, 8.5)	<0.01	0.01
Meat/day[e]	1.0	(0.6, 1.5)	0.9	(0.6, 1.4)	0.7	(0.5, 1.2)	0.04	0.09
Dairy/day	2.1 *	(1.3, 2.9)	1.5	(1.0, 2.8)	1.1 *	(0.8, 2.5)	0.01	0.05
Sweetened beverages/day[f]	1.1	(0.9, 2.0)	1.2	(0.9, 2.0)	1.1	(0.9, 1.5)	0.44	0.62
Fast food/week	0.0	(0.0, 0.0)	0.0	(0.0, 0.0)	0.0	(0.0, 0.0)	0.32	0.52
Sweets and fried snacks/day	2.3	(1.5, 3.5)	2.3	(1.4, 3.4)	1.8	(1.0, 3.1)	0.23	0.35

[a]Median and IQR's are presented due to the skewed distributions of the food ad food groups

[b] Groups with the same symbol (*) are significantly different according to the post hoc Tukey HSD test of pairwise comparisons; p-value of ≤ 0.05 considered significant

[c] California: Adjusted for socioeconomic status, maternal education, receiving food assistance, and farmworker status; Mexico: Adjusted for socioeconomic status and maternal education

[d] Includes tortillas

[e] Includes poultry, beef, pork

[f] Includes sodas and juices