SIMILARITY OF MATERNAL AND CHILD DIETARY INTAKES AMONG HISPANIC FAMILIES IN SOUTHEASTERN PENNSYLVANIA

by

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ABSTRACT

Childhood obesity is a serious crisis in the United States and is disproportionately affecting minorities. Compared to only 28.5% of white adolescents, 38.9% of Hispanic adolescents are overweight or obese indicating a need for immediate action.[1] As parents are the primary decision makers of their children's dietary intakes, it is necessary to understand what food choices parents are making for themselves and their children and what factors are influencing this relationship. As part of a larger cross-sectional study, this investigation aimed to understand the dietary intakes of 31 Hispanic mother-child dyads in Southern Chester County Pennsylvania. Twenty-four hour dietary recalls were used to measure dietary intakes among the population and bivariate analysis and regression modeling methods were used to assess the relationship between mother and child diet. The dietary intakes and mother-child diet similarity were then examined with respect to acculturation, food security, and participation in food assistance programs. Consistent with previous findings, Hispanic children and women were not meeting most recommended dietary intakes and are experiencing high rates of overweight and obesity, with 42% of children and 81% of mothers in this sample classified as overweight or obese. Overall, our study found that the diets of the mothers had minimal modeling effects on the diets of their children (majority of $p > 0.05$), and that the diets of the children were mainly constrained by food availability. Future interventions should focus on increasing access and availability of healthy foods to low income and immigrant families.

Chapter 1

INTRODUCTION

1.1 The Problem

As of 2012, 12.7 million adolescents in the United States, or 17%, are overweight or obese, a 22% increase since 2000.[1,2] This includes 8.4% of 2-to-5-year-olds, 17.7% of 6-to-11-year-olds, and 20.5% of 12-to-19-year-olds.[1] Obesity during childhood can have devastating consequences including diabetes, hypercholesterolemia, and hypertension, as well as psychosocial effects, such as eating disorders and behavioral and learning difficulties.[3] Children who are obese are also twice as likely to become obese adults and, unfortunately, obesity has become the second leading preventable cause of death in the United States.[4,5] Childhood obesity is a tremendous problem that disproportionately affects minorities as well. In 2012, only 14.1% of white adolescents were obese compared to 20.2% of black children and 22.4% of Hispanic children.[1] It is important to understand obesity in the Hispanic population because Hispanics account for almost 17% of the entire US population, the largest minority group in the nation, and are expected to become 29% of the population by the year 2060.[6]

A base for healthy food choices as an adult can be created during early childhood as nutritional intakes during adolescence track into the development of lifelong eating behaviors.[7] Studies have shown that parental dietary intake may be closely correlated to child diet intake and, thus, child weight. Because parents are the primary decision makers in providing the foods their children eat, it is important to know what food choices they are making for themselves and how this relates to what their children are consuming. These dietary choices are likely to be associated with overweight or obesity among their children. It is necessary to understand and evaluate the causes that lead to childhood obesity to implement effective programs to improve dietary quality and reduce obesity rates in America.

1.2 Parent-Child Diet Associations

When looking at specific parental-child dietary intake associations, mixed results have been found. A study conducted by Santiago-Torres and colleagues[8] of one hundred eighty-seven Hispanic children and their parents assessed diet quality using the USDA 2005 Healthy Eating Index Score (HEI) with total scores ranging from 0 to 100. A positive association was found between parental fruit and vegetable intake and the total HEI of their children; a negative association was found between parental soda and energy-dense snack intake and the child's total HEI. On the other hand, parental intake of 100% fruit juice and milk were associated with the child's total HEI score. Overall, the study found the average total HEI score of the children to be 59.4 ± 8.8 (parental HEI scores were not reported), indicating a significant need of improvement in the dietary quality of Hispanic children in the US. A possible effective intervention could be to increase children's HEI by increasing vegetable and fruit intake of their parents and the availability of these foods at home as indicated by this study. The availability of energy-dense, nutrient-poor snacks and drinks in the home should also be reduced due to their negative affects on children's diet quality

Project Eat-II conducted by Arcan et al.[9] aimed to assess the longitudinal associations of parental intakes of fruits, vegetables, and dairy and the home availability of these foods with the child's intakes of the same foods. Using the Youth and Adolescent Food-Frequency Questionnaire and the Project EAT survey, researchers questioned middle and high school students about their eating patterns and weight status and parents were interviewed by phone, given a modified version of the Project Eat survey. A second survey was given to the students five years later. Both a younger and an older cohort of adolescents were evaluated. Hispanics accounted for 13% of the study sample and 37% of the sample were of low or middle socioeconomic status. Results were adjusted for baseline adolescent fruit, vegetable, and dairy intake, race/ethnicity, adolescent age, adolescent cohort, adolescent gender, parent sociodemographic characteristics and categories representing biological mother or 'other'. Researchers found that while parents reported high availability of fruits, vegetables, and dairy at home neither parents nor their children were consuming the daily recommended amounts of these foods, indicating availability of these foods, alone, is not enough to encourage children to eat them. The children reported even lower fruit, dairy and vegetable intake five years later than what they had initially reported. When parents stated they consumed four or more servings of fruits, vegetables, and dairy, compared to less than one serving, it was found that young adults consumed 0.50, 0.62, and 0.54 additional servings of fruit, vegetables, and dairy, respectively, at the five-year follow up. Results were considered to be generalizable to other adolescent populations due to the large, ethnically, and socio-economically diverse sample population. This study indicates that children learn dietary habits from their parents and parental intake of fruits, vegetables, and dairy can predict their long-term intake of these foods. This study suggests a strong correlation between the diets of children and their parents and a need to improve the diets of parents in order to improve that of their children.

Nicklas et al.[10] found a similar relationship between the diets of Hispanic children and their mothers. They recruited 112 low-income mothers and their pre-school aged children (41% Hispanic and 59% African American) from Head Start centers to study the association of food intake between them. Using a digital photography method and plate weighing during home dinner meals the researchers found that there was a moderate to large association between what the mothers and children consumed, varying for each food category. They also found a significant linear association between the amount of food and beverage the mothers and children were served and the amount that was consumed. Similar to the studies of Arcan et al. and Santiago-Torres et al., these findings indicate that by changing parental dietary intake, it may be possible to indirectly improve the diets of Hispanic children, due to the correlations between their diets.

While the previously described studies found strong associations between the diets of Hispanic parents and their children, Beydoun and Wang[11] found a relatively weak relationship between the two. In order to study the association of dietary intake of a group of parents and their children, Beydoun and Wang used two 24-hour dietary recalls from the nationally representative data from the Continuing Survey of Food Intake by Individuals 1994-96 conducted by the US Department of Agriculture (USDA). Using the USDA 2005 Healthy Eating Index Score to assess all parent-child correlations for overall dietary quality, a weak correlation of 0.26 was found between parent and child diets. Twelve percent of Beydoun and Wang's sample was Hispanic and they found that the Hispanic parents and children had a significantly higher correlation of overall dietary quality (0.36) compared to whites (0.30) and blacks (0.27), suggesting that Hispanic children are more likely to have diets similar to their parents. However, the moderate value suggests that there are other factors at play in the diets of both Hispanic and non-Hispanic children.

Given the inconsistency in the results of these studies and the lack of research specifically examining Hispanic populations, it is necessary to conduct additional research aimed at understanding the association between parent-child dietary intakes, especially among groups at high risk for obesity such as Hispanic and low-income populations. In addition, the mixed findings for maternal-child diet associations may be due to differences in various populations studies with respect to factors such as acculturation, food insecurity, and food assistance programs.

1.3 Effect of Acculturation

The effect of acculturation is important to study due to its possible effect on the overall health behaviors of children. Wiley et al.[12] measured the acculturation of mothers via the Brief Acculturation Rating Scale for Mexican Americans-II and child dietary intake using the Children's Dietary Questionnaire. They found that children of Hispanic mothers with greater acculturation to the United States had higher BMIs and consumed unhealthier foods than the children of less acculturated mothers. The mothers with less US acculturation also served less non-core foods such as doughnuts, cookies, cakes, processed foods, and sugar-sweetened beverages. This study indicates a significant negative relationship between the mother's acculturation and the child's diet quality in Hispanic populations.

Gordon-Larsen et al.[13] aimed to determine how acculturation affects overweight status and its determinants among a sample of 8,163 first and second-generation Hispanic adolescent immigrants enrolled in the National Longitudinal Study of Adolescent Health. Similar to the findings of Wiley et al., researchers found an association between overweight behaviors and acculturation. Among Puerto Ricans and Cubans, more time living in the US was associated with increased overweight. However, while controlling for acculturation factors, diet and physical activity, first generation Hispanic adolescents had higher prevalence of overweight than US-born adolescents due to lifestyle differences. These studies indicate a clear pattern of unhealthy dietary behaviors as Hispanic adolescents become more acculturated to the US.

1.4 Effect of Food Security Status

The 2009 Current Population Survey Food Security Supplement identified 18.7% of Hispanic households with children as food insecure compared with 10.6% of all households in the United States[14], indicating a necessary need to understand the effects of food security on childhood obesity and dietary intake. Sharkey et al.[15] collected 24-hour dietary recalls and food security measures from 50 Mexican children living in the US. Researchers found that among those children that indicated having very low food security, they consumed more total energy, calcium, and percentage of calories from fat and added sugar. Among all children, few to none met the recommendations for calcium, dietary fiber, sodium, potassium, and vitamin D intakes. Weekend dietary intake, where children were not consuming school breakfasts or lunches, was even more insufficient. This study indicates alarming nutritional deficiencies among Hispanic children, especially in low food security situations.

Matheson et al.[16] examined the effect of food security status on whole food and energy intake and body mass index (BMI) among 124 Hispanic fifth-grade children using three 24-hour dietary recalls. Conflicting with the findings of Sharkey et al., researchers found no significant relationship between food security status and the children's food intakes, however food insecurity was found to be negatively associated with household food availability and the children's BMI. While lower than that of the food secure children, BMIs of food insecure children were still within normal range. These negative relationships between health factors and food insecurity suggest a need to bring food security to all homes in order to help children live healthy lives.

1.5 Effect of Food Assistance Programs

Food assistance programs in the US for families and children include The Special Supplemental Nutrition Program for Women, Infants and Children (WIC), the Supplemental Nutritional Assistance Program (SNAP), the National School Lunch Program (NSLP), and state and local food banks. Leung et al.[17] studied the effects of the Supplemental Nutrition Assistance Program (SNAP) on dietary quality and obesity in children aged 4 to 19 years in households with incomes $\leq$ 130% of the federal poverty level using 24-hour dietary recalls. Twenty-six percent of this study population were Hispanic children. Low income children who participated in SNAP stamps as well as those who did not participate, consumed less than the USDA recommended intakes of whole grains, fruit, vegetables, fish and potassium and were above recommended intakes of processed meat, sugar sweetened beverages, saturated fat and sodium. SNAP participants consumed significantly more sugar-sweetened beverages, high-fat dairy, and processed meats, but fewer nuts, seeds and legumes. However, SNAP was not associated with higher rates of obesity, total energy, or Healthy Eating Index scores. These results indicate no significant improvement in total dietary quality with SNAP participation and a possible need to restructure the program to better benefit low-income children.

Rose et al.[18] found some opposing results among children 1 to 4 years old participating in WIC and SNAP. Researchers conducted one 24-hour recall and two days of food recorders for 499 children, 21.3% of which were Hispanic, with incomes $\leq$ 130% of the federal poverty level. WIC participation was found to have a positive relationship with the intakes of protein, vitamin E, thiamin, riboflavin, niacin, vitamin B-6, folate, phosphorous, magnesium, and zinc. SNAP participation increased the intake of iron, vitamin A, thiamin, niacin and zinc. Neither WIC nor SNAP participation affected fat, saturated fat, or cholesterol intake. Compared to the findings of Leung et al., this study does not exhibit a decrease of dietary quality with participation in food assistance programs, and rather, an increase in micronutrient consumption. However, effects on BMI or HEI were not studied, indicating a need for further research.

1.6 Summary

As suggested by previous studies, the influences of the diets of children are often complex and multifaceted with overwhelming evidence pointing to a parental influence. Conflicting data among previous studies indicates the need for more research into the relationship between maternal and child dietary intakes. Childhood obesity is a problem that disproportionately affects Hispanic minorities leading to many social, physical, and mental health consequences. It is necessary to continue to research and understand the causes of obesity in order to establish culturally appropriate interventions that will appeal to the specific population. A better understanding of the factors leading to childhood obesity can help move the world in a healthier direction.

1.7 Study Aims

In order to gain a better understanding of these issues the following aims will be addressed (Figure 1)

Aim 1: Assess the association between dietary intakes of Hispanic mothers and children.

Aim 2: Examine influence of food assistance programs, food security, and time spent in the US on dietary intakes of mothers and children.

Aim 3: Assess whether associations between mother and child dietary intake differ by food assistance program participation, food security status, and years living in the US

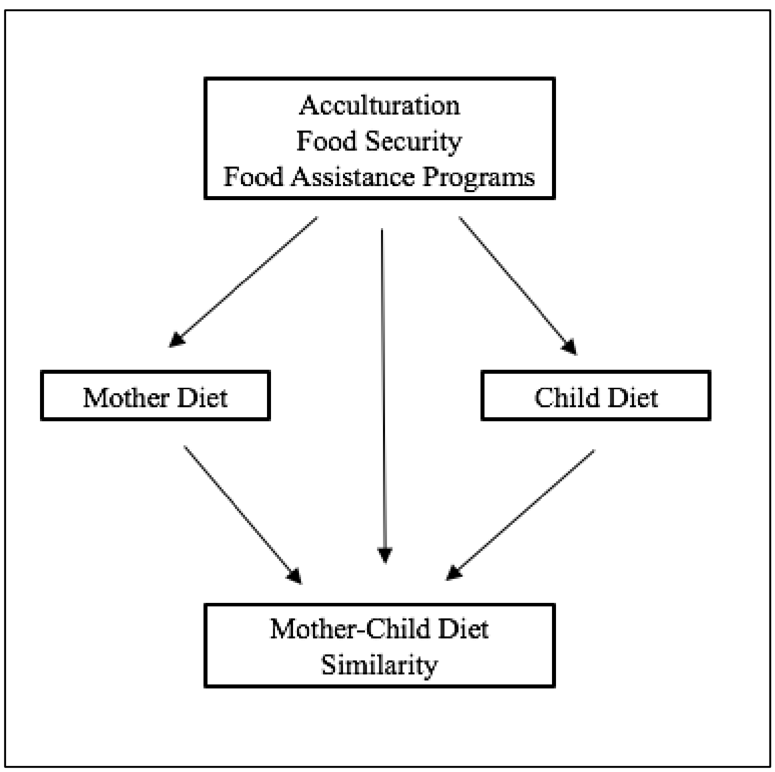

Figure 1. Diagram of the three specific study aims

Chapter 2

PROJECT VIDA SANA

2.1 La Comunidad Hispana

Research was conducted at La Comunidad Hispana (LCH), a federally qualified health clinic providing health and social services to low-income Hispanic families in Kennett Square, Pennsylvania. The clinic opened in 1973 with a mission to

> "…help low-income, residents in southern Chester County to stay healthy, build strong families and lead productive lives by providing high-quality, culturally welcoming services."[19]

2.2 Methodology

In partnership with LCH, a research study was conducted entitled Project Vida Sana. The purpose of Project Vida Sana was to assess the association between household food insecurity, maternal diet, and physical activity and obesity prevalence in Hispanic families residing in Kennett Square, Pennsylvania. This chapter will discuss the study design, sample, data collection, and data analysis.

2.2.1 Design

The current study on the relationship between maternal and child diet quality, is part of a larger cross-sectional study of Hispanic, low-income mothers conducted by Dr. Mia Papas, at La Comunidad Hispana. Research staff worked with La Comunidad Hispana clinic staff to identify and recruit eligible participants. The data on exposure and outcome measures were collected among willing participants during an interview-administered questionnaire, about one hour in length, over a 3-month time frame. Women were asked to bring the youngest child between the ages of 2 and 8 years that resides in their household with them and babysitting was provided during the interview.

2.2.1.1 Anthropometry

Trained research assistants collected two measures of heights and weights for both the mothers and children. A stadiometer (Seca model 213, SECA Corp., Hamburg, Germany, 2008), was used to measure height to the nearest 0.1 centimeter. Using a digital calibrated scale (Seca model 869, SECA Corp., Hamburg, Germany, 2008), weight was collected to the nearest 0.1 kg. A third measure was taken if the first two measures of height were not within 0.5 cm of each other or if the first two measures of weight were not within 0.1 kg. Two measures of height and weight were averaged and used to calculate the Body Mass Index (BMI) by dividing weight in kilograms by height in meters squared. Maternal BMI was defined as underweight (BMI < 18.5), normal (BMI ≥ 18.5 and BMI < 25), overweight (BMI ≥ 25 and BMI$<$ 30) and obese (BMI ≥ 30).[20] Using the Centers for Disease Control and Prevention BMI- for-age growth charts, child BMI percentiles were calculated and defined as as underweight (<5th percentile), healthy weight (≥5th percentile and < 85th percentile), overweight (≥85th and < 95th percentile), and obese (≥95th percentile).[21]

2.2.1.2 Questionnaire Measures

Demographic, mental health, food insecurity, neighborhood food, and mother dietary intake, dietary behavior, physical activity behavior and sedentary behavior data were collected via in person interviews by trained bilingual interviewers. Demographic data included education, marital status, number of children in the household, employment status, monthly income, health history, place of origin, preferred language, and length of stay in the United States. Nineteen questions from the validated Spanish translation of the United States Department of Agriculture Household Food Security Survey Module were used to assess food security. Affirmative responses to the questions regarding conditions and behaviors were summed to provide a raw score on the continuum of household food security for one or more children. Raw scores were then classified as very low food security, low food security, or food secure (including both high and marginal food security).

2.2.2 Automated Self-Administered 24-Hour Recall system

The Automated Self-Administered 24-Hour Recall systems (ASA24) from the National Cancer Institute was used to assess dietary intake. This method was chosen because compared to traditional 24-hour dietary recalls, the ASA24 does not require trained interviewers and multiple administrations to estimate usual intakes. It is also superior to food frequency questionnaires, which contain substantial error.[22] The ASA24 was offered in English and translated into Spanish by trained staff. Mothers responded for both themselves and then again for their children.

2.2.3 Sample

A convenience sample of 71 eligible mothers who were able to provide informed consent, were at least 18 years of age, have at least one child between the ages of 2 and 8, and reside in the same household as their children were included in this study. Five were then removed due to pregnancy and one was removed due to missing data. A total of 65 mothers were used for the analytic sample. Thirty-four mothers failed to follow-up for the second visit with their child, so the diets of 31 mother-child dyads in total were evaluated. The average age of the mothers was 32.7

years (SD = 5.1), ranging from 23 to 44 years old with an average of 2.6 (SD = 1.0) children per household. Children ranged from 2 to 8 years old with an average age of 4.8 years (SD = 1.9). All participants were Hispanic (93% from Mexico) and have resided in the United States for an average of 9.3 years (SD = 4.7). Over half (58%) of the families reported household incomes under the Federal poverty lines and 69% participated in the Women, Infants, and Children (WIC) food assistance programs, 26% participated in SNAP and 69% of children received free or reduced school lunches. The majority of mothers were overweight or obese, 39% and 37%, respectively, with an average BMI of 28.3 kg/m^2 (SD = 4.6). About half of the children were classified as overweight or obese, 15% and 30%, respectively, and were on average in the 73rd BMI percentile for their age group (SD = 24.4 BMI percentile) (Table 2).

2.3 Mother Follow-up

Of the 65 mothers initially interviewed, 31 returned for the follow-up meeting with their youngest child. Demographic characteristics of mothers who did and did not follow-up are described in Table 3. Mothers were compared in order to determine if the final sample was representative of the initial 65 mothers or if there was a significant difference among those mothers who did not follow up. Two sample t-tests were used for continuous data (age, BMI, number of children in the household, the number of years living in the US) and chi-squared tests of independence for nominal data (food security status, employment status, education level, marital status, primary language, car ownership, access to transportation and income level) with the level of significance set for all tests at $p \leq 0.05$.

Comparing those that were and were not included in this study, no significant difference was found for age, BMI, food security status, the number of children in the household, the number of years living in the United States, employment status, education level, marital status, primary language, owning a car, or access to transportation. Income level was significantly different ($p = 0.0006$) with more mothers who did not follow up having monthly family incomes below $1000 ($n = 13$) compared to mothers who did follow up ($n = 0$) (Table 3).

This study provides a rich dataset that can be used to assess the associations between maternal and child diet. In addition, association with respect to the number of years the mother's have been in in the U.S (as a measure of acculturation), the family's food security status, and participation in food assistance programs will be explored.

Chapter 3

METHODS

3.1 Dietary Intake

Two 24-hour dietary recalls were used to record dietary intake of the mothers and children. The United States Department of Agriculture's Healthy Eating Index-2010 (HEI) guidelines were used to convert ASA24 dietary recall data of the mothers and children into dietary quality scores, which assess conformance to Federal Dietary Guidelines.[23] Total HEI score is measured from 0 to 100, as a sum of 12 component scores, including Total Fruit, Whole Fruit, Total Vegetables, Greens and Beans, Whole Grains, Dairy, Total Protein Foods, Seafood and Plant Proteins, Fatty Acids, Refined Grains, Sodium, and Empty Calories. Higher Refined Grain, Sodium, and Empty Calorie scores indicate lower consumption, while high scores for all other categories indicate higher consumption.[23] Scoring standards for each component are described in Table 4. Macronutrient and micronutrient intake was compared to the USDA recommended Dietary Allowances (RDA) and Adequate Intakes (AI) where applicable.[24]

3.2 Acculturation

Acculturation, for the purpose of this study, is measured as the number of years that the mothers had been living in the United States at the time of the interview.

3.3 Food Security

Food security was measured on a scale of 1 to 3 based on a series of interview questions asked of the mother. Being food secure was scored as 0, food insecure without hunger as 1, food insecure with moderate hunger as 2, and food insecure with severe hunger as 3.

3.4 Food Assistance Programs

In the interviews, mothers reported participation in SNAP, WIC, and food pantries, as well as, if their child participated in free or reduced school lunches. For data analysis affirmative responses were recorded as 1 and negative responses as 2.

3.5 Data Analysis

JMP Software version 12.01 (SAS Institute Inc., 2015) was used to merge HEI scores and dietary data with demographic data of each mother and child to form one cohesive data set. JMP was then used to analyze data to meet the three specific aims of this investigation.

To examine the first specific aim (assess the association between dietary intakes of Hispanic mothers and children), the relationship between the mother and child's BMI, HEI scores, macronutrient and micronutrient intakes were measured using the Pearson's Product-Moment Correlation was used to measure associations. Effect size will be described as small $0.1 \le r < 0.3$, medium $0.3 \le r < 0.5$, and large $r \ge 0.5$.[25]

To meet the second specific aim (examine influence of food assistance programs, food security, and time spent in the US on dietary intakes of mothers and children), correlation coefficients were computed to measure the association between acculturation and HEI sub-scores, total scores, BMI, and macronutrient and micronutrient intakes of the mothers and children. For all correlation analyses, correlation coefficient size were described as small $0.1 \le r < 0.3$, medium $0.3 \le r < 0.5$, and large $r \ge 0.5$.[25] Associations between food security status and HEI sub-scores, total scores, BMI, and macronutrient and micronutrient intakes of the mothers and children were measured by one-way analysis of variance (ANOVA). The level of significance was set at $p \leq 0.05$. If a significant result was found by ANOVA, a Tukey-Kramer post hoc test was used to compare mean dietary intakes between pairs of those described as food secure, food insecure without hunger, food insecure with moderate hunger, and food insecure with severe hunger, with the level of significance at $p \leq 0.05$. Finally, associations were measured between participation or no participation in SNAP, WIC, and food pantries with mother and child HEI scores, BMI, macronutrient and micronutrient intake using a two sample t-test. The children's dietary intake was also measured in relation to participation in free or reduced school lunches using a two-sample t-test. The level of significance for both analyses were set at $p \leq 0.05$.

To meet the third aim of this research investigation (assess whether associations between mother and child dietary intake differ by food assistance program participation, food security status, and years living in the US), regression modeling was used to measure the effect of time in the US, food security status, and participation in food assistance programs on mother-child diet associations. The difference in Beta coefficient values, measuring the strength of the association between mother and child dietary intake values, before and after the inclusion of the three moderators of interest will be reported. The level of significance for was set at $p \leq 0.05$.

Chapter 4

RESULTS

4.1 Maternal Dietary Intake

The distributions of the mothers' macronutrient and micronutrient intake are described in Tables 5 and 6, respectively. Only 15% of the mothers met RDA/AI guidelines for kilocalorie consumption, 77% were below recommended intakes and 8% were above the recommended intakes. The majority of mothers did not meet RDA/AI guidelines for cholesterol, fiber, folate, vitamin C, vitamin D, vitamin A, vitamin E, iron, calcium or sodium. The majority of mothers did meet guidelines for all other macronutrients and micronutrients (Tables 5, 6).

The overall average Healthy Eating Index (HEI) of the mothers was 47.2 (SD = 12.2), below the US average adult score of 63.9 (Table 7).[26] Over half of the mothers, 57%, met the USDA HEI guidelines for total fruit consumption, 49% met the HEI guidelines for whole fruit consumption, and 51% met HEI guidelines for total protein consumption. The majority of mothers did not meet HEI intake guidelines for total vegetables, whole grains, dairy, seafood and plant proteins, greens and beans, or fatty acids and consumed more refined grains, sodium, and empty calories than recommended (Table 7).

4.2 Child Dietary Intake

The distributions of the children's macronutrient and micronutrient intake are described in Tables 8 and 9, respectively. Among children age 1 to 3, 27% of children met recommended kilocalorie consumption, 27% of children were below recommended consumption, and 45% were above. Among females age 4 to 8, 9% of the children met recommended kilocalorie consumption, 72% of children were below recommended consumption, and 18% were above. Among male children age 4 to 8, 25% of children met recommended kilocalorie consumption, 63% of children were below recommended consumption, and 13% were above. The majority of children did not meet USDA RDA/AI guidelines for fiber, vitamin D, or vitamin E. The majority of children age 1 to 3 and males age 4 to 8 consumed more sodium than recommended, while females age 4 to 8 did not pass the Tolerable Upper Intake limit of sodium. The majority of females and males age 4 to 8 consumed less calcium than recommended, while children age 1 to 3 consumed adequate amounts of calcium. The majority of children across each group met the recommended RDA/AI guidelines (Tables 8, 9).

The overall average HEI of the children was 48.9 (SD = 15.5), below the US average score of 74.4 for children ages 2 to 3 and 68.4 for children ages 4 to 6 (Table 10). [27] Fifty-eight percent of the children met the USDA HEI guidelines for total fruit consumption, 55% met HEI guidelines for dairy consumption, 48% met HEI guidelines for total protein consumption, and the majority of children did not meet USDA recommendations for whole fruits, total vegetables, whole grains, seafood and plant proteins, greens and beans, and fatty acids and consumed more refined grains, sodium, and empty calories than recommended (Table 10).

4.3 Relationship Between Maternal and Child Diet

No relationship was seen between total HEI or BMI of the mother and the child. There was a significant, small negative relationship between mother's HEI total vegetable sub score intake and that of the child's ($r^2 = -0.19$, $p = 0.02$), however no relationship was seen between the other HEI sub scores (Table 11).

The mother's vitamin B-12 intake had a small, not statistically significant, negative correlation with that of the child's ($r^2 = -0.10$, $p = 0.08$) and a small, significant, negative correlation was seen between mother and child zinc intake ($r^2 = -0.12$, $p = 0.05$). No relationship was seen between any other micronutrient or macronutrient intake of the dyads (Table 11).

4.4 Effect of Acculturation on Maternal Diet

The number of years the mother has been in the US showed a significant, weak positive correlation with the total fruit HEI sub-score ($r^2 = 0.11$, $p = 0.007$). All other sub scores of HEI, total HEI, macronutrient and micronutrient consumption, and BMI of the mothers had close to no correlation with time living in the US (Table 12).

4.5 Effect of Acculturation on Child Diet

The number of years the mother has been in the US showed a very weak, non-significant, positive correlation with the child's calcium consumption ($r^2 = 0.093$, $p = 0.09$). All other sub scores of HEI, total HEI, macronutrient and micronutrient consumption, and BMI of the child had close to no correlation with the mother's time living in the US (Table 12).

4.6 Effect of Acculturation on Maternal-Child Diet Association

Regression models showed no significant effect of the number of years in the U.S. on the relationship of diets between mothers and their children with insignificant p-values for all intake measurements (B-coefficients described in Table 12).

4.7 Effect of Food Security on Maternal Diet

There was a significant effect of food security score on the total protein HEI score of the mothers [F (3,61) = 3.14, p = 0.032], with food secure mothers having the highest total protein HEI score (M = 4.67 g, SD = 0.61) and those that were food insecure with moderate hunger scoring the lowest (M = 2.78 g, SD = 2.29). There was also a significant effect of food security on the mothers' copper intake [F (3,61) = 2.84, p = 0.045]. Food secure mothers consumed the most copper (M = 1.14 mg, SD = 0.54) and food insecure with severe hunger consumed the least (M = 0.60 mg, SD = 0.21). Post hoc tests using the Tukey-Kramer method showed no significant difference between pairs of food security statuses for both protein HEI score and copper intake. Food security status did not affect maternal BMI, total HEI and all other sub scores of HEI, macronutrient, or micronutrient intake (Table 13).

4.8 Effect of Food Security on Child Diet

There was a significant effect of food security status on the BMI of the children [F (3,27) = 7.17, p = 0.001], with food insecure with moderate hunger children having the greatest BMI (M = 23.65, SD = 3.18) and food insecure with severe hunger children having the smallest BMI (M = 15.45, SD = 0.49). Post hoc comparisons using the Tukey-Kramer method indicated a significant difference between the BMI of children identified as food insecure with moderate hunger (M = 23.65, SD = 3.18) and those identified as food secure with severe hunger (M = 15.45, SD = 0.49) (p = 0.002). There was also a significant difference between the BMI of the food insecure children with moderate hunger (M = 23.65, SD = 3.18) and the food secure children (M = 16.68, SD = 1.14) (p = 0.0009). There was also a significant difference between the BMI of the food insecure children with moderate hunger (M =

23.65, SD = 3.18) and the food insecure children without hunger (M = 17.70, SD = 2.33) (p = 0.003). No other pairs of food security statuses were significantly different (Table 13).

Vitamin A intake was also significantly associated with food security status [F (3,27) = 5.70, p = 0.004]. Children that were food insecure with moderate hunger consumed the most vitamin A (M = 972.51 mg RAE, SD = 194.84) and children identified as food secure consumed the least (M = 362.63 mg RAE, SD = 192.51). Post hoc comparisons using the Tukey-Kramer method indicated a significant difference of Vitamin A intake between children identified as food insecure with moderate hunger (M = 972.51 mg RAE, SD = 194.84) and children identified as food secure (M = 362.63 mg RAE, SD = 192.51) (p = 0.002), as well as, between children identified as food insecure with moderate hunger (M = 972.51 mg RAE, SD = 194.84) and children identified as food insecure without hunger (M = 428.91 mg RAE, SD = 186.78) (p = 0.004), with children with moderate hunger having the highest intakes of vitamin A and food secure children having the lowest intakes of vitamin A. However, no other pairs of food security statuses were significantly different (Table 13).

No significant effect was found between food security status with total HEI, any HEI sub scores and macronutrient intake, or other micronutrient intakes of the child (Table 13).

4.9 Effect of Food Security on Maternal-Child Diet Association

In the unadjusted model, maternal vitamin B-12 was not significantly associated with the child's intake of vitamin B-12 (B = -0.40, p = 0.08). After adjustment for food security score, maternal vitamin B-12 was significantly inversely associated with child vitamin B-12 intake (B = -0.48, P = 0.05). All other p-values of dietary intake relationships with food security were insignificant (B-coefficients described in Table 13).

4.10 Effect of Food Assistance Programs on Maternal Diet

There was a small significant difference in the empty calories HEI sub score for mothers who did (M = 12.6, SD = 6.5) and did not (M = 8.7, SD = 6.7) participate in SNAP ($p = 0.05$) with mothers participating in SNAP having higher diet quality scores when it came to empty calories than those who do not participate in SNAP. A significant difference was found between the vitamin B12 intake of the mothers who did (M = 4.0 mcg, SD = 1.7) and did not (M = 5.7 mcg, SD = 3.9) participate in SNAP ($p = 0.01$), with higher intakes of B12 in those mothers who did not participate in SNAP. There was no significant difference in BMI scores, total HEI scores, the other HEI sub categories, the other micronutrients, or any macronutrient intakes between mothers who did and mothers who did not participate in SNAP (Table 14).

There was no significant difference for any intake category in mothers who did and did not participate in WIC (Table 14).

There was a significant difference for vitamin D intake for mothers who did (M = 2.5 IU, SD = 1.9) and did not (M = 4.6 IU, SD = 3.0) participate in food pantries ($p = 0.006$), with mothers who did not participate in food pantries having higher vitamin D intakes than those who did participate. There was no significant difference in BMI scores, total HEI scores, HEI sub categories, the other micronutrients, or any macronutrient intakes between mothers who did and mothers who did not participate in food pantries (Table 14).

4.11 Effect of Food Assistance Programs on Child Diet

There was a significant difference between kilocalorie intake of children who did (M = 1344.2 kcal, SD = 379.3) and did not (M = 1002.8 kcal, SD = 285.5) participate in SNAP ($p = 0.043$). There was a significant difference of protein intake for children who did (M = 69.5 g, SD = 28.4) and did not (M = 44.1 g, SD = 24.1) participate in SNAP ($p = 0.045$). There was also a significant difference between phosphorous intake of children who did (M = 1088.4 mg, SD = 341.4) and did not (M = 751.8 mg, SD = 288.5) participate in SNAP ($p = 0.030$). There was a significant difference between saturated fat intake of children who did (M = 20.2 g, SD = 9.3) and did not (M = 12.2 g, SD = 5.2) participate in SNAP ($p = 0.045$). There was a significant difference in vitamin C intake of children who did (M = 41.0 mg, SD = 31.9) and did not (M = 81.0 mg, SD = 31.9) participate in SNAP ($p = 0.051$). There was no significant difference in BMI scores, total HEI scores, any HEI sub categories, the other micronutrients, or the other macronutrient intakes between children who did and children who did not participate in SNAP (Table 14).

There was a significant difference of phosphorous intake of children who did (M = 925.2 mg, SD = 346.0) and did not (M = 657.0 mg, SD = 220.5) participate in WIC ($p = 0.015$). There was also a significant difference of calcium intake of children who did (M = 854.5 mg, SD = 337.8) and did not (M = 455.3 mg, SD = 207.4) participate in WIC ($p = 0.0004$) and, similarly, a significant difference ($p = 0.051$) of HEI total dairy sub scores between those who did (M = 9.0, SD = 1.9) and did not participate (M = 6.0, SD = 4.0). There was no significant difference in BMI scores, total HEI scores, or the other HEI sub categories, micronutrients and macronutrient intakes between children who did and children who did not participate in SNAP (Table 14).

There was no significant difference in any category when comparing children based on participation in reduced or free school lunches (Table 14).

Children with mothers who participated in food pantries (M = 25.1 mg, SD = 22.1) had significantly less vitamin C intake than those who did not (M = 81.7 mg, SD = 73.5) ($p = 0.003$). There was a significant difference of riboflavin intake of children who did (M = 1.1 mg, SD = 0.5) and did not (M = 1.7 mg, SD = 0.9) participate in food pantries ($p = 0.052$). There was also a significant difference of vitamin B6 intake of children who did (M = 0.8 mg, SD = 0.5) and did not (M = 1.7 mg, SD = 1.2) participate in food pantries ($p = 0.019$). There was also significant difference of HEI whole grain scores of children who did (M = 0.5, SD = 0.9) and did not (M = 2.8, SD = 3.9) participate in food pantries ($p = 0.014$). There was no significant difference in BMI scores, total HEI scores, macronutrients or the other HEI sub categories micronutrients intakes between children who did and children who did not participate in SNAP (Table 14).

4.12 Effect of Food Assistance Programs on Maternal-Child Diet Association

Regression models showed no significant effect of SNAP, WIC, or Food Pantry participation on the relationship of diets between mothers and their children with insignificant p-values for all intake measurements (B-coefficients described in Table 14).

Chapter 5

DISCUSSION

5.1 Dietary Quality

The first aim of this study proposed to evaluate the dietary quality of 31 Hispanic mother and child dyads. Consistent with previous findings, both Hispanic mothers and children fell below the US average for Healthy Eating Index scores and did not meet recommended dietary guidelines for most HEI subcategories, macronutrient and micronutrient intakes.[8,28] Overweight or obesity statistics among Hispanic children and mothers was also very similar to that of previous studies[1,29], with 42% of children and 81% of the mothers in this sample classified as overweight or obese. This is compared nationally to 67.2% of white adults and 28.5% of white children classified as obese or overweight.[29,1] Obesity during both childhood and adulthood causes an increased risk for a number of health issues including high blood pressure, high cholesterol, and type II diabetes.[3,30] Therefore, it is imperative that interventions are enacted to address this issue. Inequities in healthcare and access to heathy foods as well as higher rates of hunger and food insecurity in Latino communities contribute to the higher rates of obesity.[31]

The 34 mothers from the initial sample who had failed to follow-up for the second visit with their child had significantly less income than the mothers who did follow-up, indicating that the stress of living in poverty trumped the ability to participate in a research study. While it was not addressed in the questionnaire, it is also possible that the mothers who did not follow-up may have been illegal immigrants and were afraid of meeting with researchers a second time due to possible perceived repercussions.

5.2 Acculturation

Aim 2 of this study intended to examine the influence of acculturation on the diets of this specific population. For the purpose of this study, acculturation was measured as the number of years that the mothers have been living in the United States. As the number of years that the mothers have been living in the United States increased, the mothers' HEI total fruit scores also increased. This is contradictory to the findings of Ayala et al.[32], whose literature review concluded that less acculturated Hispanics in the United States consumed more fruit than more acculturated individuals. This may be explained by increased exposure to messages that encourage increasing fruit intake or may have been a result of over-reporting. If the mothers are aware that they should be eating fruits they may tend to report consuming more than is true. It also may have been a result of the use of number of years living in the US as a measure acculturation. Results may have differed if a more accurate measurement of acculturation had been used, such as Marin and Gamba's Bi-Dimensional Acculturation Scale for Hispanics.[33]

The children in this study also had increased calcium intake as the acculturation of the mothers increased. Calcium intake increases in the children may be due to an increase in the exposure mothers have, over the years, to programs which encourage parents to give milk to their children, such as the now defunct "Got Milk?" campaign. Compared to previous studies, we did not find a significant increase in overweight related behaviors[12,32], but rather a positive effect of acculturation in the aspects of fruit and calcium consumption.

5.3 Food Security

Aim 2 also intended to study the effect of food security on dietary intakes of the mothers and children. Food insecurity rates (71%) in this study were much higher than national averages for Hispanic families (23.7%).[34] This may have been due to the small sample size or because the clinic is specifically aimed at low income families, which is correlated with food insecurity. In this sample, mothers that were less food secure consumed less protein, as expected, due to the high cost of protein rich foods such as meat, fish, and cheese. The mothers' copper intakes also decreased with decreasing food security status, similar to the findings of food insecure white and African-American adults.[35] However, copper deficiency is rare and not of concern for this study.[36]

Food security status in this sample had a similar effect on the BMI of the children as found in previous studies[37], where the marginally food secure and the low-food secure children were more likely to be overweight or obese than their very low-food secure and high-food secure counterparts. The mothers of the marginally and low-food secure households are believed to be purchasing cheap, energy-dense foods consisting of high amounts of refined grains, added sugars, and fats that maximize their calories per dollars. These nutritionally deficit purchases have been linked to obesity. Compared to the high-food secure households who can purchase healthier, more expensive foods and the very-low food secure households who can not purchase sufficient amounts of any type of food and are considered to have severe hunger, the marginally and low-food secure children are more likely to be affected by obesity.[38]

Vitamin A intake was also found to be significantly greater for the "food insecure with moderate hunger" children, while the intake among children of all other food security groups was about equal. It is likely that this result was due to the small, uneven sample size, with only two children in the "food insecure with moderate hunger" group skewing the results.

5.4 Food Assistance Programs

The final goal of Aim 2 was to analyze the effect of SNAP, WIC, and food pantry participation on the dietary intakes of the mothers and children, and free and reduced school lunches on the diets of children.

5.4.1 SNAP

Consistent with the findings of the USDA[39], mothers that participated in SNAP consumed significantly more empty calories than those who did not. This may be due to a lack of knowledge of healthy food choices or due to the higher costs of healthy foods. Reducing the intake of empty calories from solid fats, alcohol, and added sugar will improve the overall health of SNAP participants.[23] Mothers who participated in SNAP also consumed significantly less B-12 than the mothers who did not. Sources of B-12, include meat, eggs, and dairy products[40], which are high cost items, reducing their availability to low income families. The staff at La Comunidad Hispana reported high rates of anemia among the women at their clinic (personal communication), which if nutritionally related, may be a result of low vitamin B-12, folate, or iron intake. Short-term symptoms of B-12 deficiency include bowel irritability, fatigue, loss of appetite, and concentration difficulties. Long term B-12 anemia can result in a change in mental status, depression, balance issues, and extremity numbness, indicating the need for sufficient B-12 intake.[41]

Children who participated in SNAP consumed significantly more total calories than those children who did not. While not a significant difference, children who participated in SNAP consumed more empty calories than those that did not. This may indicate that their total calorie consumption may be a result of their increased empty calorie consumption, similar to their mothers.

Children who participated in SNAP also consumed more protein, more phosphorus, and more saturated fat, than those who did not, all of which are found in meat and milk.[42-44] When considered with their mothers' decreased vitamin B-12 intake, it may be possible that the mothers are giving meat and milk to their children but not consuming it themselves. It was observed that, while not considered a strong correlation, there was negative correlation between the HEI dairy and total protein scores of the mothers and the children, further supporting this hypothesis. Children on SNAP also consumed less vitamin C, which is found in fruits and vegetables[45], both of which all of the children were not consuming enough of. Adequate intake of fruits and vegetables is necessary as it is associated with lower incidence of obesity and cardiovascular disease.[46]

5.4.2 WIC

The dietary intakes of the mothers in this study who participated in WIC were not significantly different for any category when compared to mothers who did not participate in WIC, indicating that WIC participation did not negatively or positively impact the diets of mothers. Children whose mothers participated in WIC consumed more phosphorous and calcium and scored better on the HEI total dairy scale, all of which can be attributed to increased milk consumption.[43] Increased milk consumption is expected among WIC participants because the program's vouchers provide women and children with low-fat milk[47]

5.4.3 Food Pantries

Mothers that participated in state and local food pantries consumed significantly less vitamin D than those who did not, which is found commonly in fish and fortified dairy products.[48] Children consumed significantly less vitamin C, which is found in fruits[45], less riboflavin, found in dairy products[49], and less vitamin B-6, found in meats and vegetables[50], than those children who did not participate in food pantries. These observations are may be due to the lack of fresh meats and fish, dairy, vegetables, and fruits found in food pantries. Children whose mothers participated in food pantries also consumed less whole grains than those who did not, as expected from previous studies that indicate food pantry options are low in whole grains.[51]

5.4.4 Free or Reduced School Lunches

Free or reduced school lunch participation by the children in this study was consistent with national average Hispanic children participation rates (71% vs. 77%, respectively).[52] Contradictory to studies that have found school lunch participants consume more nutrients and vitamins and minerals[53,54], our study found no effect of free or reduced school lunch participation on the diets of children. Analysis of school lunch participation effects on the diets of children may have been affected by the responses in the ASA24 of the mothers. Mothers may have not known what their child was eating at school and so they may have reported their child's intakes inaccurately. The children who did not participate in these programs may also have been buying a full price lunch so the children in both groups may have been consuming the same thing, resulting in no significant difference. Further investigation should be conducted within the schools to directly observe differences in lunch intake.

5.5 Mother-Child Relation

The third aim of this study was to examine the association between the diets of the mothers and their children. The negative correlation (-0.187) between the mother's vegetable HEI score and that of the child with the average child's HEI vegetable score of 0.5 and the mothers of 3.5 indicates the mothers may be eating vegetables and not giving them to their children or that the children refuse to eat them. Our findings were contradictory to a previous study that found among Hispanic families, the parental vegetable intake was positively associated with the child's vegetable HEI score.[8] However, the sample of this study was 10 to 14-year old children, which may have affected results compared to the younger participants in this study. While the parental-child relationship was contradictory, this study confirmed that Hispanic children are consuming frightening low amounts of vegetables, indicating a need for an immediate, effective intervention.

There was also a small negative correlation between the B-12 and zinc intakes of the mothers and the children. Both B-12 and zinc are found in meat[40,55], further supporting the previously described conclusions that mothers are giving their children meat and not consuming adequate amounts themselves. After adjustment for food security score, maternal vitamin B-12 was significantly inversely associated with child vitamin B-12 intake, indicating a significant negative relationship in meat consumption for food insecure families. These findings suggest a need to either provide mothers with more meat products to adequately meet the needs of themselves and their children or encourage the mothers to eat meat if they are just choosing not to. The lack of meat consumption among these women may be affecting their intake of vitamin B-12, zinc, and protein. Proper intake of vitamin B-12 and protein are necessary because inadequacy is associated with increased risk of anemia.[56]

5.6 Limitations

A limitation of this study was the small sample size, which is unlikely to accurately represent the entire Hispanic population. Lack of secondary follow-up reduced the sample size by about half. A more representative study would have included an even distribution of participants in each of the categories studied such as food security score or participation in select food assistance programs. It should have also included more than one dyad that did not participate in any food assistance programs to compare dietary intakes. However, while unlikely to represent all Hispanic mothers and children, this study will be useful to the staff at La Comunidad Hispana and will allow them to see what problems their specific population faces and what interventions may be needed. A second limitation is the collection of only one day of dietary intake for children, thus results should be interpreted as the nutritional intake of the group as a whole, rather than individuals.

Analysis of acculturation effects was limited by the research questions asked in the initial study. Results may have differed if a more accurate measurement of acculturation had been used such as Marin and Gamba's Bi-Dimensional Acculturation Scale for Hispanics, which has been found to have high consistency and validity when measuring acculturation.[33]

However, despite these limitations we concluded that overall this study provides a rich dataset and an important insight into the dietary quality of Hispanic mothers and children.

5.7 Conclusion and Future Implications

Consistent with previous findings, Hispanic children and women are not adhering to recommended dietary intakes and are experiencing higher rates of overweight and obesity compared to their white counterparts. The weight status of Hispanic children is negatively affected by their food security status and hunger levels, indicating a need for effective interventions that provide healthier options to these children. The SNAP and food pantry programs have shown to have an overall negative effect on the dietary intakes of mothers and children and a restructuring of these programs to provide healthier foods is necessary. The WIC program, on the other hand, which provides vouchers for specific foods, is seen to have a positive effect on dietary intakes. SNAP and food pantries may be more effective if they provide families with specific healthy foods. Another significant finding of this study was that, possibly due high cost and lack of availability, mothers are giving their children the majority of the family's meat and not consuming adequate amounts themselves. There is a need to either provide low-income Hispanic mothers with more meat products to adequately suffice the needs of themselves and their children or encourage the mothers to eat meat.

Our study found that the diets of the mothers had no positive modeling effect on the diets of their children. Rather, the diets of the children were mainly constrained by food availability. Future research should focus on how food availability affects the diets of children, as well as investigating other factors that influence what food adolescents choose as they get older and make their own choices. Neumark-Sztainer et al.[60] studied the influence of factors, besides parents, on the diets of Hispanic children. The researchers interviewed twenty-one focus groups of seventh and tenth grade students from two large intercity school with 60% minority students, including 6% Hispanics. They found that the most common impact on food choices was hunger and food cravings, appeal of food, time considerations, and the convenience of food.

Parental food choices were reported to be less influential but still important. Also persuasive were mood, body image, cost, and the media. This study indicates that while there may be some parental effect on the dietary intakes of children, it is also likely that other factors may play a more significant role as children age.

Future implications of this study include a need to investigate the dietary quality of low-income Hispanic children and mothers. As Hispanics are expected to account for over a quarter of the population by 2060[6], it is necessary to invest in their health. Unhealthy food choices and lack of adherence to dietary guidelines can lead to childhood obesity and dangerous health consequences.[3] Children who are obese are also twice as likely to become obese adults[4], which has become the second leading preventable cause of death in the United States.[5] As nutritional intakes during adolescence track into the development of lifelong eating behaviors[7], it is necessary to understand the causes that lead to childhood obesity to enact effective programs to improve dietary quality and reduce obesity rates in America.

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Appendix A

TABLE 1

Table 1. Literature review

Authors	Year	Population	Parental Intake	Child Intake	Analysis	Results
Laskarzewski et al.[61]	1980	294 children (ages 6-19) and their parents. 234 White children and 60 black children	One 24-hour dietary recall	One self-reported 24-hour dietary recall	Spearman's correlations	Positive relationship between parent nutrient intake and child intake of carbohydrates, saturated fat, polyunsaturated fat, and calories.

Table 1 continued

Cullen et al.[62]	2002	132 Children (4th-6th grade) and 132 parents. 42% white, 20% African-American, 30% Mexican-American, 8% Asian-Americans	21-Item Food Frequency Questionnaire regarding fat practice over the previous week	Self-reported up to 7-day food records	Spearman's correlations	Parent low fat practices, fat substitutions, and fruit, vegetable, and juice practices were significantly correlated with the child's low fat practices.
Arcan et al.[9]	2007	509 Parent-child dyads. 37% of low or middle SES	5-a-day power plus program parent survey	149-Item Youth Adolescent Food Frequency Questionnaire	Spearman's correlations	Vegetables served at dinner during adolescents predicted vegetable intake at 5-year follow up for all groups. Milk served at dinner predicted dairy intake for young adults. Parental intake of fruits, vegetables, and dairy predicted young adult intakes.

Table 1 continued

Wang et al.[63]	2009	121 African American mothers and children (ages 10-14)	Adult Food Frequency Questionnaire	Self-reported Youth Adolescent Food Frequency Questionnaire	Spearman's correlations	Weak dietary association between parents and children. Mother-daughter associations were stronger than that with sons. Stronger dietary association for normal weight mothers and children than overweight mothers.
Oliveria et al.[64]	1992	White middle class families. 91 Children (ages 3-5), 87 mothers, and 83 fathers	Four sets of 3-day food records at 3-month intervals	Four sets of 3-day food records at 3-month intervals. Reported by mother with help from child or adult at day care	Pearson's correlations	Significant but modest correlation between diets of parents and children for most nutrients.

Table 1 continued

Runyan et al.[65]	2003	72 Mother-daughter pairs (child ages 11-14)	3-Day food record and calcium intake survey	Self-reported 3-day food record and calcium intake survey	Pearson's correlations	0.33 Correlation of calcium between mothers and daughters.
Stanton et al.[66]	2003	404 Children (ages 12-15 years) and mother dyads. 72% White and 28% black	Food Frequency Questionnaire	Food Frequency Questionnaire	Pearson's correlations	Significant fat correlation between children and mothers. Modest to no fiber correlation between children and mothers
Mitchell et al.[67]	2003	1364 members of 42 Mexican-American families (children younger than 16 years old)	Food Frequency Questionnaire modified for Mexican-American population	Self-reported Food Frequency Questionnaire modified for Mexican-American population	Age and sex adjusted familial correlations	Correlation between baseline and follow up behaviors highly significant. Familial effects stronger as genetic heritability than as a shared household effect.

Table 1 continued

Galloway et al.[68]	2005	173 Non-Hispanic white girls (7 years at baseline) and mothers	Three 24-hour Food Frequency Questionnaires when the girls were 7 years old and at 9 years old	Three 24-hour Food Frequency Questionnaires when the girls were 7 years old and at 9 years old, reported by the mother	Correlation coefficients	Mothers' fruit and vegetable intake at baseline predicted the girls' intake two years later
Papas et al.[69]	2009	109 Primiparous low-income African-American adolescent mothers and toddlers	Youth Adolescent Food Frequency Questionnaire	73-Item feeding checklist completed by mother	Paired sample correlation coefficients	Maternal and child intake of fruits, vegetables, snacks, meat, dairy, and soda were significantly correlated. No association between maternal and child dietary variety and obesity. Mothers who purchased groceries consumed more fruit and vegetables and provided more variety for their children.

Table 1 continued

Nicklas et al.[10]	2012	112 Low-income mothers and preschool aged children. 41% Hispanic and 59% African-American.	Two home observations with digital photography methods and plate weighing	Two home observations with digital photography methods and plate weighing	Linear regressions	Significant correlations between mother-child intake of food/beverages consumed at dinner. Positive association between amount of total energy consumed at dinner.
Santiago-Torres et al.[8]	2014	187 Hispanic children (10-14 years old) and 173 parents	Home environment surveys of home food availability, familial eating habits, own habitual diet	Food frequency questionnaire	Linear regression	Children's average total HEI= 59.4$\pm$ 8.8 Children with lower HEI had sugar-sweetened beverages available at home and watched television during family meals more often than children with higher HEI scores.

Table 1 continued

Zive et al.[70]	1998	202 Mexican-American children and 149 non-Hispanic children, of low-middle income (mean= 4.4 years)	Interview administered questionnaire	12 24-hour dietary recalls over 2.5 years	Bivariate and regression analyses	Parental salt avoidance behavior predicted child's energy intake. Parental salt and fat avoidance behavior, control over fat and food, and prompts to increase/decrease eating significantly associated with child's percentage energy from fat. Mexican-American children consumed less total energy, higher percentage of energy from fat, and more sodium than white children.

Table 1 continued

Beydoun and Wang[11]	2009	2291 Parents (20-65 years old) and 2692 children (2-18 years old). 12.6% ± 2.2 Hispanic	Two non-consecutive 24-hour dietary recalls 3-10 days apart (From USDA Continuing Survey of Food Intakes by Individuals 94-96)	Two non-consecutive 24-hour dietary recalls 3-10 days apart (From USDA Continuing Survey of Food Intakes by Individuals 94-96) (7% and 11% self response on days 1 and 2)	Adjusted Pearson correlation coefficients approximated by the linear regression coefficient	Hispanics 0.36 correlation between parents and children for overall dietary quality (HEI). Varied across food groups, dyads. Mother-daughter overall HEI correlation the weakest between the four dyads. Very weak parent child resemblance relation to SES.
Fisher et al.[71]	2002	191 non-Hispanic white girls (5 years old) and parents	Food Frequency Questionnaire	Food Frequency Questionnaire	Structural equation modeling	Girls' fruit and vegetable intake was positively related to parent fruit and vegetable intake. Girls' fruit and vegetable intake positively related to their micronutrient intakes and negatively associated with fat intake

Appendix B

TABLE 2

Table 2. Demographics and weight status of 31 mother/child dyads

Maternal Characteristics	**Mean (SD)**	**Min, Max**
Age (years)	32.1 (4.8)	23.5, 44.2
Children in household	2.5 (1.0)	1, 5
Years living in United States	9.1 (4.2)	0, 18
	N	**Percentage (%)**
Country of Origin		
Mexico	30	97
Ecuador	0	0
Central America	0	0
Other	1	3
Monthly Household Income		
Less than $500	0	0
$500-999	0	0
$1,000-1,999	14	47
$2,000-2,999	14	47

Table 2 continued

$3,000-3,999	1	3
$4,000-4,999	1	3
$5,000-5,999	0	0
Employment Status		
Unemployed	21	68
Employed	10	32
Food Assistance Program Participation		
None	1	3
SNAP	8	26
WIC	21	68
Free or reduced school lunch	22	71
Food pantries	6	19
Other	1	3
Food Security Status		
Food secure	9	29
Food insecure without hunger	18	58
Food insecure with moderate hunger	2	6
Food insecure with severe hunger	2	6
Weight Status		
Normal weight (BMI<25.0)	6	19
Overweight ($25.0 \leq BMI < 30.0$)	14	45
Obese ($BMI \geq 30.0$)	11	36

Table 2 continued

Child Characteristics	**Mean (SD)**	**Min, Max**
Age	4.9 (1.9)	2.2, 8.1
BMI percentile	73.0 (24.4)	4, 99
	N	**Percentage (%)**
Males	11	35
Females	20	65
Child Weight Status		
Underweight (BMI$\leq$5th %)	1	3
Normal Weight (5th %<BMI<85th %)	17	55
Overweight (BMI$\geq$85th %)	4	13
Obese (BMI$\geq$95th %)	9	29

Appendix C

TABLE 3

Table 3. Demographics of mothers with and without secondary follow-up

	With Secondary Follow-Up (n = 31)		Without Secondary Follow-Up (n = 34)	
Maternal Characteristics	**Mean (SD)**	**Min, Max**	**Mean (SD)**	**Min, Max**
Age (years)	32.1 (4.8)	23.5, 44.2	33.2 (5.5)	23.5, 42.6
Children in household	2.7 (1.0)	1, 5	2.4 (1.1)	1, 5
Years living in United States	9.1 (4.2)	0, 18	8.8 (5.3)	0, 25
BMI	28.5 (3.8)	19.7, 35.7	28.2 (4.5)	20.5, 41.1
	N	**Percentage (%)**	**N**	**Percentage (%)**
Food Security Status				
Food secure	9	29	9	26
Food insecure without hunger	18	58	18	53
Food insecure with moderate hunger	2	6	5	15
Food insecure with severe hunger	2	6	2	6
Employment Status				
Unemployed	21	68	19	56
Employed	10	32	15	44
Education Level				
Some 1st-6th grade	2	6	2	6

Table 3 continued

Finished through 6th grade	17	55	8	24
Some 7th-9th grade	3	10	2	6
Finished through 9th grade	3	10	10	29
Some 10th-12th grade	2	6	3	9
Finished some 12th grade	4	13	6	18
Vocational, trade, business school	0	0	1	3
4-year college graduate	0	0	1	3
More than a 4-year college degree	0	0	1	3
Marital Status				
Now married	23	74	23	68
Separated	2	6	3	9
Divorced	0	0	1	3
Never married	6	19	7	21
Primary Language				
Only Spanish	20	65	19	56
Spanish more than English	9	29	14	41
Spanish and English the same	2	6	1	3
Car Ownership				
No	4	13	7	21
Yes	27	87	27	29
Access to Transportation				
No	2	6	2	6
Very Limited	3	10	6	18
Most of the Time	7	23	5	15
All of the Time	19	61	21	62

Table 3 continued

Income Level				
Less than $500	0	0	6	18
$500-999	0	0	7	21
$1,000-1,999	14	47	8	24
$2,000-2,999	14	47	12	35
$3,000-3,999	1	3	0	0
$4,000-4,999	1	3	0	0
$5,000-5,999	0	0	1	3

Appendix D

TABLE 4

Table 4. USDA HEI -2010 scoring components[23]

HEI-2010 component[1]	Maximum	Standard for maximum score	Standard for minimum score of 0
Higher score indicates higher consumption			
Total Fruit[2]	5	≥ 0.8 cup equivalent/1,000 kcal	No fruit
Whole Fruit[3]	5	≥ 0.4 cup equivalent/1,000 kcal	No whole fruit
Total Vegetables	5	≥ 1.1 cup equivalent/1,000 kcal	No vegetables
Greens and Beans	5	≥ 0.2 cup equivalent/1,000 kcal	No dark-green vegetables, beans, or peas
Whole Grains	10	≥ 1.5 ounce equivalent/1,000 kcal	No whole grains
Dairy	10	≥ 1.3 cup equivalent/1,000 kcal	No dairy
Total Protein Foods	5	≥ 2.5 ounce equivalent/1,000 kcal	No protein foods
Seafood and Plant Proteins	5	≥ 0.8 ounce equivalent/1,000 kcal	No seafood or plant proteins
Fatty Acids[4]	10	(PUFAs+MUFAs)/SFAs ≥ 2.5	(PUFAs+MUFAs)/SFAs ≤ 1.2
Higher score indicates lower consumption			
Refined Grains	10	≤1.8 ounce equivalent/1,000 kcal	≥ 4.3 ounce equivalent/1,000 kcal
Sodium	10	≤1.1 gram/1,000 kcal	≥ 2.0 grams/1,000 kcal
Empty Calories[5]	20	≤ 19% of energy	≥ 50% of energy

1. Intakes between the minimum and maximum standards are scored proportionately.
2. Includes 100% fruit juice.
3. Includes all forms of fruit except juice.
4. PUFAs = polyunsaturated fats, MUFAs = monounsaturated fats, SFAs = saturated fatty acids
5. Calories from solid fats, alcohol, and added sugars

Appendix E

TABLE 5

Table 5. Mother macronutrient intake (n = 65)

	USDA RDA/AI[1]	Mean	Standard Deviation	Min, Max	95% Confidence Interval
Sugar (g)	N/A	77.6	36.2	19.7, 212.7	68.7-86.6
Protein (g)	46	66.4	35.0	25.8, 252.5	57.7-75.0
Monounsaturated fat (g)	N/A	18.0	10.2	2.9, 45.8	15.4-20.5
Polyunsaturated fat (g)	N/A	9.7	5.6	1.0, 30.2	8.3-11.0
Trans fat (g)	N/A	49.4	26.2	10.3, 114.85	42.9-55.9
Kcal	1800-2000	1421.2	519.9	701.1, 2856.3	1292.4-1550.1
Cholesterol (mg)	<300	233	177.0	29.28, 914.0	189.2-276.9
Fiber (g)	25.2-28	13.9	7.5	2.8, 35.5	12.1-15.8
Saturated Fat (g)	<10% of calories	17.2	10.4	2.2, 48.5	14.6-19.8
Carbohydrates (g)	130	181.7	68.7	61.9, 378.2	164.7-198.7

1. RDA = Recommended Dietary Allowance, AI = Adequate Intake for females ages 19-50

Appendix F

TABLE 6

Table 6. Mother micronutrient intake (n = 65)

	USDA RDA/AI[a]	Mean	Standard Deviation	Min, Max	95% Confidence Interval
Thiamin (mg)	1.1	1.4	0.7	0.4, 3.1	1.2-1.6
Riboflavin (mg)	1.1	1.7	0.7	0.5, 3.9	1.5-1.9
Niacin (mg)	14	19.4	8.5	4.9, 46.5	17.3-21.5
Folate, total (mcg DFE)	400	388.9	214.8	53.9, 1060.0	335.7-442.2
Vitamin B-6 (mg)	1.3	1.9	0.9	0.5, 4.4	1.7-2.1
Vitamin B-12 (mcg)	2.4	5.3	3.5	0.1, 21.5	4.4-6.2
Vitamin C (mg)	75	87.7	60.1	6.2, 253	72.8-102.6
Vitamin D (IU)	600	168	116	4, 472	3.5-4.9
Vitamin A (mg RAE)	700	550.1	320.6	20.5, 1470.7	470.6-629.5
Vitamin E (mg AT)	15	5.5	4.1	0.9, 23.6	4.5-6.5
Iron (mg)	18	14.5	7.4	3.6, 34.7	12.7-16.3
Calcium (mg)	1,000	743.8	362.0	150.8, 1609.1	654.1-833.5
Copper (mcg)	900	900	400	400, 2700	0.8-1.0
Phosphorus (mg)	700	1036.7	440.9	368.6, 2626.9	927.4-1145.9

Table 6 continued

Sodium (mg) *	2,300	2483.2	1242.7	840.0, 7302.1	2175.3-2791.1
Zinc (mg)	8	10.8	6.6	3.3, 38.3	9.2-12.5

1.RDA = Recommended Dietary Allowance, AI = Adequate Intake for females ages 19-50
*Tolerable Upper Intake Limit

Appendix G

TABLE 7

Table 7. Mother HEI total and sub scores (n = 65)

	Mean	**Standard Deviation**	**Min, Max**	**95% Confidence Interval**
HEI Total (0-100)	47.2	12.2	13.6, 79.5	44.1-50.2
HEI Total Fruits (0-5)	3.5	2.0	0, 5	3.0-4.0
HEI Whole Fruits (0-5)	3.2	2.3	0, 5	2.6-3.7
HEI Total Vegetables (0-5)	3.5	1.7	0, 5	3.1-3.9
HEI Whole Grains (0-10)	2.4	3.2	0, 10	1.6-3.2
HEI Dairy (0-10)	6.0	3.5	0, 10	5.2-6.9
HEI Total Protein Foods (0-5)	3.7	1.8	0, 5	3.2-4.1
HEI Seafood and Plant Proteins (0-5)	1.2	1.9	0, 5	0.7-1.7
HEI Greens and Beans (0-5)	2.0	2.3	0, 5	1.4-2.5

Table 7 continued

HEI Fatty Acids (0-10)	3.8	3.3	0, 10	3.0-4.7
HEI Refined Grains (0-10) *	4.1	3.6	0, 10	3.2-5.0
HEI Sodium (0-10) *	4.1	3.6	0, 10	3.2-5.0
HEI Empty Calories (0-20) *	9.6	6.8	0, 20	8.0-11.3

* Higher score indicates lower consumption

Appendix H

TABLE 8

Table 8. Child macronutrient intake (n = 31)

	USDA RDA/AI Child Age 1-3[a]	USDA RDA/AI Females Age 4-8[a]	USDA RDA/AI Males Age 4-8[a]	Mean	Standard Deviation	Min, Max	95% Confidence Interval
Sugar (g)	N/A	N/A	N/A	69.8	32.2	21.5, 136.1	68.7-86.6
Protein (g)	13	19	19	50.6	27.2	7.0, 128.1	57.7-75.0
Monounsaturated fat (g)	N/A	N/A	N/A	13.2	7.3	2.5, 35.9	15.4-20.5
Polyunsaturated fat (g)	N/A	N/A	N/A	6.3	3.6	1.1, 14.1	8.3-11.0
Trans fat (g)	N/A	N/A	N/A	37.4	18.4	9.2, 85.9	42.9-55.9
Kcal	1,000	1,200	1,400-1,600	1090.9	341.2	532.9, 1820.1	1292.4-1550.1
Cholesterol (mg)	<300	<300	<300	175.4	136.6	34.3, 550.8	189.2-276.9
Fiber (g)	14	16.8	19.6	7.9	4.7	1.6, 17.4	12.1-15.8
Saturated Fat (g)	<10% kcal	<10% kcal	<10% kcal	14.3	7.3	3.1, 33.0	14.6-19.8
Carbohydrates (g)	130	130	130	141.3	48.1	50.6, 252.1	164.7-198.7

[a] RDA = Recommended Dietary Allowance, AI = Adequate Intake for children age 1 to 3, females age 4-8, and males age 4-8

Appendix I

TABLE 9

Table 9. Child micronutrient intake (n = 31)

	USDA RDA/AI Child Age 1-3[a]	USDA RDA/AI Females Age 4-8[a]	USDA RDA/AI Males Age 4-8[a]	Mean	Standard Deviation	Min, Max	95% Confidence Interval
Thiamin (mg)	0.5	0.6	0.6	1.2	0.7	0.3, 3.9	0.9-1.5
Riboflavin (mg)	0.5	0.6	0.6	1.6	0.9	0.3, 4.6	1.3-1.9
Niacin (mg)	6	8	8	16.2	11.6	3.0, 51.6	12.0-20.5
Folate, total (mcg DFE)	150	200	200	306.7	230.8	50.5, 1039.6	222.1-391.4
Vitamin B-6 (mg)	0.5	0.6	0.6	1.6	1.2	0.2, 4.8	1.1-1.9
Vitamin B-12 (mcg)	0.9	1.2	1.2	4.6	3.5	0.2, 15.3	3.3-5.9
Vitamin C (mg)	15	25	25	70.7	70.1	0.7, 282.2	45.0-96.4
Vitamin D (IU)	600	600	600	188	104	16, 428	3.8-5.7
Vitamin A (mg RAE)	300	400	400	447.9	231.6	168.5, 1110.3	363.0-532.9
Vitamin E (mg)	6	7	7	4.5	6.2	0.9, 30.6	2.2-6.8
Iron (mg)	7	10	10	11.8	9.0	2.8, 40.3	8.5-15.1
Calcium (mg)	700	1,000	1,000	752.7	353.5	119.3, 1729.8	596.1-855.4
Copper (mg)	340	440	440	0.6	0.3	0.2, 1.4	0.5-0.7

Table 9 continued

Phosphorus (mg)	460	500	500	838.7	332.6	154.2, 1724.4	716.7-960.7
Sodium (mg)	1,500*	1,900*	1,900*	1896.0	772.6	898.6, 4077.0	1612.5-2179.3
Zinc (mg)	3	5	5	9.1	7.8	1.1, 36.4	6.2-11.9

[a] RDA = Recommended Dietary Allowance, AI = Adequate Intake for females ages 19-50
*Tolerable Upper Intake Limit

Appendix J

TABLE 10

Table 10. Child HEI total and sub scores (n =31)

	Mean	**Standard Deviation**	**Min, Max**	**95% Confidence Interval**
HEI Total (0-100)	48.9	15.5	24.5, 80.1	43.2-54.6
HEI Total Fruits (0-5)	1.0	0.8	0, 2.8	2.9-4.4
HEI Whole Fruits (0-5)	0.5	0.5	0, 1.7	1.7-3.5
HEI Total Vegetables (0-5)	0.5	0.6	0, 2.6	1.3-2.6
HEI Whole Grains (0-10)	0.4	0.6	0, 2.2	1.0-3.7
HEI Dairy (0-10)	1.6	0.9	0, 3.4	6.9-9.1
HEI Total Protein Foods (0-5)	3.5	2.0	0, 5	2.8-4.2
HEI Seafood and Plant Proteins (0-5)	0.6	1.5	0, 5	0.1-1.2
HEI Greens and Beans (0-5)	0.9	1.8	0, 5	0.2-1.5

Table 10 continued

HEI Fatty Acids (0-10)	2.5	2.9	0, 10	1.5-3.6
HEI Refined Grains (0-10) *	5.9	3.8	0,10	4.5-7.3
HEI Sodium (0-10) *	3.7	3.3	0, 10	2.4-4.9
HEI Empty Calories (0-20) *	13.3	6.7	0, 20	10.8-15.7

*Higher score indicates lower consumption

Appendix K

TABLE 11

Table 11. Mother-child diet similarity (n = 31)

	Correlation Coefficient (r^2)
BMI	0.013
HEI Total	-0.009
HEI Total Fruits	0.013
HEI Whole Fruits	0.0001
HEI Total Vegetables	-0.187 *
HEI Whole Grains	0.001
HEI Dairy	-0.031
HEI Total Protein Foods	-0.013
HEI Seafood	-0.007
HEI Greens and Beans	0.002
HEI Fatty Acids	0.024
HEI Refined Grains	0.033
HEI Sodium	-0.002
HEI Empty Calories	0.007
Sugar	-0.0001
Protein	-0.062
Monounsaturated fat	0.002
Polyunsaturated fat	0.006
Trans fat	5.921e-5
Kcal	0.001
Cholesterol	0.001
Fiber	0.0002
Saturated Fat	0.003
Carbohydrates	0.0001
Thiamin	-0.017
Riboflavin	-0.008
Niacin	-0.037
Folate, total	0.005

Table 11 continued

Vitamin B-6	-0.011
Vitamin B-12	-0.103 *
Vitamin C	0.024
Vitamin D	0.003
Vitamin A	0.006
Vitamin E	-0.043
Iron	0.001
Calcium	-0.006
Copper	-0.003
Phosphorus	-0.007
Sodium	-0.016
Zinc	-0.124 *

*small correlation ($r^2 \leq 0.1$)

Appendix L

TABLE 12

Table 12. Mother-child dietary intake correlation with years living in the US (n = 31)

	Mothers' Correlation Coefficient (r^2)	Children's Correlation Coefficient (r^2)	Regression Modeling B-Coefficient Difference
BMI	0.039	-0.023	0.008
HEI Total	0.008	-0.037	0.053
HEI Total Fruits	0.110 *	-0.027	0.115
HEI Whole Fruits	0.026	-0.055	0.092
HEI Total Vegetables	0.001	-0.023	0.013
HEI Whole Grains	-0.0001	0.006	0.001
HEI Dairy	-0.005	0.063	0.070
HEI Total Protein Foods	0.004	-4.445e-5	-0.003
HEI Seafood	0.019	-0.032	0.043
HEI Greens and Beans	-0.007	-0.039	-0.010
HEI Fatty Acids	-0.021	-0.042	0.009
HEI Refined Grains	-0.006	-0.026	-0.038
HEI Sodium	0.017	-0.048	0.046
HEI Empty Calories	0.002	-0.002	0007
Sugar	0.033	-0.009	-0.003
Protein	-0.008	-0.043	-0.039
Monounsaturated fat	-0.024	-0.012	-0.011
Polyunsaturated fat	-0.013	-0.001	-0.002
Trans fat	-0.017	-0.002	-0.005
Kcal	-0.009	-0.006	-0.009

Table 12 continued

Cholesterol	2.402e-6	-0.007	-7.8E-06
Fiber	0.0009	2.686e-5	0.001
Saturated Fat	-0.010	0.004	0.010
Carbohydrates	1.739e-9	0.0001	0.0001
Thiamin	-0.012	0.061	0.010
Riboflavin	-0.001	0.038	0.026
Niacin	-0.002	0.002	-0.002
Folate, total	-0.003	0.001	0.002
Vitamin B-6	0.0005	-0.003	0.001
Vitamin B-12	-0.0005	-9.467e-5	-0.013
Vitamin C	0.038	0.038	-0.052
Vitamin D	0.026	0.0004	-0.0007
Vitamin A	0.011	0.019	0.029
Vitamin E	-0.010	0.018	0.012
Iron	-0.004	0.001	0.005
Calcium	0.0009	0.093 *	0.012
Copper	0.004	-0.011	0.010
Phosphorus	-0.013	0.013	0.016
Sodium	-0.011	0.012	-0.006
Zinc	-0.015	0.004	-0.007

*Small correlation ($r^2 \leq 0.1$)

Appendix M

TABLE 13

Table 13. Mother-child dietary intake correlation with food security score (n = 31)

	Mothers (p-value)	Children (p-value)	Regression Modeling B-Coefficient Difference
BMI	0.227	0.001 **	0.015
HEI Total	0.709	0.918	-0.023
HEI Total Fruits	0.851	0.066	0.026
HEI Whole Fruits	0.523	0.927	-0.049
HEI Total Vegetables	0.490	0.174	0.036
HEI Whole Grains	0.456	0.679	0.022
HEI Dairy	0.736	0.436	-0.072
HEI Total Protein Foods	0.032 *	0.199	-0.033
HEI Seafood	0.062	0.946	-0.015
HEI Greens and Beans	0.842	0.794	0.009
HEI Fatty Acids	0.768	0.633	-0.038
HEI Refined Grains	0.698	0.183	-0.044
HEI Sodium	0.144	0.433	0.107
HEI Empty Calories	0.996	0.665	0.032
Sugar	0.491	0.764	0.062
Protein	0.177	0.284	0.037
Monounsaturated fat	0.542	0.404	-0.009
Polyunsaturated fat	0.159	0.764	0.008
Trans fat	0.348	0.573	0.011

Table 13 continued

Kcal	0.134	0.672	-0.056
Cholesterol	0.096	0.109	0.043
Fiber	0.261	0.891	0.031
Saturated Fat	0.507	0.670	-0.002
Carbohydrates	0.211	0.519	-0.068
Thiamin	0.392	0.810	-0.295
Riboflavin	0.656	0.877	-0.215
Niacin	0.353	0.514	-0.333
Folate, total	0.335	0.885	-0.080
Vitamin B-6	0.532	0.522	-0.169
Vitamin B-12	0.160	0.752	-0.087 ***
Vitamin C	0.551	0.334	0.005
Vitamin D	0.220	0.376	-0.052
Vitamin A	0.532	0.004 **	-0.143
Vitamin E	0.192	0.987	-0.008
Iron	0.311	0.793	-0.216
Calcium	0.468	0.955	-0.022
Copper	0.045 *	0.273	0.034
Phosphorus	0.319	0.469	-0.026
Sodium	0.218	0.532	-0.083
Zinc	0.356	0.738	-0.016

* $p \leq 0.05$
** $p \leq 0.01$
*** Significant change in B-coefficient

Appendix N

TABLE 14

Table 14. Mother and child dietary intake correlation with participation in food assistance programs (n = 31)

	Mothers (p-value)			Children (p-value)			
	SNAP	WIC	Food Pantries	SNAP	WIC	Free and Reduced School Lunch	Food Pantries
BMI	0.461	0.402	0.384	0.882	0.130	0.904	0.368
HEI Total	0.186	0.773	0.808	0.735	0.446	0.234	0.192
HEI Total Fruits	0.670	0.848	0.868	0.060	0.942	0.806	0.105
HEI Whole Fruits	0.745	0.146	0.347	0.592	0.752	0.976	0.956
HEI Total Vegetables	0.865	0.927	0.517	0.216	0.408	0.550	0.868
HEI Whole Grains	0.775	0.835	0.609	0.673	0.523	0.145	0.014 *
HEI Dairy	0.808	0.394	0.874	0.906	0.051*	0.208	0.478
HEI Total Protein Foods	0.820	0.703	0.446	0.257	0.482	0.729	0.603
HEI Seafood	0.801	0.661	0.093	0.230	0.087	0.655	0.414
HEI Greens and Beans	0.577	0.994	0.791	0.644	0.424	0.472	0.979
HEI Fatty Acids	0.547	0.989	0.955	0.493	0.186	0.487	0.197
HEI Refined Grains	0.845	0.374	0.882	0.418	0.612	0.365	0.492
HEI Sodium	0.325	0.277	0.458	0.552	0.416	0.144	0.633
HEI Empty Calories	0.051*	0.639	0.663	0.500	0.516	0.802	0.228
Sugar	0.903	0.957	0.230	0.494	0.962	0.398	0.182
Protein	0.457	0.474	0.583	0.045 *	0.441	0.269	0.764

Table 14 continued

Monounsaturated fat	0.892	0.769	0.811	0.132	0.953	0.859	0.552
Polyunsaturated fat	0.740	0.307	0.402	0.103	0.558	0.985	0.287
Trans fat	0.773	0.667	0.933	0.061	0.632	0.818	0.581
Kcal	0.731	0.486	0.670	0.043 *	0.577	0.320	0.838
Cholesterol	0.403	0.932	0.136	0.619	0.873	0.768	0.944
Fiber	0.724	0.430	0.957	0.675	0.652	0.764	0.658
Saturated Fat	0.519	0.784	0.855	0.045 *	0.322	0.727	0.926
Carbohydrates	0.908	0.503	0.581	0.316	0.943	0.496	0.361
Thiamin	0.592	0.779	0.520	0.863	0.926	0.860	0.136
Riboflavin	0.384	0.636	0.859	0.973	0.897	0.517	0.052 *
Niacin	0.369	0.969	0.998	0.902	0.680	0.569	0.129
Folate, total	0.855	0.779	0.927	0.971	0.705	0.758	0.095
Vitamin B-6	0.750	0.717	0.289	0.946	0.370	0.910	0.019 *
Vitamin B-12	0.014 *	0.733	0.360	0.247	0.556	0.991	0.091
Vitamin C	0.766	0.643	0.875	0.051 *	0.678	0.569	0.003 **
Vitamin D	0.345	0.749	0.006 **	0.545	0.135	0.282	0.678
Vitamin A	0.907	0.255	0.622	0.811	0.467	0.527	0.823
Vitamin E	0.796	0.340	0.414	0.421	0.610	0.113	0.097
Iron	0.161	0.915	0.494	0.763	0.453	0.968	0.070
Calcium	0.739	0.463	0.591	0.130	0.0004 **	0.178	0.258
Copper	0.490	0.620	0.861	0.249	0.142	0.872	0.195
Phosphorus	0.749	0.780	0.866	0.030 *	0.0148 *	0.099	0.591
Sodium	0.708	0.122	0.178	0.078	0.248	0.813	0.993
Zinc	0.193	0.540	0.886	0.476	0.714	0.818	0.289

* $p \leq 0.05$
** $p \leq 0.01$

Table 14 continued

	Regression Modeling B-Coefficient Difference		
	SNAP	WIC	Food Pantries
BMI	0.003	-0.047	0.001
HEI Total	0.007	-0.004	-0.046
HEI Total Fruits	-0.056	0.005	0.001
HEI Whole Fruits	-0.031	-0.176	6.39E-05
HEI Total Vegetables	-0.008	-0.046	-0.0006
HEI Whole Grains	-0.018	-0.037	-0.067
HEI Dairy	-0.039	0.011	0.020
HEI Total Protein Foods	0.019	0.012	0.002
HEI Seafood	-0.059	0.001	0.012
HEI Greens and Beans	0.012	0.009	0.0001
HEI Fatty Acids	-0.018	0.086	0.029
HEI Refined Grains	-0.004	-0.006	-0.005
HEI Sodium	0.0001	-0.045	-0.009
HEI Empty Calories	0.013	0.010	-0.018
Sugar	-0.035	0.001	-0.022
Protein	-0.022	0.008	0.004
Monounsaturated fat	-0.028	-3.67E-05	0.018
Polyunsaturated fat	0.023	-0.004	0.021
Trans fat	-0.024	0.001	0.015
Kcal	-0.046	-0.002	-0.003
Cholesterol	0.007	-0.008	0.002

Table 14 continued

Fiber	0.006	-0.005	-0.017
Saturated Fat	-0.091	0.007	0.003
Carbohydrates	-0.019	-0.001	-0.005
Thiamin	0.001	5.6E-05	0.008
Riboflavin	-0.002	-0.003	0.039
Niacin	0.0002	0.010	0.043
Folate, total	0.002	0.004	0.002
Vitamin B-6	-0.013	0.031	0.012
Vitamin B-12	0.031	0.011	0.035
Vitamin C	0.012	0.005	-0.063
Vitamin D	-0.015	-0.030	-0.010
Vitamin A	0.003	0.006	0.006
Vitamin E	0.017	0.010	-0.028
Iron	-0.007	0.023	0.017
Calcium	-0.099	0.001	-0.014
Copper	0.030	-0.015	-0.044
Phosphorus	-0.119	0.012	0.0002
Sodium	-0.009	-0.013	-0.009
Zinc	0.012	-0.004	0.002

Appendix O

FIGURE 2

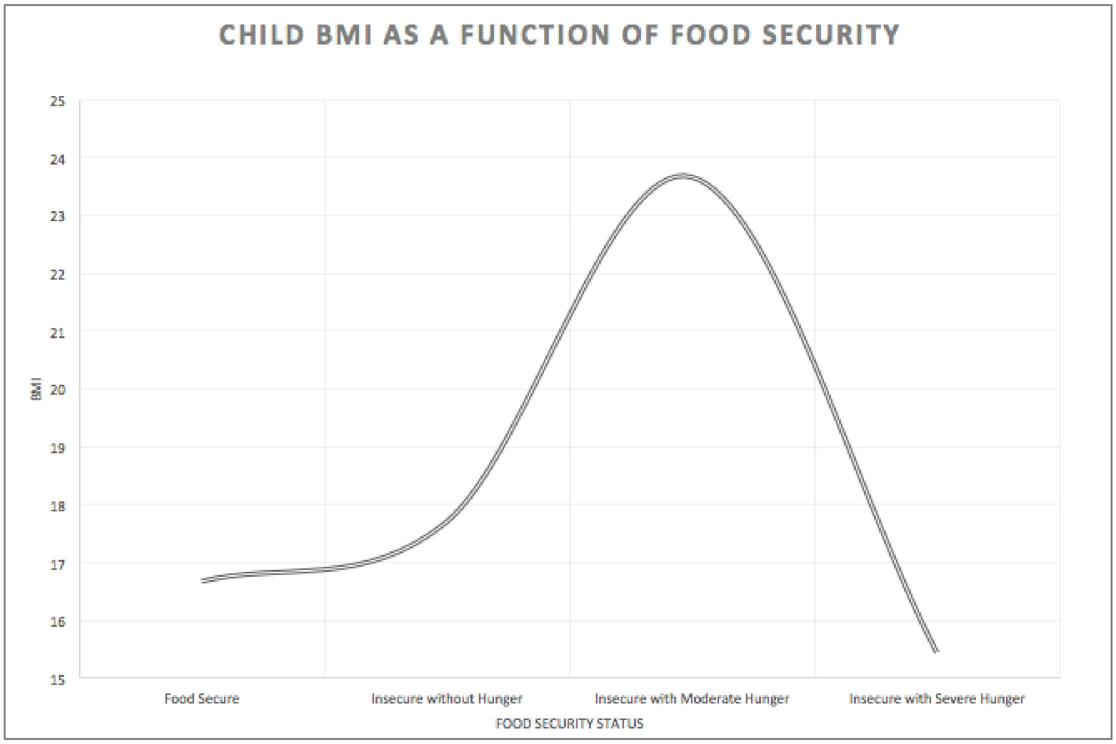

Figure 2. Child BMI as a function of food security

Appendix P

FOLLOW UP RESULTS

After examining the data, further investigation was completed to compare the diets of children who did and did not breastfeed as an infant using a two-sample t-test with the level of significance was set at $p \leq 0.05$. Children who had breastfed as an infant scored significantly less on protein HEI scores (M = 3.2, SD = 2.1) than children who were formula fed (M = 4.7, SD = 0.2) ($p = 0.0025$). There was no significant difference between BMI, the other HEI scores, or macronutrient or micronutrient intake.

Consistent with the findings of Hopkins et al.[57], children who were breastfed as infants consume less protein than their formula-fed counterparts. A preference for protein-rich foods during childhood may be shaped by the higher protein content of formula, which is necessary to provide sufficient amounts of the essential amino acids.[58] However, while not seen in our study, previous studies have concluded that breastfed infants are less likely to obese during childhood.[59] Future research should further investigate the link between protein intake and formula feeding to understand if it is related to the higher obesity rates in formula-fed infants.