Spring 5-2018

Bridging the Gap between Food Insecurity and Subsequent Child Body Mass: Mediating Effects of Dietary Quality and Feeding Styles in Low-Income Hispanic Preschoolers

Nipa Kamdar

BRIDGING THE GAP BETWEEN FOOD INSECURITY AND SUBSEQUENT CHILD BODY MASS: MEDIATING EFFECTS OF DIETARY QUALITY AND FEEDING STYLES IN LOW-INCOME HISPANIC PRESCHOOLERS

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN NURSING

UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT HOUSTON

CIZIK SCHOOL OF NURSING

BY

NIPA KAMDAR RN, FNP-BC, MSN

MAY 2018

Approval Form D-3

UTHealth | Cizik School of Nursing
The University of Texas Health Science Center at Houston

Houston, Texas

2/28/2018
Date

To the Dean for the School of Nursing:

I am submitting a dissertation written by Nipa Kamdar and entitled "Bridging the Gap between Food Insecurity and Subsequent Child Body Mass: Mediating Effects of Dietary Quality and Feeding Styles in Low-Income Hispanic Preschoolers." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Nursing.

Janet C Meininger
Committee Chair

We have read this dissertation
and recommend its acceptance:

Cheryl O. Hughes

Cathy Rozmus

Wanyan Chan

Accepted

Dean for the School of Nursing

Acknowledgements

- I express my gratitude to the Robert Wood Johnson Future of Nursing Scholars Program for their excellent support throughout my program.
- I also express gratitude to the Hamill Foundation and J.P. McGovern Foundation for their support of my education.
- Thank you to the USDA/ARS Children's Nutrition Research Center.
- Thank you to Kirstin Vollrath, MS, RD for her guidance on calculating the Healthy Eating Index Score.
- Thank you to Stanley Cron for his suggestion on looking for updated methods for mediation analysis.

Abstract

Bridging the Gap between Food Insecurity and Subsequent Child Body Mass: Mediating Effects of Dietary Quality and Feeding Styles in Low-Income Hispanic Preschoolers

Nipa Kamdar

May 2018

Background: Low-income Hispanic preschoolers face disproportionately high prevalence of food insecurity (FI) and obesity. Consumption of low-cost, energy-dense foods to compensate for FI leads to excess body-mass. FI parents may adopt feeding styles that contribute to decline in children's dietary quality. Feeding style describes the amount of demandingness (i.e., control of children's eating) and responsiveness (i.e., warmth used to express demandingness). FI may indirectly contribute to obesity through dietary quality and feeding style.

Purpose: This study investigated: 1. if dietary quality mediated the relationship between food security status (FSS) at Time 1 (T1) and child body-mass at Time 2 (T2), 2. if feeding demandingness (PFD) and/or responsiveness (PFR) mediated the relationship between FSS at T1 and child dietary quality at T2, 3. explored if gender and/or parental acculturation moderated the mediation.

Method: The current study was a secondary analysis of an observational study (R01 HD06257, PI: Hughes). Hispanic parent-preschooler dyads (n=137) provided data through the 6-item Household Food Security Survey, Healthy Eating Index-2015 (HEI), Caregiver's Feeding Style Questionnaire, Bidmensional Acculturation Scale, and body-mass-index z-score (BMIz) at two timepoints 18 months apart. Mediation and moderated

mediation analyses were conducted using regression models while controlling co-variates. Bias-corrected bootstrap confidence intervals estimated indirect effects.

Outcomes: FSS_{T1} did not indirectly influence child $BMIz_{T2}$ through HEI_{T1} (*ab*= -0.00, bootstrap CI [-0.00, 0.00]). FSS_{T1} also did not indirectly influence HEI_{T2} through PFD_{T1} (*ab*= -0.01, bootstrap CI [-0.15, 0.03]) or PFR_{T1} (*ab*= 0.01, bootstrap CI [-0.04, 0.15]). However, as FSS_{T1} worsened, HEI-2015_{T2} improved (*c*= 1.06, 95% CI [0.43, 1.69]). As a co-variate, higher baseline English $acculturation_{T1}$ predicted lower HEI-2015_{T2} (β= -3.44, 95% CI [-5.62, -1.26]) and higher $BMIz_{T2}$ (β= 0.13, 95% CI [0.05, 0.21]); however, it did not have significant conditional effects in moderated mediation models. Gender ($p_{FSSxGender}$= .04) moderated the direct effect of FSS_{T1} on $BMIz_{T2}$; however, effect size ((β= 0.05, 95% CI [0.002, 0.09]) was too small to be clinically relevant.

Conclusion: FI did not affect body-mass through dietary quality, nor did it affect dietary quality through PFD or PFR. However, an unexpected positive direct relationship between FI and subsequent dietary quality warrants further exploration.

Keywords: Food security, Child obesity, Parenting, Diet

Table of Contents

Summary of Study

This study is a secondary analysis of a parent study that examined the relationship between parenting behaviors and children's eating behaviors. The parent study was conducted at the Children's Nutrition Research Center in Houston, TX. The subjects were parents (mostly mothers) and preschooler dyads recruited from Head Start centers in Houston.

The purpose of the current study was to increase our understanding of the relationship between household food insecurity, dietary quality, body mass, and parenting feeding demandingness and responsiveness in low-income Hispanic preschoolers. Food insecurity and child obesity disproportionately affect low-income Hispanic preschoolers. They also share common risk factors. This study tested dietary quality as a potential mechanism through which food insecurity and child obesity were indirectly related. Additionally, parents of preschoolers control their children's dietary quality. Using Conger's (2007) Family Stress Model as a theoretical framework, the current study also tested parenting feeding demandingness (i.e., control) and responsiveness (i.e., warmth) as a potential mechanism through which food insecurity and dietary quality were indirectly related. Finally, the study sought to identify if child gender or maternal level of acculturation to US lifestyle influenced the direct and /or indirect pathways. The knowledge gained from this investigation could be applied to building robust interventions and policies directed towards food security and child nutrition.

Immense work went into learning the statistical methods needed to analyze the study aims prior to the proposal defense. Because of this work, there were limited issues

that developed during the course of the study which was heavily rooted in data analysis. The issues that were encountered included:

1. Miscalculation of Time 1's Whole Fruit Component score. This error resulted in erroneous dietary quality scores. Once the issue was realized, the necessary corrections were made to the component score and dietary quality. I updated the dataset and repeated the analyses.
2. Pending publication of the evaluation of Healthy Eating Index-2015 (HEI-2015). I wrote to several researchers familiar with HEI and asked their opinion on continuing to use a score that had no published psychometrics. The general consensus was that I should continue to use it. However, I had calculated the Healthy Eating Index-2010 scores. Therefore, I decided to test the aims using this score as sensitivity analysis.
3. Also, during the writing of the manuscript, I grew concern about using the food security score as a continuous variable. The majority of published studies categorize the raw score. Therefore, I reran the aims using food security as a traditional categorical variable as part of sensitivity analyses.
4. Using Dr. Chan's suggestions, I revised the method used to test potential co-variates. I kept only those co-variates that had significant influence ($p \leq .1$) in my models.
5. Made corrections with the type of statistical test I used for comparisons. I was using non-parametric t-tests to compare categorical data. This was corrected to Chi-square analyses.

Overall, there were no major changes made to the proposal after its approval.

The dissertation is organized the guidelines for preparation of the doctoral dissertation. The dissertation manuscript contains the final results of the study. This is followed by appendices that include components of the study manual (Appendices A-F), two manuscripts- one published (Appendix G) and one under review (Appendix H). Finally, the dissertation concludes with my curriculum vitae.

BRIDGING THE GAP BETWEEN FOOD INSECURITY AND SUBSEQUENT CHILD BODY MASS: MEDIATING EFFECTS OF DIETARY QUALITY AND FEEDING STYLES IN LOW-INCOME HISPANIC PRESCHOOLERS

A DISSERTATION PROPOSAL SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN NURSING

UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT HOUSTON

CIZIK SCHOOL OF NURSING

BY

NIPA KAMDAR RN, FNP-BC, MSN

AUGUST, 2018

Dissertation Proposal

Specific Aims

Low-income Hispanic preschoolers are disproportionately at risk for two major public health issues that have long-lasting health consequences—food insecurity and obesity. Food insecurity, which is inadequate access to food, contributes to poor dietary quality and obesity. Dietary quality is critical for healthy growth and development. Parents have strong influence on preschoolers' diet, and subsequently, their dietary quality. Food insecurity, child obesity, dietary quality, and parenting feedings styles (PFS) have complex, layered relationships. The knowledge gained from this study could be used to design robust interventions and provide support for food security and child nutrition policy reforms.

Child obesity and food insecurity have overlapping risk factors that include having low-income, being of Hispanic ethnicity, and having a head of household with high school or less education (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2016; Gibbs & Forste, 2014; Ogden, Carroll, Kit, & Flegal, 2014). Hispanic preschoolers have an almost 5-fold increased prevalence of obesity compared to Caucasian preschoolers (Ogden et al., 2014), and one out of four Hispanic families with children is food insecure (Coleman-Jensen et al., 2016). Low-income Hispanic preschoolers are also at risk for low dietary quality (Quandt et al., 2016) which is a determinant for obesity. Low-income Hispanic parents with increased stress tend to have feeding styles that are low in parental control and warmth (Hughes, Power, Liu, Sharp, & Nicklas, 2015; Hurley, Black, Papas, Caulfield, & Caufield, 2008). This style is associated with nutritionally poor diets (Hoerr et al., 2009). Feeding style is a parenting behavior determined by the amount of

demandingness, or control, a parent places on what and how their children eat and the amount of responsiveness, or warmth, by which the parent expresses that demandingness (Hughes, Power, Orlet Fisher, Mueller, & Nicklas, 2005).

While there is evidence of association between: 1. food insecurity and obesity, 2. food insecurity and dietary quality, and 3. parenting feeding style and dietary quality, no study to date has examined how these factors relate to each other overtime in low-income Hispanic preschoolers. Currently, programs and policies often target food insecurity and obesity separately. By identifying potential mediating mechanisms, such as dietary quality and PFS through levels of demandingness and responsiveness, interventions designed to target these mechanisms may subsequently improve long-term health outcomes in this vulnerable population.

The study will use secondary analysis of longitudinal data from a parent study that examined parenting and dietary behaviors in low-income Hispanic preschoolers over 18 months (R01 HD06257, PI: Hughes). It will focus on the direct and indirect pathways that bridge food insecurity with obesity through dietary quality. Because parents have critical influence on preschoolers' diet, the study will also focus on the direct and indirect pathways that bridge food insecurity with dietary quality through parental levels of demandingness and responsiveness, the domains used to determine PFS.

Based on the family stress model (Conger & Donnellan, 2007), food insecurity is an environmental stress that could sway parents to adopt low levels of parental demandingness and responsiveness which would then lead to poor dietary quality. The central hypothesis of this study is that exposure to food insecurity will overtime directly, and indirectly through poor dietary quality, result in increased child body-mass. The

potential mediators of dietary quality and PFS could be targets for change in interventions to ultimately reduce prevalence of child obesity.

Aims

1. To investigate if dietary quality mediates the relationship between food security status (FSS) at Time 1and body-mass-index (BMI) at Time 2 in low-income Hispanic preschoolers.

   Hypothesis 1: Poor dietary quality will mediate the relationship between low FSS at Time 1 and elevated BMI at Time 2 in low-income Hispanic preschoolers.

2. To investigate if parental feeding demandingness and/or responsiveness mediate the relationship between food security status (FSS) at Time 1 and dietary quality at Time 2 in low-income Hispanic preschoolers.

   Hypothesis 2a: Low levels of feeding demandingness will mediate the relationship between low FSS at Time 1 and poor dietary quality at Time 2 in low-income Hispanic preschoolers.

   Hypothesis 2b: Low levels of feeding responsiveness will mediate the relationship between low FSS at Time 1 and poor dietary quality at Time 2 in low-income Hispanic preschoolers.

3. To explore if factors such as gender and/or acculturation moderate the direct and indirect effects of the mediations being tested in Aim 1 and 2.

The shared risk factors and disproportionally high prevalence of food insecurity and child obesity afflicting low-income Hispanic preschoolers raises suspicion of potential mediators connecting these two issues. Identification of modifiable mediators will

provide alternative approaches to address the problems. Positive changes made at this point of child development have potential for life-long impact.

Proposal Abstract

Background: Low-income Hispanic preschoolers are disproportionately at risk for two public health issues that have long-lasting consequences—food insecurity and obesity. Children living in households that lack access to food may not consume nutritious food. Parents may compensate for the stress of being food insecure by adopting feeding styles that contribute to poor diets. Feeding style is a parenting behavior determined by the amount of demandingness, or control, a parent places on their children's eating and amount of responsiveness, or warmth, with which a parent expresses that demandingness (Hughes et al., 2005).

Purpose: The primary aims of this study are to investigate: 1. if dietary quality mediates the relationship between food security status (FSS) at Time 1 and child body-mass-index (BMI) at Time 2, 2. if parental levels of feeding demandingness and responsiveness mediate the relationship between FSS at Time 1 and dietary quality at Time 2, 3. explore factors that that moderate the mediation being tested in Aim 1 and 2.

Method: The study will use secondary analysis of longitudinal data from a parent study that examined parenting and dietary behaviors in low-income Hispanic preschoolers (R01 HD06257, PI: Hughes). Analysis will be conducted using a half-longitudinal model for mediation and bootstrap method to test for significance of the indirect effects. Moderation will be tested on the mediation model using regression analysis.

Expected Outcomes: Poor child dietary quality will mediate the relationship between low FSS at Time 1 and elevated child BMI at Time 2 in low-income Hispanic preschoolers. Low levels of parental feeding demandingness and responsiveness will mediate the relationship between low FSS at Time 1 and poor child dietary quality at Time 2 in low-

income Hispanic preschoolers. Gender and acculturation may moderate the mediation effects.

Conclusion: This study will increase understanding of the relationship between food insecurity and weight status in children through identification of potential direct and indirect mediating mechanisms and moderators of the mediation. Findings will be used to improve interventions focused on improving child weight status. Findings can also be used to support food security and child nutrition policy reforms.

Significance

Food insecurity and obesity are two public health issues that disproportionately affect low-income Hispanic preschoolers (Coleman-Jensen et al., 2016; Ogden et al., 2016). These children are at risk for additional health disparities as they grow older because of potential long-lasting health and social consequences associated with these issues (Gundersen & Ziliak, 2015; Reilly & Kelly, 2011). Early intervention and targeted policy change may help reduce these disparities.

Despite growing recognition that food insecurity and obesity co-exist (Larson & Story, 2011), many of the interventions and policies address each issue separately. Identification of the factors that mediate food insecurity and obesity will allow for more comprehensive intervention and policy design to achieve better outcomes (Rutten, Yaroch, Patrick, & Story, 2012; Troy et al., 2011).

The conceptual framework guiding this study is presented in Figure 1. The figure also depicts study aims 1 and 2. The solid arrows represent the mediation that will be tested in Aim 1. The dotted arrows represent the mediation that will be tested in Aim 2. Aim 2 is based on the Family Stress Model (FSM). Per the FSM, sources of stress, such

as economic hardship, influence parenting behaviors. The stress/hardship and parenting behavior directly and indirectly affect the child's well-being (Conger & Donnellan, 2007). A summary of what is known with respect to the associations to be tested is described in this section.

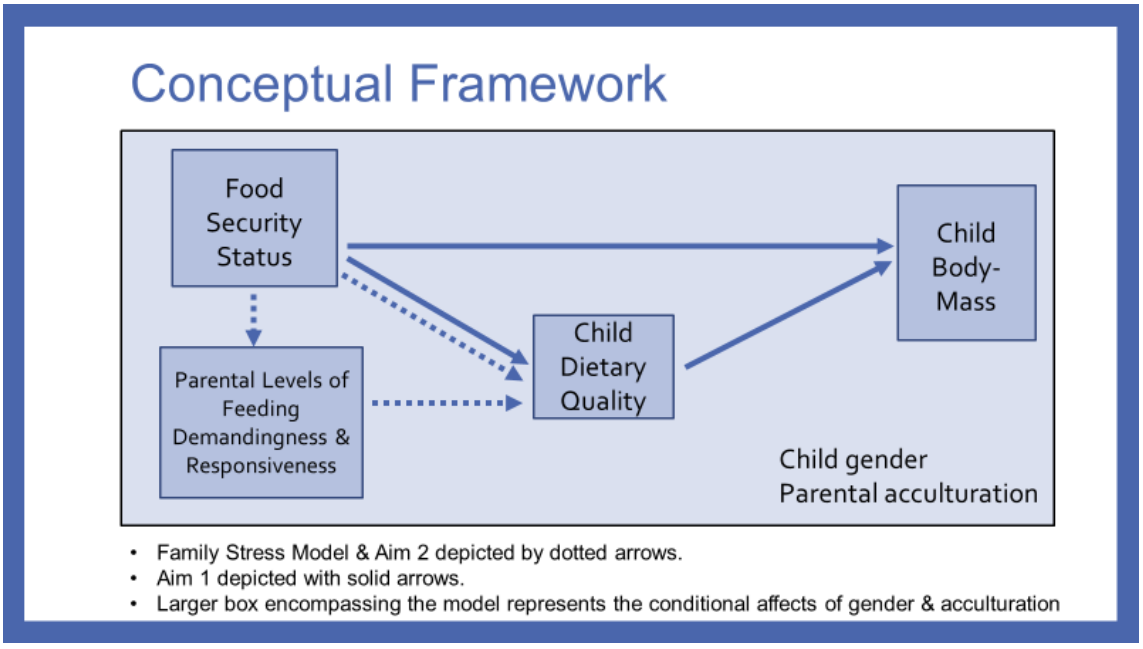

Figure 1. Conceptual Framework with Family Stress Model embedded.

Food Insecurity and Obesity

Food insecurity is a concern, or lack, of access to enough food to meet perceived nutritional needs for each member of a household due to restricted financial resources. In the US, one out of every four Hispanic families with children are food insecure (Coleman-Jensen et al., 2016). These children are at greater risk for poor fetal development, iron deficiency anemia, poor school performance, and increased risk of mental health concerns (Gundersen & Ziliak, 2015).

Obesity in children is defined as a body-mass-index greater than the 95th percentile for gender and age (CDC, 2015). It affects 16.7% of Hispanic preschoolers

(Ogden et al., 2014; Skinner, Perrin, & Skelton, 2016). Obesity increases morbidity through early-onset diabetes, hypertension, hyperlipidemia, and other health issues.

Although evidence of a linear association between food insecurity and obesity is well-established in women, in preschoolers the evidence remains mixed (Larson & Story, 2011). Cross-sectional studies on young Hispanic children have conflicting findings with respect to the correlation between food insecurity and obesity (Hernandez, Reesor, Alonso, Eagleton, & Hughes, 2016; Papas, Trabulsi, Dahl, & Dominick, 2016). Possible explanations for these discrepancies could be due to the cross-sectional design of these studies which limits the tested relationship to a single snapshot.

Longitudinal studies have also had mixed findings. Three longitudinal studies found no association between food insecurity and child obesity (Bhargava, Jolliffe, & Howard, 2008; Rose & Odor, 2006; Winicki, & Jemison, 2003). Four other longitudinal studies; however, did find significant increases in odds of obesity in young children living in food insecure households (Bronte-Tinkle, Sallow, Capps, Horowitz, & McNamara, 2007; Dubois, Farmer, Girard, & Proceri, 2006; Jyoti, Frongillo, & Jones, 2005; Metallinos-Katsaras, Must, & Gorman, 2012). In Bronte-Tinkle's (2007) study, the positive association between food insecurity and obesity worked indirectly through the mediating effects of parental depression and practices. Her study highlights the need to test for additional potential mediators. Gender may also have a conditional influence on the relationship between food insecurity and obesity as indicated by Jansen (2017) and Jyoti (2005).

Food insecurity and child obesity share a high prevalence, risk factors, and profound consequences in low-income Hispanic preschoolers. Clarification on the co-

existence and possible interdependence of these issues needs to be further examined to help reduce health disparity.

Food Insecurity and Dietary Quality in Children

Studies examining the association between food insecurity and dietary intake in children provide evidence that as food security decreases, the dietary quality diminishes as well (Hanson & Connor, 2014; Kaiser et al., 2003; Matheson, Varity, Varady, & Killen, 2002). A recent study examining preschool-aged children of US-based Latino farmworkers, a population vulnerable to food insecurity, found that their dietary quality was below national recommendations (Quandt et al., 2016). Kaiser's (2002) study on Hispanics also found that children with greater levels of food insecurity were less likely to meet dietary recommendations as suggested by the Food Pyramid. As food security lowered, consumption of low-fat milk decreased and tortillas increased (Kaiser et al., 2002). A study that sampled Hispanic children along the Texas border found that total calories, proteins, and sugars increased as food security decreased and emphasized the need to understand the relationship between food insecurity and dietary intake of children in households with limited resources (Sharkey, Nalty, Johnson, & Dean, 2012).

The studies described above are cross-sectional. A longitudinal assessment of the relationship between food insecurity and dietary quality in low-income Hispanic preschoolers would provide insight on the potential influence exposure to food insecurity has on diets during this critical time of children's growth and development.

Parenting Feeding Style and Dietary Intake

Parents generally have a great deal of control over the types of food they offer their children to eat, especially in young children. Studying parenting behaviors, such as

parental feeding style, increases our understanding of parental influence on children's diets. Parenting feeding style (PFS) is a concept used to describe the emotional climate in which parents feed their children (Hughes et al., 2005). It is based on the parenting style framework (Darling & Steinberg, 1993).

PFS is measured on two continuous, parent-reported scales: demandingness and responsiveness. Demandingness refers to the amount of control and supervision a parent expresses when feeding his/her child. Responsiveness refers to the amount of warmth with which a parent expresses that demandingness. Cutpoints on the demandingness and responsiveness scales are used to categorize parents into one of four feeding style categories: authoritarian (high demandingness, low responsiveness), authoritative (high demandingness, high responsiveness), indulgent (low demandingness, high responsiveness), and uninvolved style (low demandingness, low responsiveness) (Hughes et al., 2012).

Distinctive styles are associated with different patterns of dietary intake. Authoritative feeding style is associated with greater parental attempt for children to eat dairy, fruit, and vegetables (Patrick & Nicklas, 2005; Patrick, Nicklas, Hughes, & Morales, 2005). Indulgent style is associated with increased intake of foods with low nutrient density (Hennessy, Hughes, Goldberg, Hyatt, & Economos, 2012). Indulgent and uninvolved PFS are also associated with decreased fruit, vegetable, and dairy intake compared to children of parents with an authoritarian PFS (Hoerr et al., 2009). Hispanic parents tend to exhibit an indulgent feeding style (Hughes et al., 2005) which is associated with increased child weight status (Hughes, Power, O'Connor, Orlet Fisher, & Chen, 2016).

Typically, PFS is studied using the four categorical feeding styles previously described. However, changes to levels of demandingness and responsiveness over the course of 18 months- the time between the study's two timepoints - may not be great enough to reach threshold cutpoints. To capture these subtle shifts in trajectory, PFS will be tested using continuous scale scores for demandingness and responsiveness which is a deviation from how previous studies tested PFS.

Family Stress Model and Parental Levels of Demandingness and Responsiveness

Understanding the relationship between food insecurity, PFS, and dietary quality in the context of obesity prevention will allow for a more complete understanding of which factors to target in intervention design. The family stress model (FSM) (Conger & Donnellan, 2007) and previous studies on parenting stress and PFS guide hypothesis testing for the second aim. Please refer to Figure 1 for a depiction of the application of the FSM to this study.

Per FSM, factors such as economic hardship are sources of stress for parents (Conger & Donnellan, 2007). This stress affects parenting behaviors which then affects children's well-being. Two studies examining parenting stress and PFS found that parents with increased stress levels reflected PFS that were lower in demandingness (Hughes et al., 2016) and responsiveness (Hughes et al., 2016; Hurley et al., 2008).

While there is a gap in studies examining the association between food insecurity and PFS, studies have found that food insecure parents place increased pressure to eat on their children compared to those who are food secure (Conlon et al., 2015; Gross, Mendelsohn, Fierman, Racine, & Messito, 2012). These studies support the idea that food insecurity affects parenting behavior. The proposed study will narrow the gap in

knowledge related to the mediating role of PFS between food insecurity and child's dietary quality.

Conditional Factors affecting Relationships between Food Insecurity and Feeding Style, Dietary Quality, and Child Weight Status

Researchers have controlled for gender and acculturation in numerous studies examining food insecurity, parenting feeding styles, dietary quality, and child weight status. However, fewer studies have tested these variables for moderation despite evidence to suggest that gender and acculturation have some influence on these variables.

A recent study looking at food insecurity and dietary quality found that preschool girls living in household that had an increase in food security also had an improvement in dietary quality (Jansen et al., 2017). However, a similar trend was not observed in boys within the same study. Buscemi (2011) found acculturation to be a significant moderator between food insecurity and child body mass in a study of Latino children in which age and gender were controlled. Other studies have identified that level of acculturation is a predictor of parenting feeding styles (Power, O'Connor, Orlet Fisher, & Hughes, 2015; Tovar et al., 2012).

Although few, these studies suggest the need to further investigate the potential moderating effects of gender and acculturation in the proposed mediation models. Mediation testing of dietary quality between food security status and child body mass and mediation testing of parental feeding style between food security status and dietary quality will increase understanding of the mechanisms at work that influence both outcomes. However, moderation testing will help increase the understanding of in what conditions or for whom these mechanisms work more effectively (Hayes, 2013).

The results of this study will provide information to bridge the gap between food insecurity and subsequent child weight status. If dietary quality is found to mediate the relationship between food security status and child weight status, then it, along with food security, would be targets for interventions focused on healthy child weight status. Similarly, if parental feeding style is found to mediate the relationship between food security status and dietary quality, then it too would need to be factored into interventions. Finally, identification of potential moderators allows for more precise intervention planning and policy reforms.

Innovation

To the extent known, this is the first study to examine the effect of food security on dietary quality in low-income Hispanic preschoolers over time. It is also the first study to test dietary quality as a mediator between food security status and child BMI. Additionally, this is the first study to test parenting feeding style as a mediator between food security and dietary quality. Finally, this study will examine PFS through its two domains of demandingness and responsiveness. This approach will allow demandingness and responsiveness to be tested as continuous variables and help identify changes in demandingness and/or responsiveness over time that may be too small to cross pre-determined cutpoints (Hughes et al., 2012).

Approach

Research Design and Setting

The study is a longitudinal design that will use data collected from a previous study (R01 HD062567, PI: Hughes). The primary aim of the parent study was to examine

the bidirectional relationship between parenting behaviors and children's eating behaviors.

Most of the data that will be used in this study was collected at the USDA/ARS Children's Nutrition Research Center (CNRC) in Houston, TX. Two of the three 24 dietary-recalls for each timepoint were collected over the phone. Time 1 data collection began in August 2011. The second time wave occurred after 18 months.

Population, Sample, Sampling Procedures

At Time 1, data was collected from 187 self-identified Hispanic parent-child dyads. The second time wave occurred 18 months later with 144 parent-child dyads. To minimize attrition, participants were called every 3 months. They also received birthday cards.

The nonprobability sample was recruited through Head Start Centers located in Houston, TX. Rolling recruitment continued until the predetermined sample size was met. Recruitment strategies included distribution of flyers sent home with children and announcements at parent meetings. Research assistants were also present during child drop-off and pick-up times for direct recruitment of parents. Only one child and parent per family were recruited into the study.

For a child to enroll in Texas Head Start, he or she must be a resident of the state. Most children reside in a household that has income at or below the federal poverty level. At the time of the parent study recruitment, an income of ≤ $22,350 before tax for a family of four was at or below the federal poverty level (Sebelius, 2011).

Sample selection criteria for the parent study included: children being between four and five years of age at time of recruitment. Adults had to be the primary caregiver

of the child when child was not at school. Because children would be eating food prepared at the research center, children with food allergies were excluded. Children who were unable to serve themselves or eat without assistance were also excluded.

Instruments

Table 1 contains a list of instruments used to operationalize the variables. Details about the instruments, including psychometrics are also listed in Table 1. All surveys were available in English and Spanish. The Spanish versions were developed using back-translation by CNRC staff members who were from Mexico, Central America, and South America. They all spoke Spanish fluently.

Food security status (FSS) was measured using a paper and pencil version of the 6-item Household Food Security Survey (6-item HFSS). This instrument has robust evidence of reliability and validity (Blumberg, Bialostosky, Hamilton, & Briefel, 1999; Harrison, Stormer, Herman, & Winham, 2003). It is also widely used in research (Marques, Reichenheim, de Moraes, Antunes, & Salles-Costa, 2015).

The USDA provides guidelines on how to score the 6-item HFSS (Economic Research Service, 2012). The final food security status score is calculated by adding the number of affirmative responses. Raw scores can range from zero to six. Higher scores indicate less food security. In this study, FSS will be used as a continuous variable. The USDA's guidelines provide a scoring system to convert the raw FSS score to an interval-level scale score (Economic Research Service, 2012).

The Caregiver's Feeding Styles Questionnaire (CFSQ) was used to operationalize demandingness and responsiveness. This instrument was developed from research on low-income minority populations in the US- namely African Americans and Hispanics

(Hughes et al., 2005). The instrument consists of 19 items with 4-point Likert-scale responses. Demandingness score is determined by an average of the responses for all 19 items (parent-centered and child-centered) and can range from one to five. Higher scores represent greater control by parents with respect to their child's feeding/eating. Responsiveness scores are calculated as a ratio between the mean of seven child-centered questions (item numbers 3, 4, 6, 8, 9, 15, and 17) and the demandingness score. Scores will range between .20 to 2.02 with higher scores representing greater parental warmth.

Dietary quality will be measured using the Healthy Eating Index 2015 (HEI-2015). The HEI-2015 measures how closely individuals meet the Dietary Guidelines for Americans (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015) and may be used in children ≥ 2 years of age (Guenther et al., 2014). Data from three 24-hour dietary recalls will be used to calculate the HEI-2015 scores at each timepoint. Total scores can range from 0 to 100. Higher scores reflect greater adherence to dietary guidelines.

Child's weight status will be determined using BMI z-scores. Heights and weights used to calculate the BMI z-score were measured using a standard protocol (Lohman, Roche, & Martorell, 1988). Each child was measured twice for height (cm) and weight (kg). The average height and weight measures were used to generate age and gender specific BMI z-scores (Kuczmarski et al., 2002).

Acculturation, a potential covariate to dietary quality and child weight status, was measured using the Bidimensional Acculturation Scale (Marin & Gamba,1996). This is a 24-item questionnaire that consists of a Hispanic domain (12 items) and non-Hispanic domain (12 items). All answers are on a 4-point Likert scale. Per the developers'

instructions, the respondents receive scores for each of the two domains. Each score is an average of the 12 responses that correspond with the Hispanic and non-Hispanic domains. The final score for each domain ranges between one and four (Marin & Gamba,1996).

Demographics include child's gender, number of children living in household, number of household members, parental marriage status, employment status, and education level.

Table 1

Summary of key variables.

Variable	**Operationalization**	**Measurement & Scoring Method**	**Psychometrics**
Household Food Security Status (FSS) (Independent variable)	6-item Household Food Security Questionnaire Description of survey: 6-item, parent-report survey, dichotomous responses, time to complete= 5 minutes.	Continuous Raw food security score determined by tally of affirmative responses.	Correctly identified level of food security in 95.6% of all households with children; Face & content validity for Spanish version (Blumberg et al., 1999; Harrison et al., 2003)
Parenting Feeding Style Domains: Demandingness Responsiveness (Mediating variable)	Demandingness score and Responsiveness score from the Caregiver's Feeding Styles Questionnaire Description of survey: 19 items, parent-report survey, 5-point Likert-scale responses, time to complete= 15 minutes	Continuous Demandingness score= mean of all 19 items Responsiveness score= mean of the seven child-centered ÷ the mean of all 19 items (Hoerr et al., 2009; Hughes et al., 2005)	Demandingness scale test-retest r=.85 Responsiveness Scale test-retest: r=.82 Internal consistency Cronbach alpha=.85 Convergent validity with Child Feeding Questionnaire, $F(9,518)=3.17$, $p<0.001$; Parenting Dimensions Inventory, $F(27,602)=2.26$, $p<0.001$ (Hughes et al., 2005)

Table 1

continued

Variable	Operationalization	Measurement & Scoring Method	Psychometrics
24-hour Dietary Recall (Needed to calculate dietary quality score)	2 weekdays, 1 weekend day 24-hour recalls. Collected using 5-step multipass method and Nutritional Data Software Research (Time 1: version 2012, Time 2: version 2014) developed by the Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN).	Nominal	Based on systematic review, parent-reported three 24-hour multiple pass recalls that include weekdays and weekends and use is the most accurate method for estimating total energy intake in children ages 4 to 11 (Burrows, 2010)
Child Dietary Quality (In Aim 1: Mediating variable In Aim 2: Dependent variable)	Healthy Eating Index 2015 (HEI 2015) (Epidemiology and Genomics Research Program, 2017a): Calculated based on data from three 24-hour dietary recall Description of index: Consists of 13 dietary subcomponent scores that are summed for an overall dietary score.	Continuous HEI-2015 scores are calculated per instructions provided on "Guide to Creating Variables Needed to Calculate Scores for Each Component of the Health Eating Index 2015." (Nutrition Coordination Center, University of Minnesota, 2017)	Construct validity: HEI-2010 scores were at or near the maximum levels for the exemplary menus. PCA consistent with 12 dietary components. Internal Consistency: Cronbach's α= 0.68 (Epidemiology and Genomics Research Program, 2017b; Guenther et al., 2014)

Table 1

Continued

Variable	Operationalization	Measurement & Scoring Method	Psychometrics
Child Body Mass (Dependent variable)	Body Mass Index z score (BMI z-score) calculated per CDC reference standards: age & gender specific BMI (Kuczmarski et al., 2002)	Continuous	Construct validity for children ages 2-5: BMI-for-age= 78.3% sensitivity and 88.3% specificity in ability to overweight at 85th percentile (Mei et al., 2002)
Parental Acculturation (Covariate)	Bidimensional Acculturation Scale (Marin & Gamba, 1996) Description of survey: 24 items, parent-report survey, 4-point Likert-scale responses, time to complete= 15 minutes	Continuous Hispanic domain score= mean of 12 responses in Hispanic domain non-Hispanic domain score= mean of 12 responses in non-Hispanic domain	Internal consistency: Cronbach's α= .9 (Hispanic domain), .96 (non-Hispanic domain) Validity correlations with generation, age at arrival, residence in US, education, self-identification: .46 to.86 (non-Hispanic domain), -.28 to -.66 (Hispanic domain) (Marin & Gamba, 1996b)

Data Collection Procedures

Data collection at Time 1 and Time 2 followed the same protocols. All data except for two of the three food recalls were completed at the CNRC lab. Trained CNRC staff members who were fluent in Spanish and English obtained data from participants in the language of the participant's choice. All surveys, including the 6-item HFSS and CFSQ, were given to participants for completion in random order. Participants were compensated $65 at Time 1 and $140 at Time 2.

At each time wave, data were collected over the course of two separate visits to the CNRC. Each visit lasted approximately two hours. Parents completed surveys over the course of these two visits. Transportation or free parking was available for research participants.

Trained staff members of the CNRC measured parents and children's heights and weights using a stadiometer and electronic self-calibrating digital scale. Children removed their shoes and wore light clothing. Height was recorded to the nearest 0.1cm and weight to 0.1kg. Height and weight measurements were obtained twice and averaged for each participant at each time point.

24-hour dietary recalls will be used to calculate the Healthy Eating Index-2015. Three dietary recalls (two weekdays, one weekend) will be used in the calculation. Recalls were collected by trained research assistants using the 5-step multipass method and Nutrition Data System for Research Software. The method consists of five steps: 1) a quick, uninterrupted list of foods and beverages consumed, 2) query of foods that are often frequently forgotten, 3) time and occasion of food consumption, 4) use of the Food Model Booklet and measuring guides to elicit descriptions of foods and amounts eaten, and 5) a final probe review (Conway, Ingwersen, Vinyard, & Moshfegh, 2003). The first recall was completed at the CNRC in person. The remaining two recalls for each data point were completed by phone. The parent participating in the study provided dietary recall information for their preschoolers as well as themselves.

Data Analysis

The sample size for this study is based on the parent study. At baseline, the sample size was 187 parent-child dyads. At 18-months post-baseline the sample size dropped to 144 parent-child dyads.

IBM SPSS Statistics version 24 will be used to conduct statistical analysis. Bootstrap confidence intervals of the indirect effect that cross through zero will indicate that the indirect effect is not statistically different from zero and, therefore, not significant. Statistical significance for tests that generate a p-value is set at $\geq .05$.

The HEI-2015 scores for parent and child will be calculated using three 24-dietary recalls that were collected in the parent study using Nutrition Data Systems for Research (NDSR) software versions 2012 (Time 1) and 2014 (Time 2). Each participant's food group or nutrient intake will be averaged across the three recalls which is the same method used by Guenther (2014). These averages will be then used to calculate the variables needed to obtain the 13 HEI-2015 component scores. The variables will be calculated per guidelines developed by the Nutrition Coordination Center at the University of Minnesota (2017). Finally, each of the 13 HEI components will be assigned a proportional score based on scoring standards provided by the Epidemiology and Genomics Research Program (Epidemiology and Genomics Research Program, 2017). These 13 component scores will then be summed for each participant's overall HEI-2015 score.

Descriptive statistics will examine the distributions and variability across the time waves for food security status, child body-mass-index z-scores, child HEI-2015 scores, and parental levels of demandingness and responsiveness. Pearson correlations will

determine if food security status is correlated with child BMI z-scores, child HEI-2015, demandingness, and responsiveness between time waves.

T-tests will determine if there are statically significant differences in participants who remained in the study compared with those lost to attrition. Comparisons will be made using baseline data for: food security status, child HEI-2015, levels of parental demandingness and responsiveness, and child body-mass-index.

Mediation analysis for Aim 1 and 2 will be tested using PROCESS (Hayes, 2013), a path analysis tool that works through SPSS. The half-longitudinal study design will allow testing of an autoregressive model of mediation (Cole & Maxwell, 2003). Total, direct, and indirect effects will be calculated along with bootstrap method for significance of indirect effect. Bootstrapping is a nonparametric test that does not require normal distributions for the product of ab and has more power compared to Sobel test (Preacher & Hayes, 2004). Aim 3 will be tested using PROCESS model 59 (Hayes, 2013).

Mediation testing for Aim1

Hypothesis 1: Poor dietary quality will mediate the relationship between low FSS at Time 1 and elevated BMI at Time 2 in low-income Hispanic preschoolers. Figure 2 is a visual depiction of the mediation model to test Hypothesis 1.

To meet the assumption that the independent and mediation variables do not interact, an interaction term (FSS_1xHEI_1) will be tested for significance. If this interaction term is significant, the possibility of moderation will need to be considered. Otherwise, using model 4 in PROCESS (Hayes, 2013), x, y, and m will be assigned variables FSS at Time 1, child BMI z-score at Time 2, and child HEI-2015 at Time 1. Because the 6-item HFSS measures food security status over the previous 12 months, it already reflects a

previous time at baseline. Therefore, child HEI at Time 1 will be used as the mediating variable.

Despite the likely high correlation between the BMI z-scores at Time 1 and Time 2, in longitudinal mediation, data from later time points need to be examined while controlling for earlier time points (A. Hayes, personal communication, August 19, 2017). Additional potential covariates will include non-Hispanic acculturation, child gender, number of household member, number of children living in household, parent's marital, employment, and educational status at Time 1. Each confounder will be tested to see if it is a significant predictor of FSS at Time 1, child HEI at Time 1, and child BMI z-score at Time 2. If the variable is significant for any of these three variables, it will be kept as a confounder in the model.

The product of coefficients for Path a and Path b, as indicated in Figure 2, represents the indirect effect. Using the bootstrap method, a confidence interval will be generated for the indirect effect. If this interval does not contain zero, then the indirect effect will be considered significant and indicate a mediation effect.

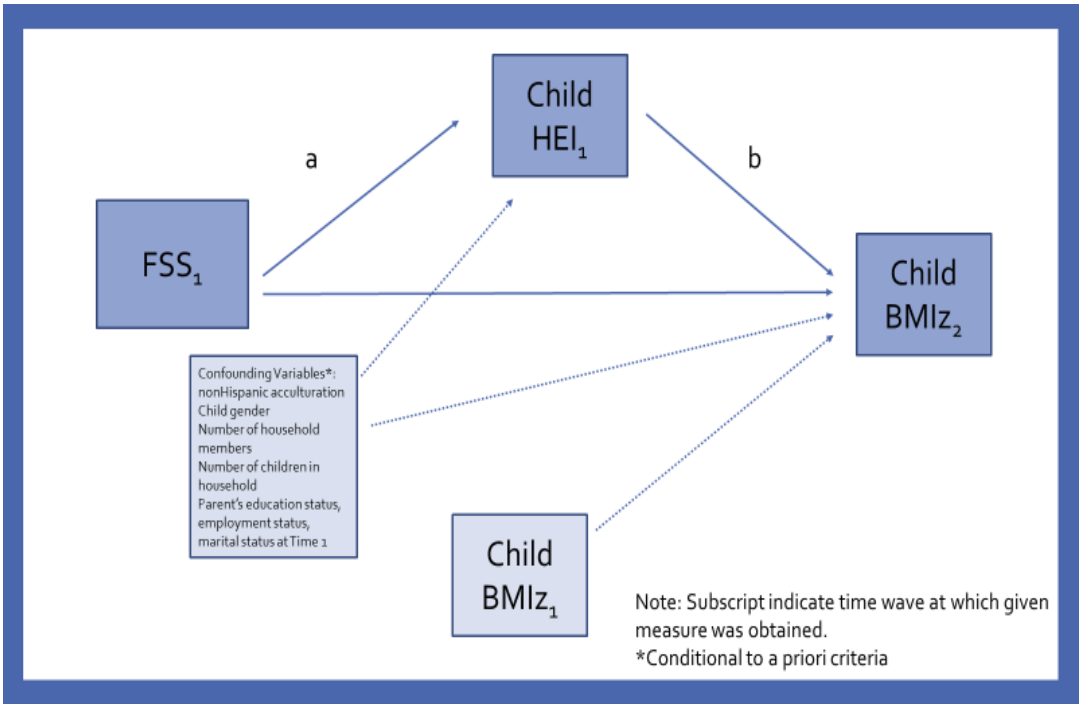

Figure 2. Visual depiction of Hypothesis 1

Mediation testing for Aim 2

Hypothesis 2a: Low levels of parental feeding demandingness will mediate the relationship between low FSS at Time 1 and poor dietary quality at Time 2 in low-income Hispanic preschoolers. Figure 3 is a visual depiction of Hypothesis 2a.

Longitudinal mediation will be tested using the same method as in Aim 1. An interaction term for FSS_1x$Demandingess_1$ will be tested for significance. If this test is significant, the possibility of moderation will need to be addressed. Otherwise, model 4 in PROCESS will be used to test for mediation. Variables x, y, and m will be assigned FSS at Time 1, Child HEI (the measure for dietary quality) at Time 2, and Feeding demandingness at Time 1, respectively.

Child HEI at Time 1 will be treated as a covariate to account for previous effects. Additional potential confounders include non-Hispanic acculturation, child gender, number of household members, number of children in household, parent's education

status, employment status, and marital status at Time 1. Each confounder will be tested to see if it is a significant predictor of FSS at Time 1, parental feeding demandingness at Time 1, and child HEI at Time 2. If the variable is significant for any of these variables, it will be kept as a confounder in the model.

PROCESS will run regression models to produce coefficients for Path a and b. The product of these coefficients is the indirect effect. Confidence intervals resulting from bootstrapping will be used to determine if the indirect effect is significantly different from zero and therefore supporting the hypothesis.

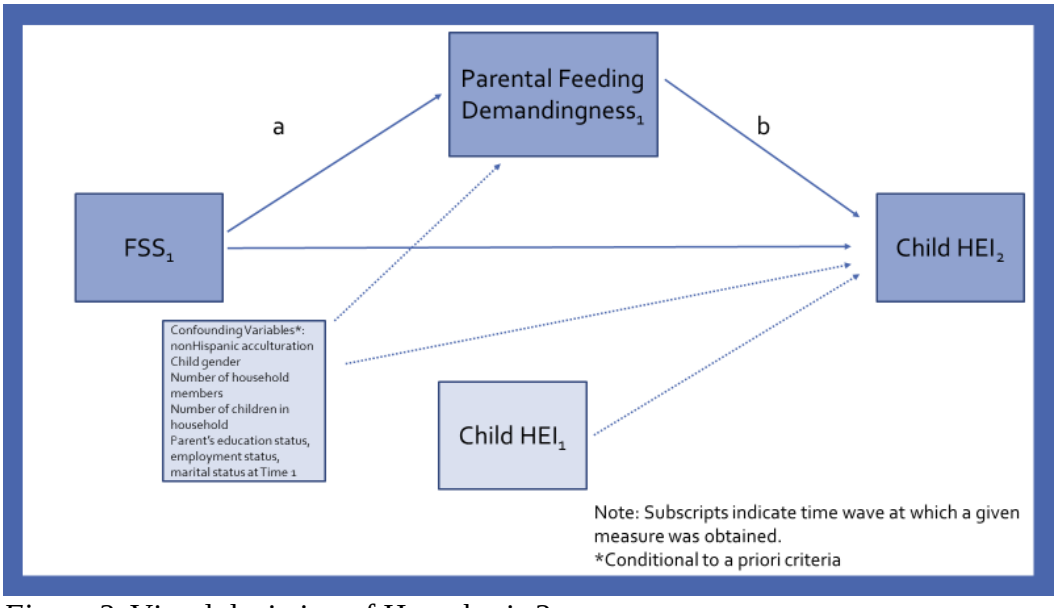

Figure 3. Visual depiction of Hypothesis 2a

Hypothesis 2b: Low levels of parental feeding responsiveness will mediate the relationship between low FSS at Time 1 and poor dietary quality at Time 2 in low-income Hispanic preschoolers. Figure 4 is a visual depiction of Hypothesis 2b. Because parental feeding responsiveness and demandingness are not independent of each other, they must be tested for mediation separately. The same steps performed to test Hypothesis 2a will

be used to test Hypothesis 2b. However, the mediating variable will be parental feeding responsiveness.

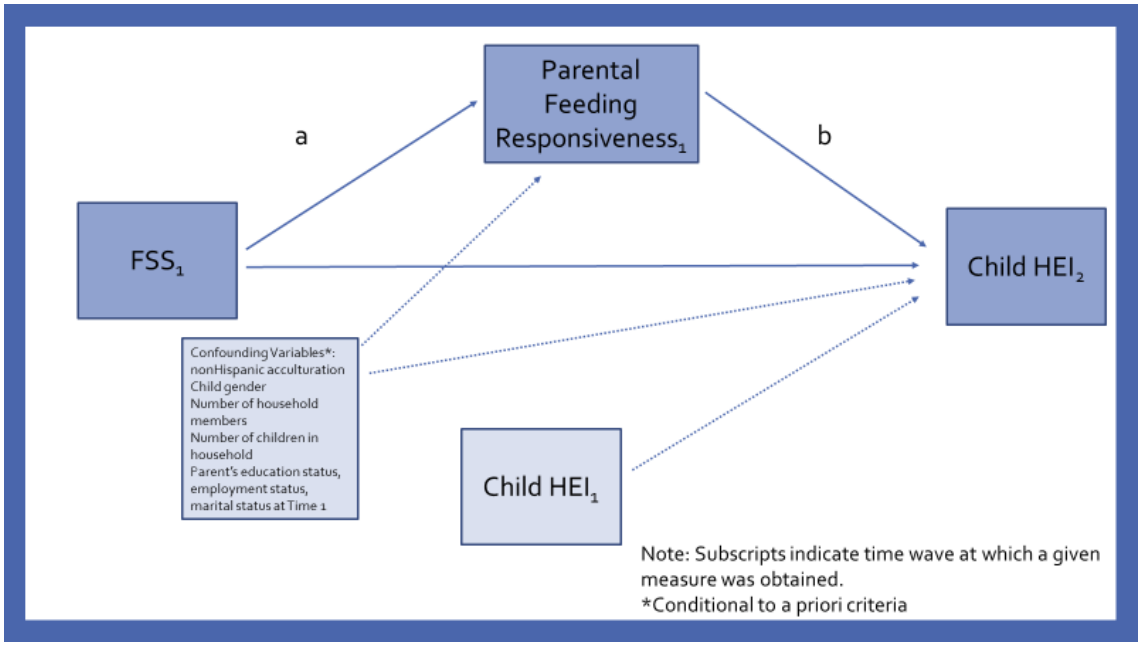

Figure 4. Visual depiction of Hypothesis 2b

Conditional process analysis of Aim 3

Aim 3: To explore if factors such as gender and/or acculturation moderate the direct and indirect effects of the mediations being tested in Aim 1 and 2. Figure 5 is a visual depiction of gender moderating the direct and indirect effects being tested in Aim 1. Figure 6 is a visual depiction of gender moderating the direct and indirect effects being tested in Aim 2.

PROCESS model 59 (Hayes, 2013) will be used to test moderation in mediation models. If the interaction terms are significant, this will indicate that gender (or acculturation) moderates the specific relationship (indirect path A, indirect path B, or the direct path).

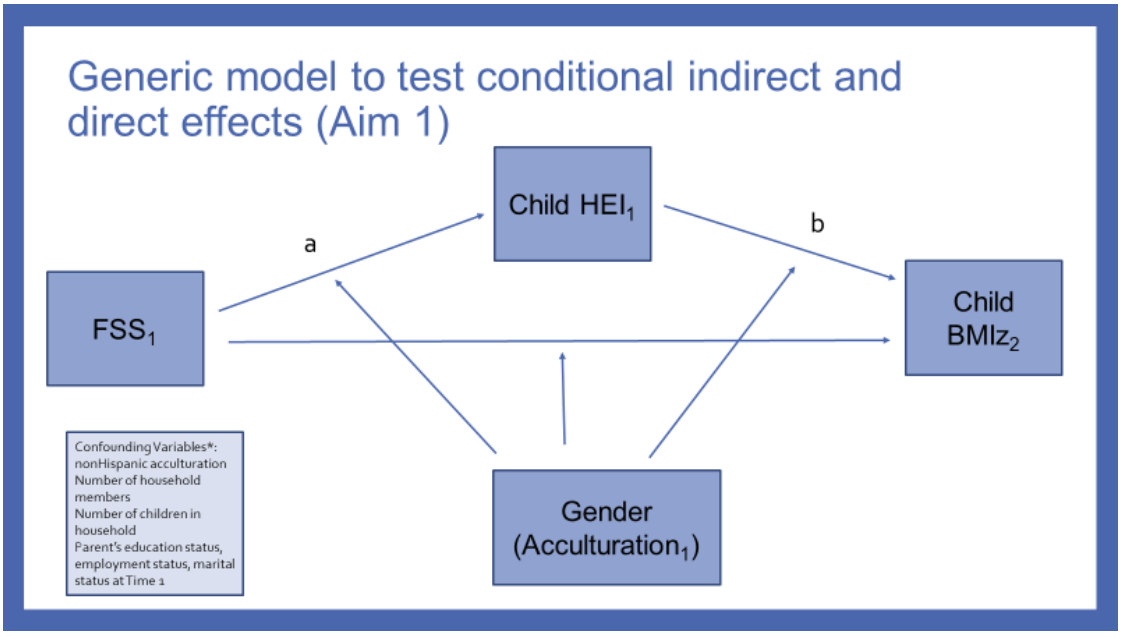

Figure 5. Visual depiction of moderation testing of mediation model in Aim 1

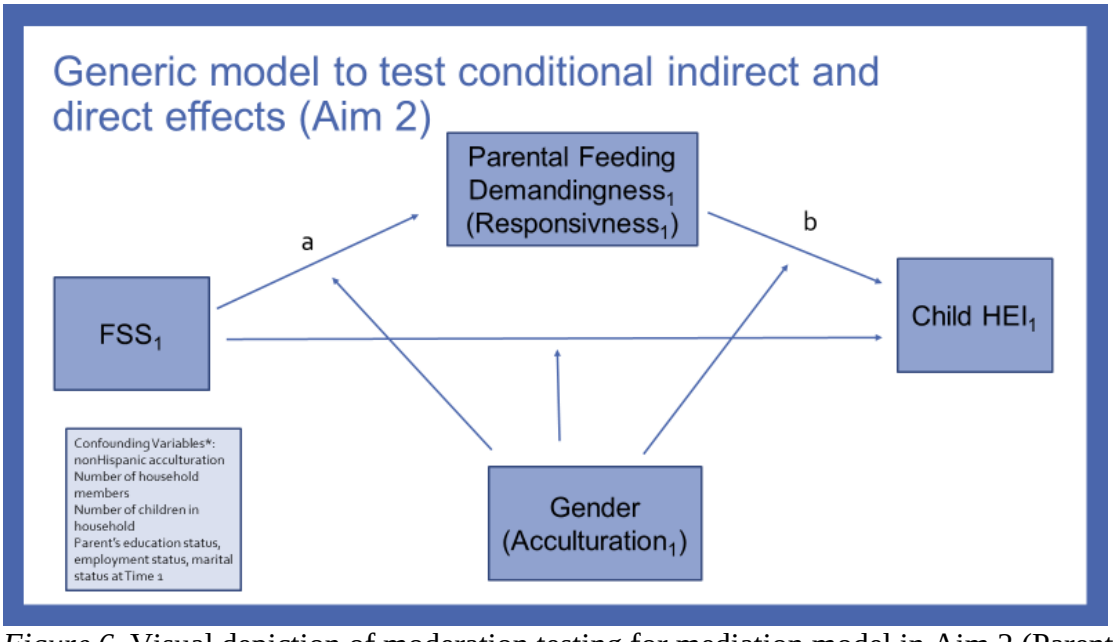

Figure 6. Visual depiction of moderation testing for mediation model in Aim 2 (Parental feeding demandingness).

Study Limitations

This study has several limitations needing acknowledgement. The nonprobability sample recruited from Head Start may limit the generalizability of findings. Low-income

families who choose not to enroll their children in Head Start programs are unrepresented in this study sample. Although about one out of every three children enrolled in Head Start are Hispanic (Child Trends Databank, 2015), a clear statistic on the number of low-income Hispanic children who are not enrolled in Head Start could not found. Participation in Head Start could also help families access other public health services such as WIC or SNAP, which could affect their food security status and dietary quality. In addition, the parents' responses on the 6-item HFSS and CFSQ are subject to self-report bias. The 24-hour dietary recall for preschoolers is also dependent on the parent's awareness of food/beverage consumption and accurate reporting of items. Parents misreport energy intake of their children (Murakami & Livingstone, 2016) Finally, although the study retained 70% of the original sample, those participants who dropped out of the study may have some common characteristics that could have influence on results of the study. Analysis to determine if the participants lost to attrition vary from those who stayed may help to quantify the size of this limitation.

Human Subjects

Approval from the Committee of the Protection of Human Subjects at University of Texas Health Science Center has been obtained. This study uses data collected from a parent study (R01 HD06257, PI: Hughes). The parent study has IRB approval from Baylor College of Medicine.

Data needed for this study will consist of responses to the 6-item Household Food Security Questionnaire, Caregiver's Feeding Styles Questionnaire, Bidimensional Acculturation Scale, 24-hour dietary recalls, and height and weight measurements for the

sample of children and parents. All data has been deidentified for subject protection. This deidentification will also secure participant confidentiality.

This study does not offer any direct benefit to the study participants. However, the findings will contribute to the body of knowledge and help improve interventions that address food insecurity, dietary quality, and obesity prevention in low-income Hispanic preschoolers. Because the data has already been collected, the participants face no additional potential risks from this study.

References

Bhargava, A., Jolliffe, D., & Howard, L. L. (2008). Socio-economic, behavioural and environmental factors predicted body weights and household food insecurity scores in the early childhood longitudinal study-kindergarten. *The British Journal of Nutrition, 100*(2), 438-444. doi:10.1017/S0007114508894366 [doi]

Blumberg, S. J., Bialostosky, K., Hamilton, W. L., & Briefel, R. R. (1999). The effectiveness of a short form of the household food security scale. *American Journal of Public Health, 89*(8), 1231-1234. doi:10.2105/AJPH.89.8.1231

Bronte-Tinkew, J., Zaslow, M., Capps, R., Horowitz, A., & McNamara, M. (2007). Food insecurity works through depression, parenting, and infant feeding to influence overweight and health in toddlers. *The Journal of Nutrition, 137*(9), 2160.

Buscemi, J., Beech, B. M., & Relyea, G. (2011). Predictors of obesity in Latino children: Acculturation as a moderator of the relationship between food insecurity and body mass index percentile. *Journal of Immigrant and Minority Health, 13*(1), 149-154. doi:10.1007/s10903-009-9263-6 [doi]

Burrows, T. (2010). A systematic review of the validity of dietary assessment methods in children when compared with the method of doubly labeled water. *J Am Diet Assoc, 110*(10), 1501-1510. doi:10.1016/j.jada.2010.07.008

CDC. (2015). Defining childhood obesity. Retrieved from https://www.cdc.gov/obesity/childhood/defining.html

CDC. (2016). Defining adult overweight and obesity. Retrieved from https://www.cdc.gov/obesity/adult/defining.html

Child Trends Databank. (2015). Head Start. Retrieved from https://www.childtrends.org/indicators/head-start

Cole, D. A., & Maxwell, S. E. (2003). Testing mediational models with longitudinal data: questions and tips in the use of structural equation modeling. *Journal of Abnormal Psychology, 112*(4), 558.

Coleman-Jensen, A., Rabbitt, M. P., Gregory, C. A., & Singh, A. (2016). *Household food security in the united states in 2015.* (Economic Research Report No. 215). United States Department of Agriculture.

Conger, R. D., & Donnellan, M. B. (2007). An interactionist perspective on the socioeconomic context of human development. *Annual Review of Psychology, 58*(1), 175-199. doi:10.1146/annurev.psych.58.110405.085551

Conlon, B. A., McGinn, A. P., Lounsbury, D. W., Diamantis, P. M., Groisman-Perelstein, A. E., Wylie-Rosett, J., & Isasi, C. R. (2015). The role of parenting practices in the home environment among underserved youth. *Childhood Obesity (Print), 11*(4), 394-405. doi:10.1089/chi.2014.0093 [doi]

Conway, J. M., Ingwersen, L. A., Vinyard, B. T., & Moshfegh, A. J. (2003). Effectiveness of the US department of agriculture 5-step multiple-pass method in

assessing food intake in obese and nonobese women. *The American Journal of Clinical Nutrition, 77*(5), 1171.

Darling, N., & Steinberg, L. (1993). Parenting style as context: An integrative model. *Psychological Bulletin, 113*(3), 487.

Dubois, L., Farmer, A., Girard, M., & Porcherie, M. (2006). Family food insufficiency is related to overweight among preschoolers. *Social Science & Medicine, 63*(6), 1503-1516. doi: 10.1016/j.socscimed.2006.04.002

Economic Research Service, U. (2012). U.S. household food security survey module: Six-item short form.

Epidemiology and Genomics Research Program. (2017a). Developing the healthy eating index. Retrieved from https://epi.grants.cancer.gov/hei/developing.html

Epidemiology and Genomics Research Program. (2017b). Evaluating the healthy eating index. Retrieved from https://epi.grants.cancer.gov/hei/evaluation-validation.html

Gibbs, B. G., & Forste, R. (2014). Socioeconomic status, infant feeding practices and early childhood obesity: SES, infant feeding and child obesity. *Pediatric Obesity, 9*(2), 135-146. doi:10.1111/j.2047-6310.2013.00155.x

Gross, R. S., Mendelsohn, A. L., Fierman, A. H., Racine, A. D., & Messito, M. J. (2012). Food insecurity and obesogenic maternal infant feeding styles and practices in low-income families. *Pediatrics, 130*(2), 254-261. doi:10.1542/peds.2011-3588 [doi]

Gundersen, C., & Ziliak, J. P. (2015). Food insecurity and health outcomes. *Health Affairs (Project Hope), 34*(11), 1830-1839. doi:10.1377/hlthaff.2015.0645

Hanson, K. L., & Connor, L. M. (2014). Food insecurity and dietary quality in US adults and children: A systematic review. *The American Journal of Clinical Nutrition, 100*(2), 684-692. doi:10.3945/ajcn.114.084525 [doi]

Harrison, G. G., Stormer, A., Herman, D. R., & Winham, D. M. (2003). Development of a Spanish-language version of the U.S. household food security survey module. *The Journal of Nutrition, 133*(4), 1192.

Hayes, A. (2013). Introduction to Mediation, Moderation, and Conditional Process Analysis. A Regression-Based Approach. 2013. *New York: Guilford, 1609182308*

Hennessy, E., Hughes, S. O., Goldberg, J. P., Hyatt, R. R., & Economos, C. D. (2012). Permissive parental feeding behavior is associated with an increase in intake of low-nutrient-dense foods among American children living in rural communities. *Journal of the Academy of Nutrition and Dietetics*, *112*(1), 142-148. doi:10.1016/j.jada.2011.08.030

Hernandez, D. C., Reesor, L., Alonso, Y., Eagleton, S. G., & Hughes, S. O. (2016). Household food insecurity status and Hispanic immigrant children's body mass index and adiposity.

Hoerr, S. L., Hughes, S. O., Fisher, J. O., Nicklas, T. A., Liu, Y., & Shewchuk, R. M. (2009). Associations among parental feeding styles and children's food intake in

families with limited incomes. *The International Journal of Behavioral Nutrition and Physical Activity, 6*(1), 55-55. doi:10.1186/1479-5868-6-55

Hughes, S. O., Cross, M. B., Hennessy, E., Tovar, A., Economos, C. D., & Power, T. G. (2012). Caregiver's feeding styles questionnaire. establishing cutoff points. *Appetite, 58*(1), 393. doi:10.1016/j.appet.2011.11.011

Hughes, S. O., Power, T. G., Liu, Y., Sharp, C., & Nicklas, T. A. (2015). Parent emotional distress and feeding styles in low-income families. the role of parent depression and parenting stress. *Appetite, 92*, 337-342. doi:10.1016/j.appet.2015.06.002

Hughes, S. O., Power, T. G., O'Connor, T. M., Orlet Fisher, J., & Chen, T. (2016). Maternal feeding styles and food parenting practices as predictors of longitudinal changes in weight status in Hispanic preschoolers from low-income families. *Journal of Obesity, 2016*, 1-9. doi:10.1155/2016/7201082

Hughes, S. O., Power, T. G., Orlet Fisher, J., Mueller, S., & Nicklas, T. A. (2005). Revisiting a neglected construct: Parenting styles in a child-feeding context. *Appetite, 44*(1), 83-92. doi:10.1016/j.appet.2004.08.007

Hurley, K. M., Black, M. M., Papas, M. A., Caulfield, L. E., & Caufield, L. E. (2008). Maternal symptoms of stress, depression, and anxiety are related to nonresponsive feeding styles in a statewide sample of WIC participants. *The Journal of Nutrition, 138*(4), 799.

Jansen, E. C., Kasper, N., Lumeng, J. C., Brophy Herb, H. E., Horodynski, M. A., Miller, A. L., . . . Peterson, K. E. (2017). Changes in household food insecurity are related to changes in BMI and diet quality among Michigan head start preschoolers in a sex-specific manner. *Social Science & Medicine, 181*, 168-176. doi:10.1016/j.socscimed.2017.04.003

Jyoti, D. F., Frongillo, E. A., & Jones, S. J. (2005). Food insecurity affects school children's academic performance, weight gain, and social skills. *The Journal of Nutrition, 135*(12), 2831-2839. doi:135/12/2831 [pii]

Kaiser, L. L., Melgar-Quinonez, H., Townsend, M. S., Nicholson, Y., Fujii, M. L., Martin, A. C., & Lamp, C. L. (2003). Food insecurity and food supplies in Latino households with young children. *Journal of Nutrition Education and Behavior, 35*(3), 148-153.

Kaiser, L. L., Melgar-Quinonez, H. R., Lamp, C. L., Johns, M. C., Sutherlin, J. M., & Harwood, J. O. (2002). Food security and nutritional outcomes of preschool-age Mexican American children. *Journal of the American Dietetic Association, 102*(7), 924-929.

Kuczmarski, R. J., Ogden, C. L., Guo, S. S., Grummer-Strawn, L. M., Flegal, K. M., Mei, Z., . . . Johnson, C. L. (2002). 2000 CDC growth charts for the united states: Methods and development. *Vital and Health Statistics. Series 11, Data from the National Health Survey, (246)*, 1-190.

Larson, N. I., & Story, M. T. (2011). Food insecurity and weight status among U.S. children and families. *American Journal of Preventive Medicine, 40*(2), 166-173. doi:10.1016/j.amepre.2010.10.028

Lohman, T. G., Roche, A. F., & Martorell, R. (1988). *Anthropometric standardization reference manual* Human kinetics books.

Marin, G., & Gamba, R. J. (1996). A new measurement of acculturation for Hispanics: The bidimensional acculturation scale for Hispanics (BAS). *Hispanic Journal of Behavioral Sciences, 18*(3), 297-316. doi:10.1177/07399863960183002

Marques, E. S., Reichenheim, M. E., de Moraes, C. L., Antunes, M. M. L., & Salles-Costa, R. (2015). Household food insecurity: A systematic review of the measuring instruments used in epidemiological studies. *Public Health Nutrition, 18*(5), 877-892. doi:10.1017/S1368980014001050

Matheson, D. M., Varady, J., Varady, A., & Killen, J. D. (2002). Household food security and nutritional status of Hispanic children in the fifth grade. *The American Journal of Clinical Nutrition, 76*(1), 210-217.

Mei, Z., Grummer-Strawn, L. M., Pietrobelli, A., Goulding, A., Goran, M. I., & Dietz, W. H. (2002). Validity of body mass index compared with other body-composition screening indexes for the assessment of body fatness in children and adolescents. *The American Journal of Clinical Nutrition, 75*(6), 978-985.

Metallinos-Katsaras, E., Must, A., & Gorman, K. (2012). A longitudinal study of food insecurity on obesity in preschool children. *Journal of the Academy of Nutrition and Dietetics, 112*(12), 1949-1958. doi:10.1016/j.jand.2012.08.031 [doi]

Murakami, K., & Livingstone, M. B. E. (2016). Prevalence and characteristics of misreporting of energy intake in US children and adolescents: National health and nutrition examination survey (NHANES) 2003-2012. *The British Journal of Nutrition, 115*(2), 294. doi:10.1017/S0007114515004304

Nutrition Coordination Center, University of Minnesota. (2017). *Guide to creating variables needed to calculate scores for each component of the health eating index-2015.* Unpublished manuscript.

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of childhood and adult obesity in the united states, 2011-2012. *Jama, 311*(8), 806-814. doi:10.1001/jama.2014.732 [doi]

Ogden, C. L., Carroll, M. D., Lawman, H. G., Fryar, C. D., Kruszon-Moran, D., Kit, B. K., & Flegal, K. M. (2016). Trends in obesity prevalence among children and adolescents in the united states, 1988-1994 through 2013-2014. *Jama, 315*(21), 2292-2299. doi:10.1001/jama.2016.6361

Papas, M. A., Trabulsi, J. C., Dahl, A., & Dominick, G. (2016). Food insecurity increases the odds of obesity among young Hispanic children. *Journal of Immigrant and Minority Health, 18*(5), 1046-1052. doi:10.1007/s10903-015-0275-0

Patrick, H., & Nicklas, T. A. (2005). A review of family and social determinants of children's eating patterns and diet quality. *Journal of the American College of Nutrition, 24*(2), 83-92. doi:24/2/83 [pii]

Patrick, H., Nicklas, T. A., Hughes, S. O., & Morales, M. (2005). The benefits of authoritative feeding style: Caregiver feeding styles and children's food consumption patterns. *Appetite, 44*(2), 243-249. doi:10.1016/j.appet.2002.07.001

Power, T. G., O'Connor, T. M., Orlet Fisher, J., & Hughes, S. O. (2015). Obesity risk in children: The role of acculturation in the feeding practices and styles of low-income Hispanic families. *Childhood Obesity (Print), 11*(6), 715-721. doi:10.1089/chi.2015.0036

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers: A Journal of the Psychonomic Society, Inc, 36*(4), 717.

Quandt, S. A., Trejo, G., Suerken, C. K., Pulgar, C. A., Ip, E. H., & Arcury, T. A. (2016). Diet quality among preschool-age children of Latino migrant and seasonal farmworkers in the united states. *Journal of Immigrant and Minority Health, 18*(3), 505-512. doi:10.1007/s10903-015-0304-z

Reilly, J., & Kelly, J. (2011). Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: Systematic review. *International Journal of Obesity, 35*(7), 891-898. doi:10.1038/ijo.2010.222

Rose, D., & Bodor, J. N. (2006). Household food insecurity and overweight status in young school children: Results from the early childhood longitudinal study. *Pediatrics, 117*(2), 464-473. doi:10.1542/peds.2005-0582

Rutten, L. F., Yaroch, A. L., Patrick, H., & Story, M. (2012). Obesity prevention and national food security: A food systems approach. *ISRN Public Health, 2012*, 1-10. doi:10.5402/2012/539764

Sebelius, K. (2011). 2011 poverty guidelines, federal register notice. Retrieved from https://aspe.hhs.gov/2011-poverty-guidelines-federal-register-notice

Sharkey, J. R., Nalty, C., Johnson, C. M., & Dean, W. R. (2012). Children's very low food security is associated with increased dietary intakes in energy, fat, and added sugar among Mexican-origin children (6-11 y) in Texas border colonias. *BMC Pediatrics, 12*(1), 16-16. doi:10.1186/1471-2431-12-16

Skinner, A. C., Perrin, E. M., & Skelton, J. A. (2016). Prevalence of obesity and severe obesity in US children, 1999-2014. *Obesity (Silver Spring, Md.), 24*(5), 1116. doi:10.1002/oby.21497

Tovar, A., Hennessy, E., Pirie, A., Must, A., Gute, D. M., Hyatt, R. R., . . . Economos, C. D. (2012). Feeding styles and child weight status among recent immigrant mother-child dyads. The International Journal of Behavioral Nutrition and Physical Activity, 9(1), 62-62. doi:10.1186/1479-5868-9-62

Troy, L. M., Miller, E. A., Olson, S., 1956, National Academies Press (U.S.), United States. Department of Agriculture, & Institute of Medicine (U.S.). (2011). *Hunger and obesity: Understanding a food insecurity paradigm: Workshop summary*. Washington, D.C: National Academies Press.

U.S. Department of Health and Human Services and U.S. Department of Agriculture. (2015). Dietary guidelines for Americans 2015-2020. Retrieved from https://health.gov/dietaryguidelines/2015/guidelines/

Winicki, J., & Jemison, K. (2003). Food insecurity and hunger in the kindergarten classroom: Its effect on learning and growth. *Contemporary Economic Policy*, *21*(2), 145-157. doi:10.1093/cep/byg001

BRIDGING THE GAP BETWEEN FOOD INSECURITY AND SUBSEQUENT CHILD BODY MASS: MEDIATING EFFECTS OF DIETARY QUALITY AND FEEDING STYLES IN LOW-INCOME HISPANIC PRESCHOOLERS

A DISSERTATION MANUSCRIPT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN NURSING

UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT HOUSTON

CIZIK SCHOOL OF NURSING

BY

NIPA KAMDAR RN, FNP-BC, MSN

JANUARY, 2018

Dissertation Manuscript Abstract

Background: Low-income Hispanic preschoolers face disproportionately high prevalence of food insecurity (FI) and obesity. Consumption of low-cost, energy-dense foods to compensate for FI leads to excess body-mass. FI parents may adopt feeding styles that contribute to decline in children's dietary quality. Feeding style describes the amount of demandingness (i.e., control of children's eating) and responsiveness (i.e., warmth used to express demandingness). FI may indirectly contribute to obesity through dietary quality and feeding style.

Purpose: This study investigated: 1. if dietary quality mediated the relationship between food security status (FSS) at Time 1 (T1) and child body-mass at Time 2 (T2), 2. if feeding demandingness (PFD) and/or responsiveness (PFR) mediated the relationship between FSS at T1 and child dietary quality at T2, 3. explored if gender and/or parental acculturation moderated the mediation.

Method: The current study was a secondary analysis of an observational study (R01 HD06257, PI: Hughes). Hispanic parent-preschooler dyads (n=137) provided data through the 6-item Household Food Security Survey, Healthy Eating Index-2015 (HEI), Caregiver's Feeding Style Questionnaire, Bidmensional Acculturation Scale, and body-mass-index z-score (BMIz) at two timepoints 18 months apart. Mediation and moderated mediation analyses were conducted using regression models while controlling co-variates. Bias-corrected bootstrap confidence intervals estimated indirect effects.

Outcomes: FSS_{T1} did not indirectly influence child $BMIz_{T2}$ through HEI_{T1} (*ab*= -0.00, bootstrap CI [-0.00, 0.00]). FSS_{T1} also did not indirectly influence HEI_{T2} through PFD_{T1} (*ab*= -0.01, bootstrap CI [-0.15, 0.03]) or PFR_{T1} (*ab*= 0.01, bootstrap CI [-0.04, 0.15]).

However, as FSS_{T1} worsened, HEI-2015_{T2} improved (c= 1.06, 95% CI [0.43, 1.69]). As a co-variate, higher baseline English $acculturation_{T1}$ predicted lower HEI-2015_{T2} (β= -3.44, 95% CI [-5.62, -1.26]) and higher $BMIz_{T2}$ (β= 0.13, 95% CI [0.05, 0.21]); however, it did not have significant conditional effects in moderated mediation models. Gender ($p_{FSSxGender}$= .04) moderated the direct effect of FSS_{T1} on $BMIz_{T2}$; however, effect size ((β= 0.05, 95% CI [0.002, 0.09]) was too small to be clinically relevant.

Conclusion: FI did not affect body-mass through dietary quality, nor did it affect dietary quality through PFD or PFR. However, an unexpected positive direct relationship between FI and subsequent dietary quality warrants further exploration.

Keywords: Food security, Child obesity, Parenting, Diet

Dissertation Manuscript

Background

Food insecurity and obesity are two public health issues that disproportionately affect low-income Hispanic preschoolers (Coleman-Jensen et al., 2016; Ogden et al., 2016). These children are at risk for additional health disparities as they grow older because of potential long-lasting health and social consequences associated with these issues (Gundersen & Ziliak, 2015; Reilly & Kelly, 2011). Early intervention and targeted policy change may help reduce these disparities.

Despite growing recognition that food insecurity and obesity co-exist (Larson & Story, 2011), many of the interventions and policies address each issue separately. Identification of factors that mediate food insecurity and obesity will allow for more comprehensive intervention and policy design to achieve better outcomes (Rutten, Yaroch, Patrick, & Story, 2012; Troy et al., 2011).

The conceptual framework guiding this study is presented in Figure 1. The figure also depicts study aims 1 and 2. The solid arrows represent the mediation that will be tested in Aim 1. The dotted arrows represent the mediation that will be tested in Aim 2. Aim 2 is based on the Family Stress Model (FSM). Per the FSM, sources of stress, such as economic hardship, influence parenting behaviors. The stress/hardship and parenting behavior directly and indirectly affect the child's well-being (Conger & Donnellan, 2007). A summary of known information with respect to the associations to be tested is described in this section.

Food Insecurity and Obesity

Food insecurity is a concern, or lack, of access to enough food to meet perceived nutritional needs for each member of a household due to restricted financial resources. In the US, one out of every four Hispanic families with children are food insecure (Coleman-Jensen et al., 2016). These children are at greater risk for poor fetal development, iron deficiency anemia, poor school performance, and increased risk of mental health concerns (Gundersen & Ziliak, 2015).

Obesity in children is defined as a body-mass-index greater than the 95th percentile for gender and age (CDC, 2015). It affects 16.7% of Hispanic preschoolers (Ogden et al., 2014; Skinner, Perrin, & Skelton, 2016). Obesity increases morbidity through early-onset diabetes, hypertension, hyperlipidemia, and other health issues (Pulgaron & Delamater, 2014).

Although evidence of a linear association between food insecurity and obesity is well-established in women, in preschoolers the evidence remains mixed (Larson & Story, 2011). Cross-sectional studies on young Hispanic children have conflicting findings with respect to the correlation between food insecurity and obesity (Hernandez, Reesor, Alonso, Eagleton, & Hughes, 2016; Papas, Trabulsi, Dahl, & Dominick, 2016). Possible explanations for these discrepancies could be due to the cross-sectional design of these studies which limits the tested relationship to a single snapshot.

Longitudinal studies have also had mixed findings. Three longitudinal studies found no association between food insecurity and child obesity (Bhargava, Jolliffe, & Howard, 2008; Rose & Odor, 2006; Winicki, & Jemison, 2003). Four other longitudinal studies; however, did find significant increases in odds of obesity in young children

living in food insecure households (Bronte-Tinkew, Sallow, Capps, Horowitz, & McNamara, 2007; Dubois, Farmer, Girard, & Proceri, 2006; Jyoti, Frongillo, & Jones, 2005; Metallinos-Katsaras, Must, & Gorman, 2012). In Bronte-Tinkew's (2007) study, the positive association between food insecurity and obesity worked indirectly through the mediating effects of parental depression and feeding practices. Her study highlights the need to test for additional potential mediators. Gender may also have a conditional influence on the relationship between food insecurity and obesity as indicated in studies by Jansen (2017) and Jyoti (2005).

Food insecurity and child obesity share increased prevalence, risk factors, and profound consequences in low-income Hispanic preschoolers. Clarification on the co-existence and possible interdependence of these issues needs to be further examined to help reduce health disparity.

Food Insecurity and Dietary Quality in Children

Studies examining the association between food insecurity and dietary intake in children provide evidence that as food security decreases, the dietary quality diminishes as well (Hanson & Connor, 2014; Kaiser et al., 2003; Matheson, Varity, Varady, & Killen, 2002). A recent study examining preschool-aged children of US-based Latino farmworkers, a population vulnerable to food insecurity, found that their dietary quality was below national recommendations (Quandt et al., 2016). Kaiser's (2002) study on Hispanics also found that children with greater levels of food insecurity were less likely to meet dietary recommendations as suggested by the Food Pyramid. As food security lowered, consumption of low-fat milk decreased and tortillas increased (Kaiser et al., 2002). A study that sampled Hispanic children along the Texas border found that total

calories, proteins, and sugars increased as food security decreased and emphasized the need to understand the relationship between food insecurity and dietary intake of children in households with limited resources (Sharkey, Nalty, Johnson, & Dean, 2012).

The studies described above are cross-sectional. A longitudinal assessment of the relationship between food insecurity and dietary quality in low-income Hispanic preschoolers would provide insight on the potential influence exposure to food insecurity has on diets during this critical time of children's growth and development.

Parenting Feeding Style and Dietary Intake

Parents generally have a great deal of control over the types of food they offer their children to eat, especially in young children. Studying parenting behaviors, such as parental feeding style, increases our understanding of parental influence on children's diets. Parenting feeding style (PFS) is a concept used to describe the emotional climate in which parents feed their children (Hughes et al., 2005). It is based on the parenting style framework (Darling & Steinberg, 1993).

PFS is measured on two continuous, parent-reported scales: demandingness and responsiveness. Demandingness refers to the amount of control and supervision a parent expresses when feeding his/her child. Responsiveness refers to the amount of warmth with which a parent expresses that demandingness. Cutpoints on the demandingness and responsiveness scales are used to categorize parents into one of four feeding style categories: authoritarian (high demandingness, low responsiveness), authoritative (high demandingness, high responsiveness), indulgent (low demandingness, high responsiveness), and uninvolved style (low demandingness, low responsiveness) (Hughes et al., 2012).

Distinctive styles are associated with different patterns of dietary intake. Authoritative feeding style is associated with greater parental attempt for children to eat dairy, fruit, and vegetables (Patrick & Nicklas, 2005; Patrick, Nicklas, Hughes, & Morales, 2005). Indulgent style is associated with increased intake of foods with low nutrient density (Hennessy, Hughes, Goldberg, Hyatt, & Economos, 2012). Children of parents with indulgent and uninvolved PFS are also associated with decreased fruit, vegetable, and dairy intake compared to children of parents with an authoritarian PFS (Hoerr et al., 2009). Hispanic parents tend to exhibit an indulgent feeding style (Hughes et al., 2005) which is associated with increased child weight status (Hughes, Power, O'Connor, Orlet Fisher, & Chen, 2016).

Typically, PFS is studied using the four categorical feeding styles previously described. However, changes to levels of demandingness and responsiveness over the course of 18 months- the time between the study's two timepoints - may not be great enough to reach threshold cutpoints. To capture these subtle shifts in trajectory, PFS will be tested using continuous scale scores for demandingness and responsiveness which is a deviation from previous studies in which PFS is a categorical variable.

Family Stress Model and Parental Levels of Demandingness and Responsiveness

Understanding the relationship between food insecurity, PFS, and dietary quality in the context of obesity prevention will allow for a more complete understanding of which factors to target in intervention design. The family stress model (FSM) (Conger & Donnellan, 2007) and previous studies on parenting stress and PFS guide hypothesis testing for the second aim. Please refer to Figure 1 for a depiction of the application of the FSM to this study.

Per FSM, factors such as economic hardship are sources of stress for parents (Conger & Donnellan, 2007). This stress affects parenting behaviors which then affects children's well-being. Two studies examining parenting stress and PFS found that parents with increased stress levels reflected PFS that were lower in demandingness (Hughes et al., 2016) and responsiveness (Hughes et al., 2016; Hurley et al., 2008).

While there is a gap in studies examining the association between food insecurity and PFS, studies have found that food insecure parents place increased pressure to eat on their children compared to those who are food secure (Conlon et al., 2015; Gross, Mendelsohn, Fierman, Racine, & Messito, 2012). These studies support the idea that food insecurity affects parenting behavior. The proposed study will narrow the gap in knowledge related to the mediating role of PFS between food insecurity and child's dietary quality.

Conditional Factors Affecting Relationships between Food Insecurity and Feeding Style, Dietary Quality, and Child Weight Status

Researchers have controlled for gender and acculturation in numerous studies examining food insecurity, parenting feeding styles, dietary quality, and child weight status. However, fewer studies have tested these variables for moderation despite evidence to suggest that gender and acculturation have some influence on these variables.

A recent study looking at food insecurity and dietary quality found that preschool girls living in households that had an increase in food security also had an improvement in dietary quality (Jansen et al., 2017). However, a similar trend was not observed in boys within the same study. Buscemi (2011) found acculturation to be a significant moderator between food insecurity and child body mass in a study of Latino children in which age

and gender were controlled. Other studies have identified that level of acculturation is a predictor of parenting feeding styles (Power, O'Connor, Orlet Fisher, & Hughes, 2015; Tovar et al., 2012).

Although few, these studies suggest the need to further investigate the potential moderating effects of gender and acculturation in the proposed mediation models. Mediation testing of dietary quality between food security status and child body mass and mediation testing of parental feeding style between food security status and dietary quality will increase understanding of the mechanisms that influence both outcomes. However, moderation testing will help increase the understanding of in what conditions or for whom these mechanisms work more effectively (Hayes, 2013).

This study aims to: 1. investigate if dietary quality mediates the relationship between food security status (FSS) at Time 1 and child body-mass-index (BMI) at Time 2, 2. investigate if parental levels of feeding demandingness and/or responsiveness mediate the relationship between FSS at Time 1 and dietary quality at Time 2, 3. explore factors that that moderate the mediation being tested in Aim 1 and 2. I hypothesize that poor dietary quality will mediate the relationship between low FSS at Time 1 and elevated BMI at Time 2 in low-income Hispanic preschoolers. Low levels of feeding demandingness and/or responsiveness will mediate the relationship between low FSS at Time 1 and poor dietary quality at Time 2 in low-income Hispanic preschoolers. Gender and/or acculturation to US lifestyles will moderate the direct and indirect effects in the mediation models tested in Aim 1 and 2.

Innovation

To the extent known, this is the first study to test dietary quality as a mediator between food security status and child BMI. Additionally, this is the first study to test parenting feeding style as a mediator between food security and dietary quality. It is also the first study to test if gender and acculturation moderate the relationships in a mediation model. Finally, this study examines PFS through its two domains of demandingness (PFD) and responsiveness (PFR). This approach will allow demandingness and responsiveness to be tested as continuous variables and help identify changes in demandingness and/or responsiveness over time that may be too small to cross pre-determined cutpoints (Hughes et al., 2012).

Method

Research Design and Setting

The study is a longitudinal, observational design that will use data collected from a previous study (R01 HD062567, PI: Hughes). The parent study examined the bidirectional relationship between Hispanic mothers' parenting behaviors and Hispanic preschoolers' eating behaviors. Findings from the parent study include: 1. indulgent feeding styles (low demandingness, high responsiveness) predicts subsequent increase in child body mass (Hughes, Power, O'Connor, Orlet Fisher, & Chen, 2016), 2. Increased acculturation to US lifestyles is associated with indulgent feeding style (Power, O'Connor, Orlet Fisher, & Hughes, 2015).

Data in the parent study was collected at three timepoints. Data collection at baseline and 18 months post-baseline used the same protocol and measured the same variables. However, data collected at the third timepoint, approximately three years post-

baseline, was limited to a few select variables. The current study is using data from the first two timepoints only. Data was collected at the USDA/ARS Children's Nutrition Research Center (CNRC) in Houston, TX. Two of the three 24 dietary-recalls for each timepoint were collected over the phone. Time 1 data collection began in August 2011. Data collection at the second timepoint occurred after 18 months.

Population, Sample, Sampling Procedures

At Time 1, researchers collected data from 187 self-identified Hispanic parent-child dyads. At Time 2, 144 parent-child dyads returned for data collection. To minimize attrition, participants were called every 3 months. They also received birthday cards.

The nonprobability sample was recruited through Head Start Centers located in Houston, TX. Rolling recruitment continued until the predetermined sample size was met. Recruitment strategies included distribution of flyers sent home with children and announcements at parent meetings. Research assistants were also present during child drop-off and pick-up times for direct recruitment of parents. Only one child and parent per family were recruited into the study.

For a child to enroll in Texas Head Start, he or she had to be a resident of the state and reside in a household that had income at or below the federal poverty level. At the time of the parent study recruitment, an income of $\leq$ $22,350 before tax for a family of four was at or below the federal poverty level (Sebelius, 2011).

Sample selection criteria for the parent study included: children being between four and five years of age at time of recruitment. Adults had to be the primary caregiver of the child when child was not at school. Because children would be eating food

prepared at the research center, children with food allergies were excluded. Children who were unable to serve themselves or eat without assistance were also excluded.

Human Subjects

Approval from the Committee of the Protection of Human Subjects at University of Texas Health Science Center was obtained prior to start of this study. The parent study (R01 HD06257, PI: Hughes) had Institutional Review Board approval from Baylor College of Medicine. All data was deidentified for subject protection.

Instruments

Table 1 contains a list of instruments used to operationalize the variables. Details about the instruments, including psychometrics are also listed in Table 1. All surveys were available in English and Spanish. The Spanish versions were developed using back-translation by CNRC staff members who were from Mexico, Central America, and South America. They all spoke Spanish fluently.

Food security status (FSS) was measured using a paper and pencil version of the 6-item Household Food Security Survey (6-item HFSS). This instrument has robust evidence of reliability and validity (Blumberg, Bialostosky, Hamilton, & Briefel, 1999; Harrison, Stormer, Herman, & Winham, 2003). It is also widely used in research (Marques, Reichenheim, de Moraes, Antunes, & Salles-Costa, 2015).

The United States Department of Agriculture (USDA) provides guidelines on how to score the 6-item HFSS (Economic Research Service, 2012). The final food security status score was calculated by adding the number of affirmative responses. Raw scores ranged from zero to six. Higher scores indicate less food security. The USDA's guidelines provide a scoring system to convert the raw FSS score to an interval-level

scale score (Economic Research Service, 2012). These interval-level scores were used in analysis.

The Caregiver's Feeding Styles Questionnaire (CFSQ) was used to operationalize demandingness and responsiveness. This instrument was developed from research on low-income minority populations in the US- namely African Americans and Hispanics (Hughes et al., 2005). The instrument consists of 19 items with 4-point Likert-scale responses. Demandingness (PFD) score is determined by an average of the responses for all 19 items (parent-centered and child-centered) and range from one to five. Higher scores represent greater control by parents with respect to their child's feeding/eating. Responsiveness (PFR) scores are calculated as a ratio between the mean of seven child-centered questions (item numbers 3, 4, 6, 8, 9, 15, and 17) and the demandingness score. Scores could range between .20 to 2.02 with higher scores representing greater parental warmth.

Dietary quality was measured using the Healthy Eating Index 2015 (HEI). HEI measures how closely individuals meet the Dietary Guidelines for Americans (USDA, 2015). Total scores ranged from 0 to 100. Higher scores reflect greater adherence to dietary guidelines. The HEI-2010, the predecessor of HEI-2015, is validated for use in children $\geq$ 2 years of age (Guenther et al., 2014).

HEI scores for parent and child were calculated using three 24-dietary recalls that were collected in the parent study using Nutrition Data Systems for Research (NDSR) software versions 2012 (Time 1) and 2014 (Time 2). Each participant's food group or nutrient intake was averaged across the three recalls which is the same method used by Guenther (2014). These averages were then used to calculate the variables needed to

obtain the 13 HEI component scores. The variables were calculated per guidelines developed by the Nutrition Coordination Center at the University of Minnesota (2017). Finally, each of the 13 HEI components were assigned a proportional score based on scoring standards provided by the Epidemiology and Genomics Research Program (Epidemiology and Genomics Research Program, 2017). These 13 component scores were summed for each participant's overall HEI-2015 score.

Child's body mass was determined by using BMI z-scores. Heights and weights were measured using a standard protocol (Lohman, Roche, & Martorell, 1988). Each child was measured twice for height (cm) and weight (kg). The average height and weight measures were used to generate age and gender specific BMI z-scores (Kuczmarski et al., 2002).

Acculturation, a potential covariate to dietary quality and child weight status, was measured using the Bidimensional Acculturation Scale (Marin & Gamba,1996). This is a 24-item questionnaire that consists of a Hispanic domain (12 items) and English domain (12 items). All answers are on a 4-point Likert scale. Per the developers' instructions, the respondents received a score for each domain by averaging the 12 responses that corresponded with the Hispanic and non-Hispanic domains. The final score for each domain could range between one and four (Marin & Gamba,1996).

Demographics included child's gender, number of children living in household, number of household members, maternal marriage status, employment status, and education level.

Data Collection Procedures

Data collection at Time 1 and Time 2 followed the same protocols. All data except for two of the three food recalls were completed at the CNRC lab. Trained CNRC staff members who were fluent in Spanish and English obtained data from participants in the language of the participant's choice. All surveys, including the 6-item HFSS and CFSQ, were given to participants for completion in random order. Participants were compensated $65 at Time 1 and $140 at Time 2.

At each time wave, data were collected over the course of two separate visits to the CNRC. Each visit lasted approximately two hours. Parents completed surveys over the course of these two visits. Transportation or free parking was available for research participants.

Trained staff members of the CNRC measured parents and children's heights and weights using a stadiometer and electronic self-calibrating digital scale. Children removed their shoes and wore light clothing. Height was recorded to the nearest 0.1cm and weight to 0.1kg.

Three 24-hour dietary recalls (two weekdays, one weekend) were collected by trained research assistants using the 5-step multipass method and Nutrition Data System for Research Software. The method consists of five steps: 1) a quick, uninterrupted list of foods and beverages consumed, 2) query of foods that are often frequently forgotten, 3) time and occasion of food consumption, 4) use of the Food Model Booklet and measuring guides to elicit descriptions of foods and amounts eaten, and 5) a final probe review (Conway, Ingwersen, Vinyard, & Moshfegh, 2003). The first recall was completed at the

CNRC in person. The remaining two recalls for each data point were completed by phone. The participating parents provided the dietary recall information.

Data Analysis

At baseline, the sample size was 187 parent-child dyads. At Time 2, 137 parent-child dyads had a second measure for household food security status (FSS), child HEI-2015 (HEI), and child BMI z-scores (BMIz). Due to missing data the analytic sample for the mediation models was 127.

Microsoft excel (2016) was used to calculate FSS, HEI, PFD, PFR, and English and Hispanic acculturation scores. The BMI Group Calculator-Metric, a Microsoft excel macro provided by the CDC, was used to calculate BMI percentiles for children (CDC, 2015). BMIz scores were provided by the parent study's research team. IBM SPSS Statistics version 24 was used to conduct statistical analyses.

Descriptive statistics examined the distributions and variability for FSS, BMIz, HEI, PFD, PFR, and demographics at both time points. T-tests and Chi-square analyses determined if there were statically significant differences in baseline participants and those who returned for Time 2 data collection. Comparisons were made using baseline data for: FSS, HEI, PFD, PFR, BMIz, and demographics.

Mediation was tested using PROCESS model 4 (Hayes, 2013). PROCESS is a path analysis macro that works through SPSS. PROCESS calculated a 95% confidence interval for the direct effect and 95% bias-corrected bootstrapped confidence interval using 10,000 repetitions for indirect effect for each mediation model. Bootstrapping is a nonparametric test that does not require normal distributions for the product of *ab* and has more power compared to Sobel test (Preacher & Hayes, 2004). For Aim 1, *x*, *y*, and *m*

were assigned variables FSS_{T1}, $BMIz_{T2}$, and HEI_{T1}, respectively. For Aim 2, *x*, *y*, and *m* were assigned FSS_{T1}, HEI_{T2}, and PFD_{T11} or PFR_{T1}, respectively. To more closely analyze the coefficients for the direct effects in Aim 2, multivariate linear regression was tested in which *x*= FSS_{T1} and *y*= HEI_{T2}. The significant covariates were HEI_{T1} and English $acculturation_{T1}$. (Please note that the variables' numerical subscripts indicate the data collection time point.)

To test Aim 3 (moderated mediation), a total of six models were tested using PROCESS model 59 (Hayes, 2013). Table 2 lists the key variables tested in each model. PROCESS calculated a 95% confidence interval for conditional direct effects and 95% bias-corrected bootstrap confidence interval using 10,000 iterations for conditional indirect effects using a "pick-a-point" approach to determine under which conditions moderation existed. To more closely analyze the moderation of gender on the direct effect in Aim 3 model 1a, PROCESS model 1 was used. In model 1, *x*= FSS_{T1}, *y*= $BMIz_{T2}$, *m*= gender, and significant co-variates ($BMIz_{T1}$ and English $acculturation_{T1}$).

A priori criteria

Significance for t-tests and Chi-square analyses was set at $p \leq .05$. In Aim 1 and 2, mediation was present if the confidence interval for the direct effect and the bootstrap confidence interval for the indirect effect did not cross over zero. In Aim 3, if the interaction term had a p-value $\leq .05$ then moderation for path a, b, and/or c' was present. The conditional direct effect of X on Y at the values of the moderator was significant if the 95% confidence interval did not contain 0. For a conditional indirect effect of X on Y at the values of the moderator to be significant, the 95% bias-corrected bootstrap confidence interval must not contain zero.

According to Fritz and MacKinnon (2007), a sample size of 126 can detect medium to large effect sizes for indirect paths, with power of .8, when using the bias-corrected bootstrap test of mediation. These effect sizes are clinically relevant.

When constructing models for analysis in Aim 1, 2, and 3, the following baseline variables were considered potential co-variates: child gender, number of household members and children, maternal Hispanic and English acculturation, marital status, maternal employment status, and maternal education level. The initial mediation models contained all potential co-variates. The co-variate with the greatest p-value > .1 in the model predicting the dependent variable was removed. This process of removing co-variates was repeated for Aim 1 and 2 until only those co-variates with a p-value ≤ .1 were retained in the final model. Because the mediation models were using longitudinal data with two timepoints, the previous levels of the dependent variables in each model (i.e., $BMIz_{T1}$ in Aim 1 and HEI_{T1} in Aim 2) were controlled as recommended by Cole and Maxwell (2003). Controlling for previous levels of the dependent variable reduces over- or underestimation of mediation effects (Selig & Preacher, 2009). Because the 6-item HFSS measures FSS over the previous 12 months, it already reflected a previous time at baseline. Therefore, the mediating variables from Time 1 were used as opposed to variables from Time 2.

Missing Data

No cases were removed from the dataset. All HEI scores were considered plausible. If a case had missing data, SPSS excluded it from analysis for that specific test.

The only variable for which data was imputed was for the Bi-dimensional Acculturation Scale. Seven participants were missing ≤ 2 responses. The missing

responses were assigned a value of zero, which was not a possible answer choice in the acculturation scale. Even after this imputation, 17 participants had missing acculturation scores. At baseline, six participants have no HEI score and two had no PFD and PFR scores. Only 1 case was missing data for FSS.

Results

Sample Characteristics

At Time 1, there were 187 mother-child participant dyads. Of these, 137 mother-child dyads returned for Time 2 data collection. Returning participants were defined as having values for FSS_{T2}, $BMIz_{T2}$, and HEI_{T2}. Girls accounted for 47.8% of children sampled. All children were Hispanic or Latino. Nearly all (99.5%) of mothers identified themselves as Hispanic or Latino. At Time 1 and 2 the average age of the children was 4.8 and 6.3 years, respectively. The median number of household members was five and the median number of children per household was three. At Time 1, 56.5% of participant households had some level of food insecurity (marginal, low, or very low). Table 3 lists additional sample characteristics at baseline. At Time 1 and 2, HEI, BMIz, PFD, and PFR had normal distributions.

Group comparisons

There were no significant differences in FSS, HEI, PFD, PFR, BMIz, household size and number of children, maternal marital/employment/education status between the participants who returned for Time 2 data collection and those who did not return. The returning group did have higher Hispanic acculturation ($M = 3.64$, $SD = 0.51$) compared to the group that did not return ($M = 3.44$, $SD = 0.66$) ($t\ (167) = 2.02$, $p = 0.05$). The

returning group also had lower English acculturation (M = 2.20, SD = 0.88) compared to the non-returning group (M = 2.53, SD = 0.96) (t (167) = -2.07, p = .04).

Because this is a longitudinal study, change between Time 1 and Time 2 (18 months) was assessed. FSS, HEI, BMIz had no significant change over time. However, PFD had statistically significant decrease (less controlling) from Time 1 (M = 3.07, SD = 0.59) to Time 2 (M = 2.81, SD = 0.62) (t (135) = 5.67, p = .00). PFR had a statistically significant increase (more warmth) from Time 1 to Time 2 ($M_{difference}$ = 0.03, SD = 0.16) (t (135) = -2.34, p = .02). There was also an expected increase in English acculturation ($M_{difference}$ = 0.07, SD = 0.32) (t (124) = -2.53, p = .013) although Hispanic acculturation level remained stable ($M_{difference}$ = .00, SD = .34) (t (123) = .00, p = 1.00). Employment from T1 to T2 increased by 8.7%.

Findings for Aim 1

In Aim 1, the hypothesis was that child dietary quality at Time 1 would mediate the relationship between FSS at Time 1 and child BMI at Time 2. The findings for this aim did not support the hypothesis. There was no significant association between direct effect of FSS_{T1} on $BMIz_{T2}$ (c' = 0.01, 95% CI [-0.02, 0.03]). The indirect effect of FSS_{T1} on $BMIz_{T2}$ through HEI_{T1} was statically not different from zero (ab = -0.00, 95% bias-controlled bootstrap CI [-0.00, 0.00]). Only co-variates $BMIz_{T1}$ (β = 0.84, 95% CI [0.78, 0.90]) and English $acculturation_{T1}$ (β = 0.13, 95% CI [0.05, 0.21]) were significant predictors of $BMIz_{T2}$ in the model. Figure 2 reflects the mediation model with the unstandardized coefficients for paths *a, b, c'*, and the significant covariates.

Findings for Aim 2

Aim 2 focused on if the parenting feeding style domains of demandingness (PFD) and/or responsiveness (PFR) mediated the relationship between FSS at Time 1 and HEI at Time 2. The two domains were tested in separate mediation models to maintain the assumption of independence. However, the findings for both mediation models were similar in that the indirect pathway for PFD (*ab* = -0.01, 95% bias-corrected bootstrap CI [-0.15, 0.03]) and PFR (*ab* = 0.01, 95% bias-corrected bootstrap CI [-0.04, 0.15]) were not significantly different from zero. However, the direct path between FSS at Time 1 and HEI at Time 2 was significant in both mediation models. In the PFD mediation model, the direct path (*c'*) had an effect of 1.07 (95% CI [0.44, 1.70]). In the PFR mediation model, the direct path (*c'*) was similar with an effect of 1.05 (95% CI [0.42, 1.68]). Figure 3 reflects the PFD mediation model with the unstandardized coefficients for paths *a, b, c'*, and the significant covariates. The mediation model with PFR reflects similar direct association between FSS_{T1} and $cHEI_{T2}$ and is available on request. A parsimonious model that tested the effect of FSS_{T1} on HEI_{T2} while controlling for English acculturation $_{T1}$ and HEI_{T1}, resulted in a model in which FSS_{T1} explained 8.3% of the variance for HEI_{T2}.

Findings for Aim 3

Aim 3 was to test if gender and/or maternal acculturation to US lifestyles produced any conditional effects on the indirect and direct pathways tested in Aims 1 and 2. Because Aim 1 and 2 had no significant mediation, it was logically expected that there would be no moderation of the mediation. However, to be thorough and complete the analysis as described earlier, the 6 models described in the analysis section were tested.

The results for each test are available on request. All pathways were nonsignificant with the exception of gender moderating the direct path (*c'*) between FSS_{T1} and $BMIz_{T2}$. The interaction term FSS_{T1}*Gender (β= 0.05, 95% CI [0.002, 0.093]) is significant for the direct effect of FSS_{T1} on $BMIz_{T2}$. Figure 4 is a parsimonious model (R^2_{change} = .0041, F (1,124) = 3.98, p = .05) to more closely examine the conditional effect of gender on the direct relationship between FSS_{T1} and $BMIz_{T2}$ while controlling for English $acculturation_{T1}$ and $BMIz_{T1}$. Figure 5 is a graphical representation of the conditional effects of gender on the relationship between FSS_{T1} and $BMIz_{T2}$.

Sensitivity Analyses & Findings

Three different type of sensitivity analyses were performed. Because at the time of analysis the validity testing for HEI-2015 had not been released, Aims 1, 2, and 3 model 1a were tested using HEI-2010 scores. Food security status is commonly categorized as high/marginal, low, or very low food security. However, in this study, food security raw scores were converted to interval-level measures. To compare the results between interval-level and categorical-level, Aims 1, 2, and 3 model 1a were tested using categorical food security scores. The original set of co-variates did not include maternal body-mass and dietary quality. Therefore, Aim 1 was retested controlling for maternal body-mass at Time 1. Aim 2 was retested controlling for maternal dietary quality at Time 1. Relationships for all sensitivity analyses were similar to those reported earlier in this manuscript. Detailed results are available on request.

Discussion

The purpose of this study was to expand our understanding of how food insecurity affects body mass through dietary quality in low-income Hispanic preschoolers (Aim 1).

Keeping in mind the importance of the parents' role in children's diets, the study also sought to understand how food insecurity affects dietary quality through parenting feeding styles (Aim 2). The final aim of the study focused on examining if gender and/or maternal acculturation to US lifestyle moderated the relationships tested in Aims 1 and 2. To my knowledge, this was the first study to test these relationships using longitudinal data in low-income Hispanic preschoolers.

We learned that baseline food insecurity did not affect: 1. subsequent body mass through dietary quality 2. subsequent dietary quality through feeding demandingness or responsiveness in low-income Hispanic preschoolers. Girls who live in food insecure households were at greater risk for increased subsequent body mass; however, the overall effect of food security status on body mass was small. We also learned that, while food insecurity had no cross-sectional relationship with dietary quality, exposure to household food insecurity had a *protective* effect on subsequent dietary quality.

The purpose of Aim 1 was to investigate if dietary quality mediates the relationship between food security status at Time 1(FSS_{T1}) and body-mass-index at Time 2 ($BMIz_{T2}$) in low-income Hispanic preschoolers. As mentioned in the literature review, studies examining the association between food security status and child body mass have been mixed. Metallinos-Katsaras' (2012) longitudinal study on a racially/ethnically diverse group of low-income preschoolers found an increase in odds for obesity in children living in persistently food insecure homes. A recent study of Headstart students in Michigan also found that preschool girls in households that went from food secure to food insecure over the course of 12 months had an increase in BMIz (Jansen et al., 2017). However, two other cross-sectional studies with largely Hispanic preschool samples

found no association between food insecurity and BMI scores (Kaiser et al., 2002; Trapp et al., 2015). These conflicting findings within the same age- and income-group suggests that cultural differences in relation to food insecurity may be a factor to further investigate.

Possible explanations for the lack of association between food insecurity and BMIz in this sample of low-income Hispanic preschoolers attending Headstart and living in an urban environment such as Houston could be that:

1. Mothers protect children from the effects of food insecurity (Hanson & Connor, 2014; Nalty, Sharkey, & Dean, 2013).
2. Headstart buffers the effects of food insecurity through their nutritional programs. Headstart includes a nutrition program to provide young children and families with nutritious foods and nutrition education. Many families participating in Headstart also have access to other programs such as WIC (USDA, 2017). Overall, Headstart participants have healthier eating patterns compared to non-Headstart participants (Lee, Zhai, Han, Brooks-Gunn, & Waldfogel, 2013). The present study had an average HEI score of 61 which is above the national average HEI score (~52) for children ages 4 to 11 (Banfield, Liu, Davis, Chang, & Frazier-Wood, 2016) but comparable with the average HEI score (~60) of Headstart students sampled in Michigan (Jansen et al., 2017).
3. Physical activity may mitigate the effects of poor diet on their body mass. However, a systematic review concluded that preschoolers lack recommended levels of physical activity (Tucker, 2008).

The purpose of Aim 2 was to investigate if parenting feeding demandingness (PFD_{T1}) and responsiveness (PFR_{T1}) at Time 1 mediate the relationship between food security status (FSS_{T1}) at Time 1 and dietary quality (HEI_{T2}) at Time 2 in low-income Hispanic preschoolers. There was no significant mediation. Because this was the first study to test the relationship between FSS_{T1} and PFD_{T1} and PFR_{T1}, there are no direct comparisons that can be made with other studies. However, previous studies have found associations between food insecurity and parenting control practices such as pressuring a child to eat and monitoring of food intake (Kamdar, 2016). One possible explanation for why parenting practices- which refer to short-term parenting behaviors to address an immediate need- are associated with food security status could be that parenting practices are reactionary behaviors. In contrast, parenting feeding styles reflect a stable parenting behavior that may be influenced by factors such as culture. Indeed, acculturation was a predictor of feeding styles in this sample (Power, O'Connor, Orlet Fisher, & Hughes, 2015).

Interestingly, lower baseline household food security was associated with higher dietary quality 18 months later. Most studies that have examined the relationship between food security and diet have found: 1. low food security was associated with low dietary quality (Jansen et al., 2017; Kaiser et al., 2002; Nackers & Appelhans, 2013) or 2. no association between food security and diet (Bhattacharya, Currie, & Haider, 2004; Knol, Haughton, & Fitzhugh, 2004; Trapp et al., 2015). The presence of a longitudinal association in the absence of a cross-sectional association raises questions as to what occurs during the 18-month time lag that leads to a shift in the relationship from no

association to “protective” association. Potential explanations for the longitudinal association will be discussed in the section for future research.

The purpose of Aim 3 was to explore if factors such as gender and acculturation moderate the direct and indirect effects of the mediations being tested in Aim 1 and 2. Gender and acculturation are commonly treated as covariates in studies examining similar relationships as those tested in Aims 1 and 2. However, fewer studies have tested them for conditional effects. While maternal English acculturation was a predictor for $BMIz_{T2}$, PFD_{T1}, PFR_{T1}, and HEI_{T2}, it did not moderate the direct or indirect relationships tested in Aims 1 and 2. Previous research has found positive associations between acculturation to US lifestyles and increased body mass in Hispanics (Ayala, 2008). Dave (2012) found that increased household food insecurity and acculturation was associated with decreased fruit and vegetable consumption in Hispanic children ages 5-12. In Buscemi’s (2011) study, acculturation moderated the relationship between food security and child body mass percentile in Latino children; however, the directionality of the moderation is not clear.

There was a positive association between food insecurity and child body mass for girls but not boys. A similar effect was found in two separate studies (Jansen et al., 2017; Speirs, Fiese, & STRONG Kids Research Team, 2016). However, these studies had predominately non-Hispanic samples and larger effect sizes. While the present study found a statistical association, the effect size was very small and suggests that both genders have similar needs in this population.

Limitations

The nonprobability sample recruitment from Head Start limits the generalizability of findings. Low-income families who choose not to enroll their children in Head Start programs are not represented in this sample. Although about one out of every three children enrolled in Head Start are Hispanic (Child Trends Databank, 2015), a clear statistic on the number of low-income Hispanic children who are not enrolled in Head Start could not found. Participation in Head Start could also help families access other public health services such as WIC or SNAP, which could affect their food security status and dietary quality. In the present study, data on participation in a nutrition assistance program was not available to control as a potential co-variate. In addition, the parents' responses on the 6-item HFSS and CFSQ are subject to self-report bias. The 24-hour dietary recall for preschoolers is also dependent on the parent's awareness of food/beverage consumption and accurate reporting of items. Although the method used to collect dietary recall data is considered the most accurate method, there is room for misreporting (Burrows, 2010). Mothers accurately reported their preschooler's intake only about 64% of the time (Baranowski, Sprague, Baranowski, & Harrison, 1991). Finally, it is unclear if the time lag of 18 months is appropriate to test for effects of food security status on child dietary quality and body mass. Other studies examining the same variables have used time lags of 6 months (Metallinos-Katsaras et al., 2012; Rose & Bodor, 2006), 12 months (Jansen et al., 2017), and 24 months (Bhargava, Jolliffe, & Howard, 2008). The children in this study were in Headstart at baseline; however, by Time 2, most of them had graduated out of the program. It is unclear if this transition influenced the findings.

Strengths

A primary strength in the present mediation study is the longitudinal design. Two timepoints enable testing of the mediation effects with more rigor than a cross-sectional design (Cole & Maxwell, 2003; Selig & Preacher, 2009). The longitudinal design allows for control of prior levels of the dependent variable which subsequently reduces possible over-inflation of estimates. The longitudinal design also allows for the effects to unfold over time (Selig & Preacher, 2009). The homogeneity of the sample being recruited from Headstart controls for additional resources that are accessible to Headstart families. Finally, although the study lost ~30% of the original sample, those participants who dropped out were similar to the analytic sample for food security status, child dietary quality, child body-mass, PFD, and PFR, and most demographic characteristics.

Future research

This study has led to additional questions such as why does dietary quality not predict child body mass? Child nutrition is central to many of the interventions to curb child obesity. However, in this study, dietary quality in low-income Hispanic preschoolers was unrelated to subsequent body-mass. Are there other factors that override this logical association in this population? If so, what are they?

Additionally, finding that as food security decreased, the children had improvement to later dietary quality raises curiosity. What impacts does exposure to food insecurity early in childhood have on children and their parents to explain the longitudinal association? Are mothers adopting protective coping strategies to deal with food insecurity that have lasting benefits? If so, what are these protective strategies?

What role does Head Start have in the improved child dietary quality seen in households with low-baseline food security?

Finally, the lack of association between food insecurity and child body mass and subsequent lack of mediation by dietary quality and PFD/PFR may be related to limitations in the operationalization of food security. As currently measured, food security exclusively focuses on financial limitations for access to food. However, there are other resources that could hinder access to food beyond finances for low-income families. These include time, transportation, cooking skills and equipment, and nutritional literacy. Access to foods that are culturally familiar may also be a limitation to food security. We need a measure of food security that reaches beyond financial security.

Conclusion

This is the first study to test variables known to be predictive of either dietary quality and/or child body mass in longitudinal moderated mediation models. The lack of significant relationships indicates that these relationships are more complex than a series of linear connections. Studies with a mixed methods approach could advance our understanding for why relationships do (and do not) exist.

This study also identified factors that were protective of child dietary quality. While we should not encourage low financial food security or inhibit acculturation to US lifestyles, we should investigate why these factors were protective of child dietary quality. This information will help us in finding innovative paths to reducing the prevalence of child obesity in a young, vulnerable, and rapidly-expanding population.

References

Ayala, G. (2008). A systematic review of the relationship between acculturation and diet among Latinos in the united states: Implications for future research. *Journal of the American Dietetic Association, 108*(8), 1330-1344. doi:10.1016/j.jada.2008.05.009

Banfield, E. C., Liu, Y., Davis, J. S., Chang, S., & Frazier-Wood, A. C. (2016). Poor adherence to US dietary guidelines for children and adolescents in the national health and nutrition examination survey population. *Journal of the Academy of Nutrition and Dietetics, 116*(1), 21-27. doi:10.1016/j.jand.2015.08.010

Baranowski, T., Sprague, D., Baranowski, J. H., & Harrison, J. (1991). Accuracy of maternal dietary recall for preschool children., *91*(6), 669-674.

Bhargava, A., Jolliffe, D., & Howard, L. L. (2008). Socio-economic, behavioural and environmental factors predicted body weights and household food insecurity scores in the early childhood longitudinal study-kindergarten. *The British Journal of Nutrition, 100*(2), 438-444. doi:10.1017/S0007114508894366 [doi]

Bhattacharya, J., Currie, J., & Haider, S. (2004). Poverty, food insecurity, and nutritional outcomes in children and adults. *Journal of Health Economics, 23*(4), 839-862. doi:10.1016/j.jhealeco.2003.12.008

Blumberg, S. J., Bialostosky, K., Hamilton, W. L., & Briefel, R. R. (1999). The effectiveness of a short form of the household food security scale. *American Journal of Public Health, 89*(8), 1231-1234. doi:10.2105/AJPH.89.8.1231

Bothwell, E. (2009). Underreporting of food intake among Mexican/Mexican American women: Rates and correlates. *Journal of the American Dietetic Association, 109*(4), 624-632. doi:10.1016/j.jada.2008.12.013

Bronte-Tinkew, J., Zaslow, M., Capps, R., Horowitz, A., & McNamara, M. (2007). Food insecurity works through depression, parenting, and infant feeding to influence overweight and health in toddlers. *The Journal of Nutrition, 137*(9), 2160.

Buscemi, J., Beech, B. M., & Relyea, G. (2011). Predictors of obesity in Latino children: Acculturation as a moderator of the relationship between food insecurity and body mass index percentile. *Journal of Immigrant and Minority Health, 13*(1), 149-154. doi:10.1007/s10903-009-9263-6 [doi]

Burrows, T. (2010). A systematic review of the validity of dietary assessment methods in children when compared with the method of doubly labeled water. *Journal of the American Dietetic Association, 110*(10), 1501-1510. doi:10.1016/j.jada.2010.07.008

CDC. (2015). Children's BMI tool for schools. Retrieved from https://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/tool_for_schools.html

CDC. (2016). Defining adult overweight and obesity. Retrieved from https://www.cdc.gov/obesity/adult/defining.html

CDC. (2015). Defining childhood obesity. Retrieved from https://www.cdc.gov/obesity/childhood/defining.html

Child Trends Databank. (2015). Head start. Retrieved from https://www.childtrends.org/indicators/head-start

Cole, D. A., & Maxwell, S. E. (2003). Testing mediational models with longitudinal data: questions and tips in the use of structural equation modeling. *Journal of Abnormal Psychology, 112*(4), 558.

Coleman-Jensen, A., Rabbitt, M. P., Gregory, C. A., & Singh, A. (2016). *Household food security in the united states in 2015.* (Economic Research Report No. 215). United States Department of Agriculture.

Conger, R. D., & Donnellan, M. B. (2007). An interactionist perspective on the socioeconomic context of human development. *Annual Review of Psychology, 58*(1), 175-199. doi:10.1146/annurev.psych.58.110405.085551

Conlon, B. A., McGinn, A. P., Lounsbury, D. W., Diamantis, P. M., Groisman-Perelstein, A. E., Wylie-Rosett, J., & Isasi, C. R. (2015). The role of parenting practices in the home environment among underserved youth. *Childhood Obesity (Print), 11*(4), 394-405. doi:10.1089/chi.2014.0093 [doi]

Conway, J. M., Ingwersen, L. A., Vinyard, B. T., & Moshfegh, A. J. (2003). Effectiveness of the US Department of Agriculture 5-step multiple-pass method in assessing food intake in obese and nonobese women. *The American Journal of Clinical Nutrition, 77*(5), 1171.

Darling, N., & Steinberg, L. (1993). Parenting style as context: An integrative model. *Psychological Bulletin, 113*(3), 487.

Dave, J., & Cullen, K. W. (2012). *Dietary intakes of children from food insecure households* DigitalCommons@The Texas Medical Center.

Dubois, L., Farmer, A., Girard, M., & Porcherie, M. (2006). Family food insufficiency is related to overweight among preschoolers. *Social Science & Medicine, 63*(6), 1503-1516. doi: 10.1016/j.socscimed.2006.04.002

Economic Research Service, U. (2012). U.S. household food security survey module: Six-item short form.

Epidemiology and Genomics Research Program. (2017). Developing the healthy eating index. Retrieved from https://epi.grants.cancer.gov/hei/developing.html

Epidemiology and Genomics Research Program. (2017). Evaluating the healthy eating index. Retrieved from https://epi.grants.cancer.gov/hei/evaluation-validation.html

Gibbs, B. G., & Forste, R. (2014). Socioeconomic status, infant feeding practices and early childhood obesity: SES, infant feeding and child obesity. *Pediatric Obesity, 9*(2), 135-146. doi:10.1111/j.2047-6310.2013.00155.x

Gross, R. S., Mendelsohn, A. L., Fierman, A. H., Racine, A. D., & Messito, M. J. (2012). Food insecurity and obesogenic maternal infant feeding styles and practices in low-income families. *Pediatrics, 130*(2), 254-261. doi:10.1542/peds.2011-3588 [doi]

Guenther, P. M., Kirkpatrick, S. I., Reedy, J., Krebs-Smith, S. M., Buckman, D. W., Dodd, K. W., . . . Carroll, R. J. (2014). The Healthy Eating Index-2010 is a valid and reliable measure of diet quality according to the 2010 Dietary Guidelines for Americans. *The Journal of Nutrition, 144*(3), 399.

Gundersen, C., & Ziliak, J. P. (2015). Food insecurity and health outcomes. *Health Affairs (Project Hope), 34*(11), 1830-1839. doi:10.1377/hlthaff.2015.0645

Hanson, K. L., & Connor, L. M. (2014). Food insecurity and dietary quality in US adults and children: A systematic review. *The American Journal of Clinical Nutrition, 100*(2), 684-692. doi:10.3945/ajcn.114.084525 [doi]

Harrison, G. G., Stormer, A., Herman, D. R., & Winham, D. M. (2003). Development of a Spanish-language version of the U.S. household Food Security Survey Module. *The Journal of Nutrition, 133*(4), 1192.

Hayes, A. (2013). Introduction to mediation, moderation, and conditional process analysis. A regression-based approach. 2013. *New York: Guilford, 1609182308*

Hennessy, E., Hughes, S. O., Goldberg, J. P., Hyatt, R. R., & Economos, C. D. (2012). Permissive parental feeding behavior is associated with an increase in intake of low-nutrient-dense foods among American children living in rural communities. *Journal of the Academy of Nutrition and Dietetics, 112*(1), 142-148. doi:10.1016/j.jada.2011.08.030

Hernandez, D. C., Reesor, L., Alonso, Y., Eagleton, S. G., & Hughes, S. O. (2016). Household food insecurity status and Hispanic immigrant children's body mass index and adiposity.

Hoerr, S. L., Hughes, S. O., Fisher, J. O., Nicklas, T. A., Liu, Y., & Shewchuk, R. M. (2009). Associations among parental feeding styles and children's food intake in families with limited incomes. *The International Journal of Behavioral Nutrition and Physical Activity, 6*(1), 55-55. doi:10.1186/1479-5868-6-55

Hughes, S. O., Cross, M. B., Hennessy, E., Tovar, A., Economos, C. D., & Power, T. G. (2012). Caregiver's feeding styles questionnaire. Establishing cutoff points. *Appetite, 58*(1), 393. doi:10.1016/j.appet.2011.11.011

Hughes, S. O., Power, T. G., O'Connor, T. M., Orlet Fisher, J., & Chen, T. (2016). Maternal feeding styles and food parenting practices as predictors of longitudinal changes in weight status in Hispanic preschoolers from low-income families. *Journal of Obesity, 2016*, 1-9. doi:10.1155/2016/7201082

Hughes, S. O., Power, T. G., Liu, Y., Sharp, C., & Nicklas, T. A. (2015). Parent emotional distress and feeding styles in low-income families. the role of parent

depression and parenting stress. *Appetite, 92*, 337-342. doi:10.1016/j.appet.2015.06.002

Hughes, S. O., Power, T. G., Orlet Fisher, J., Mueller, S., & Nicklas, T. A. (2005). Revisiting a neglected construct: Parenting styles in a child-feeding context. *Appetite, 44*(1), 83-92. doi:10.1016/j.appet.2004.08.007

Hurley, K. M., Black, M. M., Papas, M. A., Caulfield, L. E., & Caufield, L. E. (2008). Maternal symptoms of stress, depression, and anxiety are related to nonresponsive feeding styles in a statewide sample of WIC participants. *The Journal of Nutrition, 138*(4), 799.

Jansen, E. C., Kasper, N., Lumeng, J. C., Brophy Herb, H. E., Horodynski, M. A., Miller, A. L., . . . Peterson, K. E. (2017). Changes in household food insecurity are related to changes in BMI and diet quality among Michigan head start preschoolers in a sex-specific manner. *Social Science & Medicine, 181*, 168-176. doi:10.1016/j.socscimed.2017.04.003

Jyoti, D. F., Frongillo, E. A., & Jones, S. J. (2005). Food insecurity affects school children's academic performance, weight gain, and social skills. *The Journal of Nutrition, 135*(12), 2831-2839. doi:135/12/2831 [pii]

Kaiser, L. L., Melgar-Quinonez, H. R., Lamp, C. L., Johns, M. C., Sutherlin, J. M., & Harwood, J. O. (2002). Food security and nutritional outcomes of preschool-age Mexican American children. *Journal of the American Dietetic Association, 102*(7), 924-929.

Kamdar, N. (2017). Ethnic/Racial Differences in Strategies Parents Use to Cope with Food Insecurity: An Integrative Review of Published Research (Unpublished

manuscript) University of Texas Health Science Center Cizik School of Nursing, Houston, Texas.

Knol, L. L., Haughton, B., & Fitzhugh, E. C. (2004). Food insufficiency is not related to the overall variety of foods consumed by young children in low-income families. *Journal of the American Dietetic Association, 104*(4), 640-644. doi:10.1016/j.jada.2004.01.018

Kuczmarski, R. J., Ogden, C. L., Guo, S. S., Grummer-Strawn, L. M., Flegal, K. M., Mei, Z., . . . Johnson, C. L. (2002). 2000 CDC growth charts for the United States: Methods and development. *Vital and Health Statistics. Series 11, Data from the National Health Survey, (246)* (246), 1-190.

Larson, N. I., & Story, M. T. (2011). Food insecurity and weight status among U.S. children and families. *American Journal of Preventive Medicine, 40*(2), 166-173. doi:10.1016/j.amepre.2010.10.028

Lee, R., Zhai, F., Han, W., Brooks-Gunn, J., & Waldfogel, J. (2013). Head start and children's nutrition, weight, and health care receipt. *Early Childhood Research Quarterly, 28*(4), 723-733.

Lohman, T. G., Roche, A. F., & Martorell, R. (1988). *Anthropometric standardization reference manual* Human kinetics books.

Marin, G., & Gamba, R. J. (1996). A new measurement of acculturation for Hispanics: The Bidimensional acculturation scale for Hispanics (BAS). *Hispanic Journal of Behavioral Sciences, 18*(3), 297-316. doi:10.1177/07399863960183002

Marques, E. S., Reichenheim, M. E., de Moraes, C. L., Antunes, M. M. L., & Salles-Costa, R. (2015). Household food insecurity: A systematic review of the measuring

instruments used in epidemiological studies. *Public Health Nutrition, 18*(5), 877-892. doi:10.1017/S1368980014001050

Matheson, D. M., Varady, J., Varady, A., & Killen, J. D. (2002). Household food security and nutritional status of Hispanic children in the fifth grade. *The American Journal of Clinical Nutrition, 76*(1), 210-217.

Mei, Z., Grummer-Strawn, L. M., Pietrobelli, A., Goulding, A., Goran, M. I., & Dietz, W. H. (2002). Validity of body mass index compared with other body-composition screening indexes for the assessment of body fatness in children and adolescents. *The American Journal of Clinical Nutrition, 75*(6), 978-985.

Metallinos-Katsaras, E., Must, A., & Gorman, K. (2012). A longitudinal study of food insecurity on obesity in preschool children. *Journal of the Academy of Nutrition and Dietetics, 112*(12), 1949-1958. doi:10.1016/j.jand.2012.08.031 [doi]

Murakami, K., & Livingstone, M. B. E. (2016). Prevalence and characteristics of misreporting of energy intake in US children and adolescents: National health and nutrition examination survey (NHANES) 2003-2012. *The British Journal of Nutrition, 115*(2), 294. doi:10.1017/S0007114515004304

Nackers, L. M., & Appelhans, B. M. (2013). Food insecurity is linked to a food environment promoting obesity in households with children. *Journal of Nutrition Education and Behavior, 45*(6), 780.

Nalty, C. C., Sharkey, J. R., & Dean, W. R. (2013). Children's reporting of food insecurity in predominately food insecure households in Texas border colonias. *Nutrition Journal, 12*(1), 15. doi:10.1186/1475-2891-12-15

Nutrition Coordination Center, University of Minnesota. (2017). *Guide to creating variables needed to calculate scores for each component of the health eating index-2015.* Unpublished manuscript.

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. *Jama, 311*(8), 806-814. doi:10.1001/jama.2014.732 [doi]

Ogden, C. L., Carroll, M. D., Lawman, H. G., Fryar, C. D., Kruszon-Moran, D., Kit, B. K., & Flegal, K. M. (2016). Trends in obesity prevalence among children and adolescents in the United States, 1988-1994 through 2013-2014. *Jama, 315*(21), 2292-2299. doi:10.1001/jama.2016.6361

Papas, M. A., Trabulsi, J. C., Dahl, A., & Dominick, G. (2016). Food insecurity increases the odds of obesity among young Hispanic children. *Journal of Immigrant and Minority Health, 18*(5), 1046-1052. doi:10.1007/s10903-015-0275-0

Patrick, H., & Nicklas, T. A. (2005). A review of family and social determinants of children's eating patterns and diet quality. *Journal of the American College of Nutrition, 24*(2), 83-92. doi:24/2/83 [pii]

Patrick, H., Nicklas, T. A., Hughes, S. O., & Morales, M. (2005). The benefits of authoritative feeding style: Caregiver feeding styles and children's food consumption patterns. *Appetite, 44*(2), 243-249. doi:10.1016/j.appet.2002.07.001

Power, T. G., O'Connor, T. M., Orlet Fisher, J., & Hughes, S. O. (2015). Obesity risk in children: The role of acculturation in the feeding practices and styles of low-income Hispanic families. *Childhood Obesity (Print), 11*(6), 715-721. doi:10.1089/chi.2015.0036

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers: A Journal of the Psychonomic Society, Inc, 36*(4), 717.

Pulgaron, E. R., & Delamater, A. M. (2014). Obesity and type 2 diabetes in children: Epidemiology and treatment. Current Diabetes Reports, 14(8), 1-12. doi:10.1007/s11892-014-0508-y

Quandt, S. A., Trejo, G., Suerken, C. K., Pulgar, C. A., Ip, E. H., & Arcury, T. A. (2016). Diet quality among preschool-age children of Latino migrant and seasonal farmworkers in the united states. *Journal of Immigrant and Minority Health, 18*(3), 505-512. doi:10.1007/s10903-015-0304-z

Reilly, J., & Kelly, J. (2011). Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: Systematic review. *International Journal of Obesity, 35*(7), 891-898. doi:10.1038/ijo.2010.222

Rose, D., & Bodor, J. N. (2006). Household food insecurity and overweight status in young school children: Results from the early childhood longitudinal study. *Pediatrics, 117*(2), 464-473. doi:10.1542/peds.2005-0582

Rutten, L. F., Yaroch, A. L., Patrick, H., & Story, M. (2012). Obesity prevention and national food security: A food systems approach. *ISRN Public Health, 2012*, 1-10. doi:10.5402/2012/539764

Sebelius, K. (2011). 2011 poverty guidelines, federal register notice. Retrieved from https://aspe.hhs.gov/2011-poverty-guidelines-federal-register-notice

Selig, J. P., & Preacher, K. J. (2009). Mediation models for longitudinal data in developmental research. *Research in Human Development, 6*(2-3), 144-164.

Sharkey, J. R., Nalty, C., Johnson, C. M., & Dean, W. R. (2012). Children's very low food security is associated with increased dietary intakes in energy, fat, and added sugar among Mexican-origin children (6-11 y) in Texas border colonias. *BMC Pediatrics, 12*(1), 16-16. doi:10.1186/1471-2431-12-16

Skinner, A. C., Perrin, E. M., & Skelton, J. A. (2016). Prevalence of obesity and severe obesity in US children, 1999-2014. *Obesity (Silver Spring, Md.), 24*(5), 1116. doi:10.1002/oby.21497

Speirs, K. E., Fiese, B. H., & STRONG Kids Research Team. (2016). The relationship between food insecurity and BMI for preschool children. *Maternal and Child Health Journal, 20*(4), 925-933. doi:10.1007/s10995-015-1881-0 [doi]

Tovar, A., Hennessy, E., Pirie, A., Must, A., Gute, D. M., Hyatt, R. R., . . . Economos, C. D. (2012). Feeding styles and child weight status among recent immigrant mother-child dyads. The International Journal of Behavioral Nutrition and Physical Activity, 9(1), 62-62. doi:10.1186/1479-5868-9-62

Trapp, C. M., Burke, G., Gorin, A. A., Wiley, J. F., Hernandez, D., Crowell, R. E., . . . Cloutier, M. M. (2015). The relationship between dietary patterns, body mass index percentile, and household food security in young urban children. *Childhood Obesity, 11*(2), 148-155. doi:10.1089/chi.2014.0105

Troy, L. M., Miller, E. A., Olson, S., 1956, National Academies Press (U.S.), United States. Department of Agriculture, & Institute of Medicine (U.S.). (2011). *Hunger and obesity: Understanding a food insecurity paradigm: Workshop summary*. Washington, D.C: National Academies Press.

U.S. Department of Health and Human Services and U.S. Department of Agriculture. (2015). Dietary guidelines for Americans 2015-2020. Retrieved from https://health.gov/dietaryguidelines/2015/guidelines/

USDA. (2017). WIC and head start: Partners in promoting health and nutrition for young children and families. Retrieved from https://www.fns.usda.gov/wic/wic-and-head-start-partners-promoting-health-and-nutrition-young-children-and-families

Winicki, J., & Jemison, K. (2003). Food insecurity and hunger in the kindergarten classroom: Its effect on learning and growth. *Contemporary Economic Policy, 21*(2), 145-157. doi:10.1093/cep/byg001

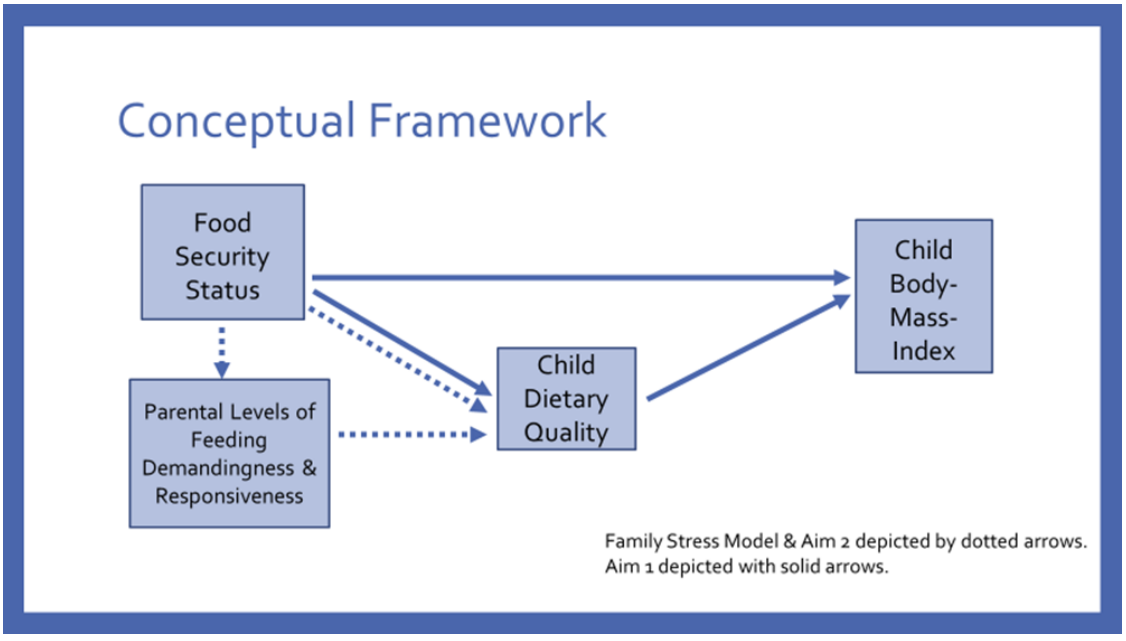

Figure 1. Conceptual Framework with Family Stress Model Embedded.

Table 1

Operationalization of Variables

Variable	Operationalization	Measurement & Scoring Method	Psychometrics
Household Food Security Status (FSS)	6-item Household Food Security Questionnaire Description of survey: 6-item, parent-report survey, dichotomous responses, time to complete= 5 minutes.	Continuous Raw food security score determined by tally of affirmative responses.	Correctly identified level of food security in 95.6% of all households with children; Face & content validity for Spanish version (Blumberg et al., 1999; Harrison et al., 2003)
Parenting Feeding Style Domains: Demandingness Responsiveness	Demandingness score and Responsiveness score from the Caregiver's Feeding Styles Questionnaire Description of survey: 19 items, parent-report survey, 5-point Likert-scale responses, time to complete= 15 minutes	Continuous Demandingness score= mean of all 19 items Responsiveness score= mean of the seven child-centered ÷ the mean of all 19 items (Hoerr et al., 2009; Hughes et al., 2005)	Demandingness scale test-retest r=.85 Responsiveness Scale test-retest: r=.82 Internal consistency Cronbach alpha=.85 Convergent validity with Child Feeding Questionnaire, $F(9,518) = 3.17$, $p<0.001$; Parenting Dimensions Inventory, $F(27,602) = 2.26$, $p<0.001$ (Hughes et al., 2005)

Table 1

Continued

Variable	Operationalization	Measurement & Scoring Method	Psychometrics
24-hour Dietary Recall	2 weekdays, 1 weekend day 24-hour recalls. Collected using 5-step multipass method and Nutritional Data Software Research (Time 1: version 2012, Time 2: version 2014) developed by the Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN).	Nominal	Based on systematic review, parent-reported three 24-hour multiple pass recalls that include weekdays and weekends and use is the most accurate method for estimating total energy intake in children ages 4 to 11 (Burrows, 2010)
Child Dietary Quality	Healthy Eating Index 2015 (HEI 2015) (Epidemiology and Genomics Research Program, 2017): Calculated based on data from three 24-hour dietary recall Description of index: Consists of 13 dietary subcomponent scores that are summed for an overall dietary score.	Continuous HEI-2015 scores are calculated per instructions provided on "Guide to Creating Variables Needed to Calculate Scores for Each Component of the Health Eating Index 2015." (Nutrition Coordination Center, University of Minnesota, 2017)	Construct validity: HEI-2010 scores were at or near the maximum levels for the exemplary menus. PCA consistent with 12 dietary components. Internal Consistency: Cronbach's $\alpha = 0.68$ (Epidemiology and Genomics Research Program, 2017; Guenther et al., 2014)

Table 1

Continued

Variable	Operationalization	Measurement & Scoring Method	Psychometrics
Child Body Mass	Body Mass Index z-score (BMI z-score) calculated per CDC reference standards: age & gender specific BMI (Kuczmarski et al., 2002)	Continuous	Construct validity for children ages 2-5: BMI-for-age= 78.3% sensitivity and 88.3% specificity in ability to overweight at 85th percentile (Mei et al., 2002)
Parental Acculturation	Bidimensional Acculturation Scale (Marin & Gamba, 1996) Description of survey: 24 items, parent-report survey, 4-point Likert-scale responses, time to complete= 15 minutes	Continuous Hispanic domain score= mean of 12 responses in Hispanic domain non-Hispanic domain score= mean of 12 responses in non-Hispanic domain	Internal consistency: Cronbach's α= .9 (Hispanic domain), .96 (non-Hispanic domain) Validity correlations with generation, age at arrival, residence in US, education, self-identification: .46 to.86 (non-Hispanic domain), -.28 to -.66 (Hispanic domain) (Marin & Gamba, 1996)

Table 2

Models tested in Aim 3

	Independent Variable	Dependent Variable	Mediating Variable	Moderating Variable
Model 1a	FSS_{T1}	$BMIz_{T2}$	HEI_{T1}	Gender
Model 1b	FSS_{T1}	$BMIz_{T2}$	HEI_{T1}	English $acculturation_{T1}$
Model 2a	FSS_{T1}	HEI_{T2}	PFD_{T1}	Gender
Model 2b	FSS_{T1}	HEI_{T2}	PFD_{T1}	English $acculturation_{T1}$
Model 3a	FSS_{T1}	HEI_{T2}	PFR_{T1}	Gender
Model 3b	FSS_{T1}	HEI_{T2}	PFR_{T1}	English $acculturation_{T1}$

Note. FSS= Food security status, BMIz= Body-mass-index z-score, HEI= Healthy Eating Index, PFD= Parenting feeding demandingness, PFR= Parenting feeding responsiveness, Numerical subscript indicates data collection time point.

Table 3

Sample Characteristics at Time 1 (N=187)

Characteristic	Levels	n (%) or mean (SD)
Food Security Status	High or marginal food security Low food security Very low food security Missing	104 (55.9%) 48 (25.8%) 34 (18.3%) 1 (0.5%)
Healthy Eating Index-2015	-	60.93 (9.53)
Body Mass Index Categories	Underweight (< 5th Percentile) Normal (<85th Percentile) Overweight (85-94th Percentile) Obese (≥ 85th Percentile)	2 (1%) 98 (52.4%) 39 (20.9%) 48 (25.7%)
Parenting Feeding Demandingness	-Potential Range 1-5	3.06 (0.58)
Parenting Feeding Responsiveness	-Potential Range (0.20-2.02)	1.23 (0.17)
Maternal Hispanic Acculturation	-Potential Range (1-4)	3.59 (0.55)
Maternal English Acculturation	-Potential Range (1-4)	2.28 (0.91)
Marital Status	Married Never married Divorced/Separated/Widowed Other* Missing	110 (58.8%) 27 (14.4%) 28 (15.0%) 20 (10.7%) 2 (1.1%)
Education Status	Some high school or less High school/GED Technical school/ Some college College graduate Missing	74 (39.5%) 46 (24.6%) 53 (28.3%) 13 (7.0%) 1 (0.5%)
Not employed	-	143 (76.5%)

Note. *Most common response to "other" marital status was 'union libre' which is living together without being legally married.

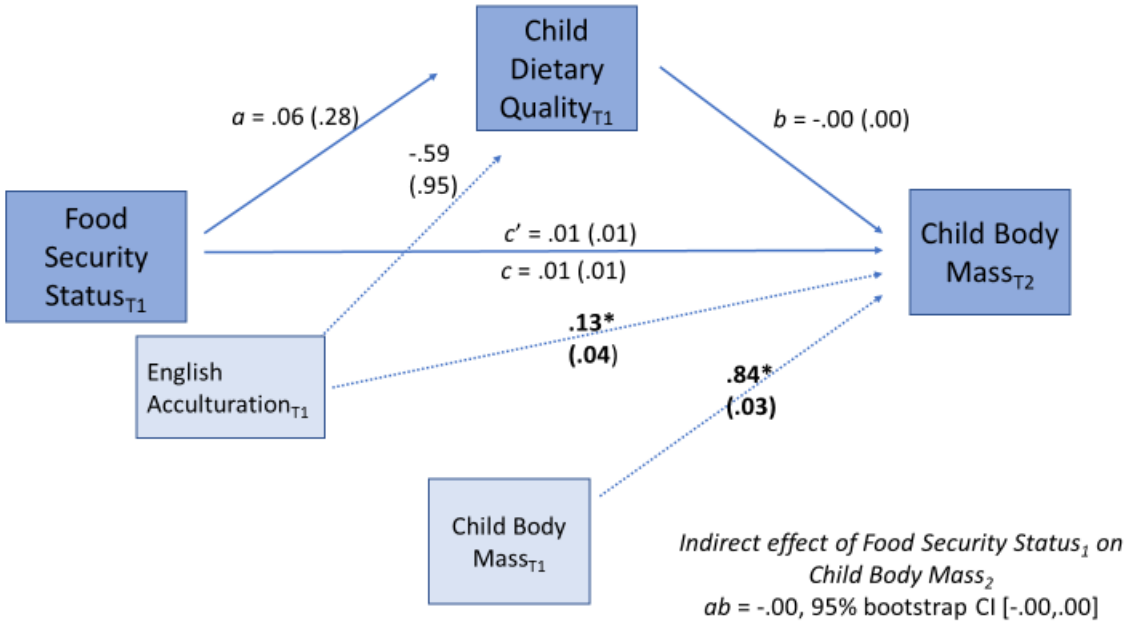

Figure 2. Aim 1 mediation model with co-variates. Subscript indicates time wave at which given measure was obtained. Numbers in bold with '*' indicates that 95% confidence interval that does not include zero. Paths are labeled with unstandardized OLS coefficients (standard error).

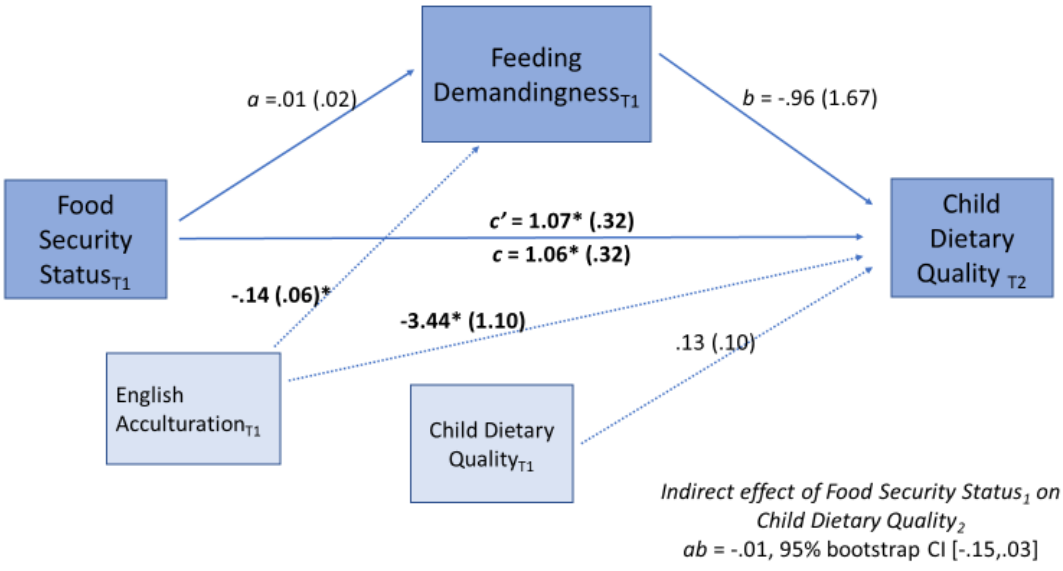

Figure 3. Aim 2 Parenting feeding demandingness mediation model with significant co-variates. Subscript indicates time wave at which given measure was obtained. Numbers in bold with '*' indicates that 95% confidence interval that does not include zero. Paths are labeled with unstandardized OLS coefficients (standard error).

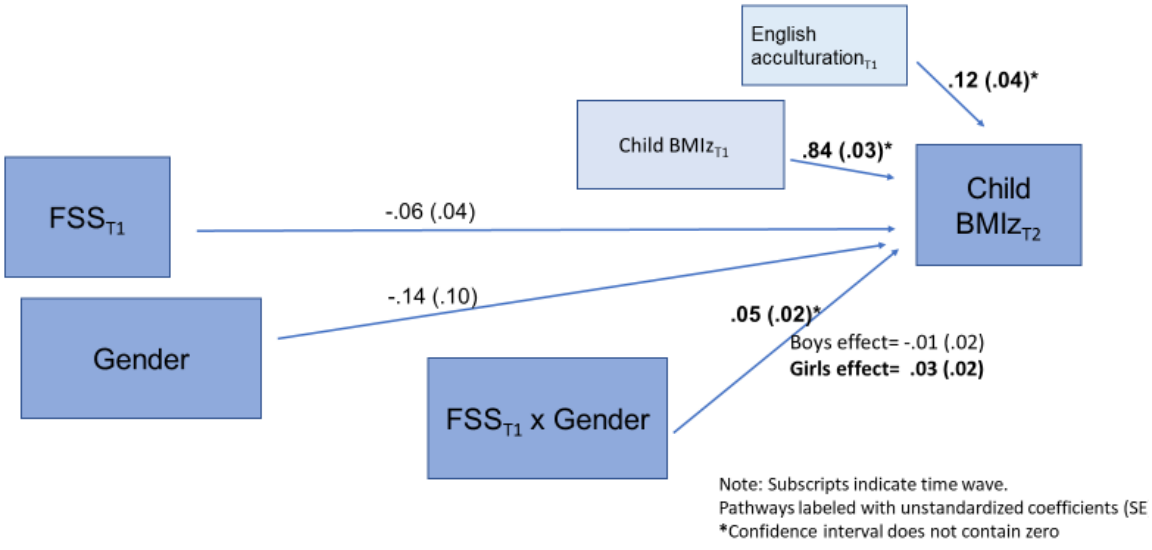

Figure 4. Conditional effects of gender on mediation model tested in Aim 1. Only unstandardized OLS coefficient for FSS1*Gender interaction term and conditional effects for boys and girls are labeled. Standard error is in parentheses. All other pathways and moderation were nonsignificant.

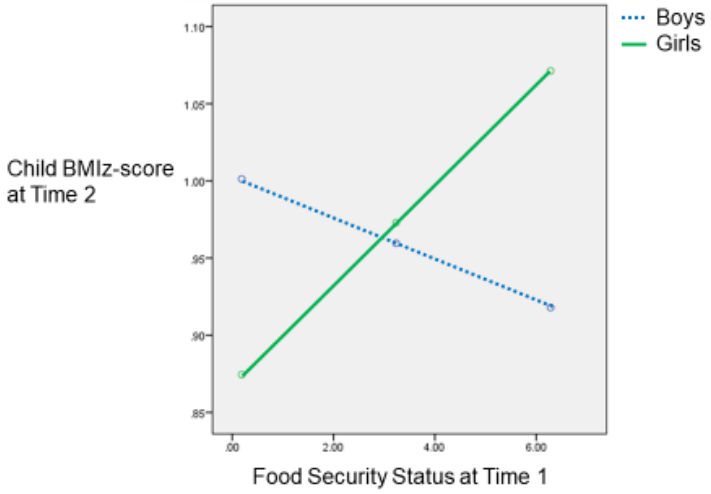

Figure 5. Interaction of Gender on the Direct Effect of FSS_1 on $cBMIz_2$

Appendix A

Human Protection Approval Letters

UTHealth
The University of Texas
Health Science Center at Houston

Committee for the Protection of Human Subjects
6410 Fannin Street, Suite 1100
Houston, Texas 77030

Dr. Nipa Kamdar
UT-H - SN - Nursing Systems

July 25, 2017

HSC-SN-17-0658 - *Bridging the Gap between Food Insecurity and Subsequent Child Weight Status: Mediating Effects of Dietary Quality and Feeding Styles*

The above named project is determined to qualify for exempt status according to 45 CFR 46.101(b)

CATEGORY #4 *: Research, involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified directly or through identifiers linked to the subjects.*

CHANGES: Should you choose to make any changes to the protocol that would involve the inclusion of human subjects or identified data from humans, please submit the change via iRIS to the Committee for the Protection of Human Subjects for review.

INFORMED CONSENT DETERMINATION:
Waiver of Consent Granted

INFORMED CONSENT: When Informed consent is required, it must be obtained by the PI or designee(s), using the format and procedures approved by the CPHS. The PI is responsible to instruct the designee in the methods approved by the CPHS for the consent process. The individual obtaining informed consent must also sign the consent document. Please note that only copies of the stamped approved informed consent form can be used when obtaining consent.

HEALTH INSURANCE PORTABILITY and ACCOUNTABILITY ACT (HIPAA):

Exempt from HIPAA-De-identified data set.

STUDY CLOSURES: Upon completion of your project, submission of a study closure report is required. The study closure report should be submitted once all data has been collected and analyzed.

Should you have any questions, please contact the Office of Research Support Committees at 713-500-7943.

UTHealth
The University of Texas
Health Science Center at Houston

Committee for the Protection of Human Subjects
6410 Fannin Street, Suite 1100
Houston, Texas 77030

NOTICE OF APPROVAL TO IMPLEMENT REQUESTED CHANGES

September 29, 2017

HSC-SN-17-0658 - Bridging the Gap between Food Insecurity and Subsequent Child Weight Status: Mediating Effects of Dietary Quality and Feeding Styles
PI: Dr. Nipa Kamdar

Reference Number: 158168

PROVISIONS; Unless otherwise noted, this approval relates to the research to be conducted under the above referenced title and/or to any associated materials considered at this meeting, e.g. study documents, informed consent, etc.

APPROVED: By Expedited Review and Approval

CHANGE APPROVED: Addition of Aim 3 - use of gender and acculturation

REVIEW DATE: September 29, 2017

APPROVAL DATE: September 29, 2017

CHAIRPERSON: L. Maximilian Buja, MD

L. Maximilian Buja

Upon receipt of this letter, and subject to any provisions noted above, you may now implement the changes approved.

CHANGES: The principal investigator (PI) must receive approval from the CPHS before initiating any changes, including those required by the sponsor, which would affect human subjects, e.g. changes in methods or procedures, numbers or kinds of human subjects, or revisions to the informed consent document or procedures. The addition of co-investigators must also receive approval from the CPHS. ALL PROTOCOL REVISIONS MUST BE SUBMITTED TO THE SPONSOR OF THE RESEARCH.

UNANTICIPATED RISK OR HARM, OR ADVERSE DRUG REACTIONS: The PI will immediately inform the CPHS of any unanticipated problems involving risks to subjects or others, of any serious harm to subjects, and of any adverse drug reactions.

RECORDS: The PI will maintain adequate records, including signed consent documents if required, in a manner that ensures subject confidentiality.

Appendix B

Study Procedures

Procedures for Data Access

Note: To access the share drive, you will need to use a computer connected to Baylor College of Medicine's intranet.

1. To access Family Interactions Nutrition Study (FINS) data, need permission from Dr. Sheryl Hughes, PI of FINS.

2. Once have permission for use of FINS data, FINS share drive that contains the SPSS file entitled *FINS Combined Dataset T1-3*.
   This dataset contains raw data for responses to Food Security Status Survey, Caregiver Feeding Style Questionnaire, Demographics, and Bi-Dimensional Acculturation Scale. **All data is deidentified.**

3. Access SPSS file entitled *FINS BMI 3 Timepoints*.
   This dataset contains the BMI z-scores for child participants.

4. For Time 1 HEI score calculation access Excel spreadsheets entitled: *FINS T1 Food Group Master Value* and *Master Base Nutritional Data by Food*

5. For Time 2 HEI score calculation access Excel spreadsheets entitled: *FINS Serving Count Totals File* and *FINS Intake Properties Totals File*.

Procedures for Data Management

Note:

- *FINS dataset has over a thousand variables. This study only needs a fraction of those. To simplify scoring of the variables of study interest and data analysis, it is advised to create a smaller file that only has the raw data that is needed for this study.*
- *Excel software is used to calculate the scores because it is easier to write logic statements that are needed to calculate values. However, the same process may be achievable on SPSS.*
- *<u>IMPORTANT</u>: When importing variables, ensure that it is being matched by Participant ID.*

1. Because all data is deidentified, you can create a new folder for the study on your own drive. Save the required data files for this study within this folder. DO NOT MAKE CHANGES TO ORGINAL FILES IN FINS SHARE DRIVE.

2. Create *Variables of Interest* Excel file: Using *FINS Combined Dataset T1-3,* create a new Excel spreadsheet that contains raw data of interest:
   - Participant ID,
   - Time 1 (T1) & Time 2 (T2) demographic responses for questions 1, 2, 6, 18, 19, &20,
   - T1 & T2 acculturation responses,
   - T1 & T2 feeding style responses,
   - T1 &T2 food security survey responses

3. Create *T1 HEI* Excel file: This file will consist of 3 sheets.
   - Sheet 1contains data from *FINS T1 Food Group Master Value.*
   - *Sheet 2 contains data from Master Base Nutritional Data by Food.*
   - Sheet 3 is where your calculations for each step of the process will be saved by Participant ID.

4. Create *T2 HEI* Excel file: This file will consist of 3 sheets.
   - Sheet 1 contains data from *FINS Serving Count Totals File.*
   - Sheet 2 contains data from *FINS Intake Properties Totals File*.
   - Sheet 3 is where your calculations for each step of the process will be saved by Participant ID.

5. As each variable is calculated, import the variable to the *Variables of Interest* excel file. *Be sure that data is being imported by matching Participant IDs. Do not simply copy and paste the variables into a new column.*

Procedures to Calculate Food Security Status

1. Open *Variables of Interest.* Create a new sheet for calculating Food Security Status at T1 and T2.

2. Use the instructions found in *Coding Responses and Assessing Households' Food Security Status* (located in Section E) to calculate food security status at T1 and T2.

3. Score the responses either 0, 1, or 2 per instructions.

4. Tally the scores per participant.

5. Reassign the numerical score for food security with the corresponding interval scale score:

For statistical procedures that require an interval-level measure, the following scale scores, based on the Rasch measurement model may be used:

Number of affirmatives	Scale score
0	NA
1	2.86
2	4.19
3	5.27
4	6.30
5	7.54
6 (evaluated at 5.5)	8.48

(Table from *U.S. Household Food Security Module: Six-Item Short Form Economic Research Service* (USDA, 2012). The full document is located in Section E.)

6. Quality checks: select 10 participants with scores ranging between 1 and 6. Hand calculate the food security score and compare with the Excel calculated score.

Procedures to Calculate Parental Feeding Demandingness

1. Open *Variables of Interest*.

2. Demandingness is scored per instructions provided by Hughes (2005). To calculate Demandingness, average the responses for all 19 items on the Caregiver Feeding Style Questionnaire.

3. Quality checks: select 10 participants. Hand calculate and compare with the Excel calculated score.

Procedures to Calculate Parental Feeding Responsiveness

1. Open *Variables of Interest*.

2. Responsiveness is scored per instructions provided by Hughes (2005). To calculate Responsiveness, average the responses for Caregiver Feeding Style questions 3, 4, 6, 8,9, 15, and 17. Then divide this number by the Demandingness score.

3. Quality checks: select 10 participants. Hand calculate and compare with the Excel calculated score.

Procedures to calculate Hispanic and English Acculturation

1. Open *Variables of Interest.* Create a new sheet for calculating Hispanic and English acculturation at T1 and T2.

2. Because zero is not an option, all missing data was given a value of zero if the participant failed to answer one of the 24 acculturation questions. If more than one question was unanswered, then no score was calculated for the participant.

3. Per Marin & Gamba (1996) (Marin & Gamba, 1996), Hispanic acculturation is calculated by averaging the 12 questions that pertain to the Hispanic domain. In this dataset these questions are 4, 5, 6, 10, 11, 12, 19, 20, 21, 22, 23, and 24.

4. The English acculturation score is calculated by averaging the responses to questions 1, 2, 3, 7, 8, 9, 13, 14, 15, 16, 17, and 18.

5. Quality checks: select 10 participants. Hand calculate English and Hispanic acculturation. Compare with the Excel calculated score.

Procedures to calculate Health Eating Index (HEI)-2015

1. To calculate HEI at Time 1, use Excel file entitled *T1 HEI*.

2. To calculate HEI at Time 2, use Excel file entitled *T2 HEI*.

3. Open the *Master Base Nutritional Data* sheet in T1 HEI. Review the column for energy. If it has value "#null" value AND the correlating food item column indicates "taco" or "sandwich", replace "#null" with 0 value. (In the Nutrition Data Systems for Research (NDSR) program, if a person reports eating a food item such as taco or sandwich, the food item is broken into its components. Therefore, taco and sandwich have no nutritional value, but its components do. Time 2 data does not have this issue.)

4. The HEI-2015 scores for parent and child will be calculated using three 24-dietary recalls that were collected in the parent study using NDSR software. Average each participant's food group or nutrient intake across the three recalls which is the same method used by Guenther (2014).

5. Perform quality check by randomly selected 4 participants. Double check to make sure that the averages are being correctly calculated.

6. These averages will be then used to calculate the variables needed to obtain the13 HEI-2015 component scores. The variables will be calculated per the Nutrition Data Systems for Research (NDSR) instructions located in Section E.

7. Because the data in Time 1 was collected using NDSR version 2012, the Whole Grains Component and Refined Grains Component will be computed using instructions as provided in the *Guide to Creating Variables Needed to Calculate Scores for Each Component of the Healthy Eating Index-2010* (NDSR, 2014). Instructions are located in Section E.

8. Quality check by reviewing *each* logic statement written to calculate the components for accuracy.

9. Finally, each of the 13 HEI components will be assigned a proportional score based on scoring standards provided on Table 1 of the *Guide to Creating Variables Needed to Calculate Scores for Each Component of the Healthy Eating Index-2015* (Nutrition Coordination Center, University of Minnesota, 2017). (See Section E for the guide.)

10. These 13 component scores will then be summed for each participant's HEI score.

References

Guenther, P. M., Kirkpatrick, S. I., Reedy, J., Krebs-Smith, S. M., Buckman, D. W., Dodd, K. W., . . . Carroll, R. J. (2014). The healthy eating index-2010 is a valid and reliable measure of diet quality according to the 2010 dietary guidelines for Americans. *The Journal of Nutrition, 144*(3), 399.

Hughes, S. O., Power, T. G., Orlet Fisher, J., Mueller, S., & Nicklas, T. A. (2005). Revisiting a neglected construct: Parenting styles in a child-feeding context. *Appetite, 44*(1), 83-92. doi:10.1016/j.appet.2004.08.007

Marin, G., & Gamba, R. J. (1996). A new measurement of acculturation for Hispanics: The bidimensional acculturation scale for Hispanics (BAS). *Hispanic Journal of Behavioral Sciences, 18*(3), 297-316. doi:10.1177/07399863960183002

NDSR. (2014). Guide to creating variables needed to calculate scores for each component of the healthy eating index-2010. Retrieved from https://drive.google.com/file/d/0B4snm2Q3-ffQQTVHUWE1NGNxUnc/view

Nutrition Coordination Center, University of Minnesota. (2017). *Guide to creating variables needed to calculate scores for each component of the health eating index-2015.* Unpublished manuscript.

USDA. (2012). U.S. household food security survey module: Six-item short form economic research service. Retrieved from https://www.ers.usda.gov/media/8282/short2012.pdf

Appendix C

Instruments

DEMOGRAPHIC SURVEY

Please fill in your answers in the space provided.

Today's date: _____

1. Thinking about the place (house, apartment, or other) where the Head Start child lives, how many people live in this place 50% of the time or more? Include yourself and the child in this number. ☐

   a. Who are the people that live with the child? (check all that apply)

      ☐ 1 Mother

      ☐ 2 Father

      ☐ 3 Sibling(s)

      ☐ 4 Grandparent(s)

      ☐ 5 Domestic Partner

      ☐ 6 Other(s), please specify: _____

2. How many children under the age of 18 years currently live with you 50% of the time or more? ☐

3. How many children do you now have enrolled in Head Start? ☐

4. How many children have you had enrolled in Head Start in the past, not counting those who are currently enrolled? ☐

The next questions are about the <u>child who is in Head Start.</u>

5. What is the child's date of birth? _____ / _____ / _____
Month *Day* *Year*

6. What is the child's sex? ☐ 1 Male ☐ 2 Female

7. Was this child born in the United States?

☐ 1 Yes **If yes, go on to Question 8**

☐ 2 No

If no, please specify his or her country of birth:
_____

If no, how long has he or she lived in the United States?
_____ years

If no, has he or she made one or more trips to his or her country of birth that lasted 2 months or longer?

☐ 1 Yes

☐ 2 No

8. What is the child's ethnicity? ("X" one answer)

☐ 1 Hispanic or Latino ☐ 2 Not Hispanic or Latino

9. To which race do you consider the child to belong?

☐ 1 American Indian or Alaska Native

☐ 2 Asian

☐ 3 Black or African-American

☐ 4 Native Hawaiian or Pacific Islander

☐ 5 White

☐ 6 Other (please specify): _____

The following questions are about you.

10. What is your date of birth? _____ / _____ / _____
Month *Day* *Year*

11. What is your sex?

☐ 1 Male ☐ 2 Female

12. What is your relationship to the child?

☐ 1 Mother

☐ 2 Father

☐ 3 Grandmother

☐ 4 Other (please specify): _____

13. What is your current height? ☐ Feet ☐ Inches

14. What is your current weight? ☐ Pounds

15. Were <u>you</u> born in the United States?

☐ 1 Yes

If yes, go on to Question 16

☐ 2 No

If no, please specify your country of birth: _____
_____

If no, how long have you lived in the United States?
_____ years

If no, have you made one or more trips to your country of birth that lasted 2 months or longer

☐ 1 Yes ☐ 2 No

16. What is your ethnicity? ("X" one answer)

☐ 1 Hispanic or Latino ☐ 2 Not Hispanic or Latino

17. What race do you consider yourself to belong?

☐ 1 American Indian or Alaska Native

☐ 2 Asian

☐ 3 Black or African-American

☐ 4 Native Hawaiian or Pacific Islander

☐ 5 White

☐ 6 Other (please specify): _____

18. Are you <u>now</u> married, divorced, widowed, separated, or have you never been married? ("X" one answer)

☐ 1 Married ☐ 4 Separated

☐ 2 Divorced ☐ 5 Never married

☐ 3 Widowed ☐ 6 Other (please specify): _____

19. Are you currently employed? ("X" one answer)

☐ 1 Yes ☐ 2 No

If yes, how many <u>hours per week</u> do you usually work? ☐
hours per week

20. What is the highest level of education you have completed? ("X" only one answer)

☐ 1 6th grade or less School

☐ 2 8th grade or less

☐ 3 Attended some High School

☐ 4 High School Graduate or GED

☐ 5 Completed Technical

☐ 6 Some College

☐ 7 College Graduate

☐ 8 Post Graduate Study

21. Do you currently live 50% of the time or more with a spouse or other partner who is employed? ("X" one answer)

☐ 1 Yes ☐ 2 No

If yes, how many hours per week do they usually work? ☐
hours per week

22. How many computers do you have in your home? ☐

23. Do you have internet access in your home? ☐ 1 Yes ☐ 2 No

Encuesta Demográfica

Por favor escriba su respuesta en el espacio dado.

Fecha de hoy: _____

1. Pensando en el hogar (casa, apartamento, u otro lugar) en donde vive el niño quien asiste en Head Start, ¿Cuántas personas viven en este hogar 50% del tiempo o más? Incluirse a sí mismo y al niño quien asiste en Head Start en esta cuenta.

.

a. ¿Quiénes son las personas que viven con el niño? (elija todos lo que corresponden)

☐ 1 Madre

☐ 2 Padre

☐ 3 Hermano(s)

☐ 4 Abuelo(s)

☐ 5 Pareja

☐ 6Otro(s), por favor especifique:
_____

2. .¿Cuántos niños menores de 18 años viven actualmente con Ud. 50% del tiempo o más?

.

3. ¿Cuántos niños tiene Ud. ahora matriculados en Head Start?

.

4. ¿Cuántos niños ha tenido Ud. matriculados en Head Start en el pasado, sin incluir a los que están matriculados actualmente?

.

Las próximas preguntas son acerca del <u>niño quien asiste en Head Start</u>.

5. ¿Cuál es la fecha de nacimiento del niño? _____ / _____ / _____
Día *Mes* *Año*

6. ¿Cuál es el sexo del niño? ☐ 1 Varón ☐ 2 Hembra

7. ¿Nació el niño en los Estados Unidos?

☐ 1 Sí -- **salteé a la pregunta #8**

☐ 2 No

Si su niño **no nació en los Estados Unidos,** por favor especifique el país de nacimiento de el/ella:

_____

Si su niño **no nació en los Estados Unidos**, ¿Cuánto hace que su niño vive en los Estado Unidos? _____ años

Si su niño **no nació en los Estados Unidos**, ¿Ha viajado el o ella a su país de origen por un tiempo de 2 meses o más?

☐ 1 Sí ☐ 2 No

8. ¿A qué grupo étnico pertenece el niño? (Elija solo uno)

☐ 1 Hispano o Latino ☐ 2 No Hispano o Latino

9. ¿A qué raza considera Ud. que pertenece el niño?

☐ 1 Americano Indio, Nativo(a) de Alaska

☐ 2 Asiático

☐ 3 Negro o Africano Americano

☐ 4 Nativo Hawaiano o Isleño Pacifico

☐ 5 Blanco

☐ 6 Otro (por favor especifique): _____

Las próximas preguntas son acerca de Ud.

10. ¿Cuál es su fecha de nacimiento? _____ / _____ / _____
Día *Mes* *Año*

11. ¿Cuál es su sexo? ☐ 1 Varón ☐ 2 Hembra

12. ¿Cuál es su relación a el niño?

☐ 1 Madre

☐ 2 Padre

☐ 3 Abuela

☐ 4 Otro (por favor especifique): _____

13. ¿Cuál es su altura actual? ____ pies _____ pulgadas o, _____ centímetros

14. ¿Cuál es su peso actual? _____ libras o, _____ kilogramos

15. ¿Nació Ud. en los Estados Unidos?

☐ 1 Sí -- **salteé a la pregunta #16**

☐ 2 No

Si contesto no, por favor especifique su país de nacimiento:

_____

Si contesto no, ¿Cuánto tiempo ha vivido en los Estados Unidos?

_____

Si contesto no, ¿Ha viajado a su país de origen por un tiempo de 2 meses o más?

1 Sí ☐ ☐ 2 No

16. ¿A qué grupo étnico pertenece Ud.? (Elija solo uno)

☐ 1 Hispano o Latino ☐ 2 No Hispano o Latino

17. ¿A qué raza considera Ud. que pertenece?

☐ 1 Americano Indio, o nativo(a) de Alaska

☐ 2 Asiático

☐ 3 Negro o Africano Americano

☐ 4 Nativo Hawaiano o Isleño Pacifico

☐ 5 Blanco

☐ 6 Otro (por favor especifique): _____

18. ¿Está ahora casada, divorciada, viuda, separada, o nunca casada? (Elija solo uno)

☐ 1 Casada ☐ 4 Separada

☐ 2 Divorciada ☐ 5 Nunca casada

☐ 3 Viuda ☐ 6 Otro (por favor especifique):

_____

19. ¿Está empleada actualmente? (Elija solo uno)

☐ 1 Sí ☐ 2 No

Si contesto sí, ¿Cuántas horas por semana trabaja usualmente?

☐ horas por semana

20. ¿Cuál es el nivel más alto de educación que Ud. ha completado? (Elija solo uno)

☐ 1 6to grado o menos

☐ 2 8vo grado o menos

☐ 3 Asistió a una parte de la escuela superior

☐ 4 Graduada de escuela superior ó el GED

☐ 5 Escuela Técnica

☐ 6 Asistió a Colegio/Universitario

☐ 7 Graduada de Colegio/Universitario

☐ 8 Estudios de postgrado

21. ¿Actualmente vive 50% del tiempo o más con un esposo o pareja quien está empleado? (Elija solo uno)

☐ 1 Sí ☐ 2 No

Si contesto sí, ¿Cuántas horas trabaja su esposo/pareja usualmente por semana? ☐ horas por semana

22. ¿Cuántas computadoras tiene Ud. en su hogar? ☐

23. ¿Tiene acceso al internet en su hogar? 1 Sí ☐ 2 No ☐

6-item Household Food Security Survey (English)

Please answer whether the statements below were often true, sometimes true, or never true for you and the other members of your household in the last 12 months.

1. The food we bought just didn't last, and we didn't have money to get more. In the last 12 months, this was:

   [ ] Often true [ ] Sometimes true [ ] Never true

2. We couldn't afford to eat balanced meals. In the last 12 months, this was:

   [ ] Often true [ ] Sometimes true [ ] Never true

---

3. In the last 12 months, did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food?

   [ ] Yes, almost every month
   [ ] Yes, some months but not every month
   [ ] Yes, only 1 or 2 months
   [ ] No

4. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?

   [ ] Yes [ ] No

5. In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?

   [ ] Yes [ ] No

6-item Household Food Security Survey (Spanish)

Por favor indique si las siguientes situaciónes fueron ciertas frecuentemente, a veces, o nunca para Usted y los otros miembros de su casa en los últimos 12 meses.

1. "La comida que compramos no duró mucho y no había dinero para comprar más." En los últimos 12 meses, esto fue cierto...

   ☐ Frecuentemente ☐ A veces ☐ Nunca

2. "No podíamos permitirnos el lujo de comer una comida balanceada (nutritiva)." En los últimos 12 meses, esto fue cierto...

   ☐ Frecuentemente ☐ A veces ☐ Nunca

---

3. En los últimos 12 meses, ¿Usted u otro adulto de su familia comió menos o se salteó comidas porque no había suficiente dinero para comprar comida?

   ☐ Sí, casi cada mes
   ☐ Sí, algunos meses, pero no todos
   ☐ Sí, solo en 1 o 2 meses
   ☐ No

4. En los últimos 12 meses, ¿alguna vez comió menos de lo que pensaba que debería comer porque no había suficiente dinero para la comida?

   ☐ Sí ☐ No

5. En los últimos 12 meses, ¿alguna vez tuvo hambre pero no comió porque no habia suficiente dinero para la comida?

   ☐ Sí ☐ No

Caregiver's Feeding Styles Questionnaire (English)

These questions deal with YOUR interactions with your preschool child during the dinner meal. Circle the best answer that describes how often these things happen. If you are not certain, make your best guess.

	How often during the dinner meal do YOU....	Never	Rarely	Some times	Most of the time	Always
1.	Physically struggle with the child to get him or her to eat (for example, physically putting the child in the chair so he or she will eat).	1	2	3	4	5
2.	Promise the child something other than food if he or she eats (for example, "If you eat your beans, we can play ball after dinner").	1	2	3	4	5
3.	Encourage the child to eat by arranging the food to make it more interesting (for example, making smiley faces on the pancakes).	1	2	3	4	5
4.	Ask the child questions about the food during dinner.	1	2	3	4	5
5.	Tell the child to eat at least a little bit of food on his or her plate.	1	2	3	4	5
6.	Reason with the child to get him or her to eat (for example, "Milk is good for your health because it will make you strong").	1	2	3	4	5
7.	Say something to show your disapproval of the child for not eating dinner.	1	2	3	4	5
8.	Allow the child to choose the foods he or she wants to eat for dinner from foods already prepared.	1	2	3	4	5
9.	Compliment the child for eating food (for example, "What a good boy! You're eating your beans").	1	2	3	4	5
10.	Suggest to the child that he or she eats dinner, for example by saying, "Your dinner is getting cold".	1	2	3	4	5
11.	Say to the child "Hurry up and eat your food".	1	2	3	4	5
12.	Warn the child that you will take away something **other than food** if he or she doesn't eat (for example, "If you don't finish your meat, there will be no play time after dinner").	1	2	3	4	5

	How often during the dinner meal do YOU....	Never	Rarely	Some times	Most of the time	Always
13.	Tell the child to eat something on the plate (for example, "Eat your beans").	1	2	3	4	5
14.	Warn the child that you will take a food away if the child doesn't eat (for example, "If you don't finish your vegetables, you won't get fruit").	1	2	3	4	5
15.	Say something positive about the food the child is eating during dinner.	1	2	3	4	5
16.	Spoon-feed the child to get him or her to eat dinner.	1	2	3	4	5
17.	Help the child to eat dinner (for example, cutting the food into smaller pieces).	1	2	3	4	5
18.	Encourage the child to eat something by using food as a reward (for example, "If you finish your vegetables, you will get some fruit").	1	2	3	4	5
19.	Beg the child to eat dinner.	1	2	3	4	5

Cuestionario Sobre los Modos de Alimentar a los Niños

Estas preguntas se tratan de sus interacciones con su niño pre-escolar durante la cena. Circule la respuesta que mejor describe cuan a menudo estas cosas ocurren. Si no esta segura, escoja su mejor alternativa.

Durante la cena, cuan a menudo…	***Nunca***	***Rara vez***	***Algunas veces***	***Seguido***	***Siempre***
1. Lucha físicamente con el niño(a) para que coma. (Por ejemplo, pone al niño físicamente en la silla.)	1	2	3	4	5
2. Le promete al niño(a) algo que no sean alimentos si él o ella come. (Por ejemplo, "si te comes los frijoles, podemos jugar pelota después la cena.")	1	2	3	4	5
3. Anima al niño(a) a comer arreglando los alimentos para que luzcan más interesantes. (Por ejemplo, adorna los panqueques con caras sonrientes.)	1	2	3	4	5
4. Le hace preguntas al niño acerca de la comida durante la cena.	1	2	3	4	5
5. Le dice al niño(a) que coma por lo menos un poco de la comida servida en su plato.	1	2	3	4	5
6. Razona con el niño(a) para que coma. (Por ejemplo, "La leche es buena para tu salud porque te ayudará a crecer más fuerte.")	1	2	3	4	5
7. Critica al niño(a) por no comerse la cena.	1	2	3	4	5
8. Permite que el niño(a) escoja los alimentos que desea comer para la cena de los alimentos que ya fueron preparados.	1	2	3	4	5
9. Felicita al niño(a) por comerse los alimentos. (Por ejemplo, "¡Que niño(a) más bueno(a)! Te estás comiendo tus frijoles.")	1	2	3	4	5
10. Le sugiere al niño(a) que se coma la cena. (Por ejemplo diciendo, "Tu cena se está enfriando").	1	2	3	4	5
11. Le dice al niño(a), "Apúrate y come tus alimentos."	1	2	3	4	5
12. Le advierte al niño(a) que le va a quitar algo que no sean alimentos si no come. (Por ejemplo, "Si no terminas la carne, no podrás jugar después de la cena.")	1	2	3	4	5

Durante la cena, cuan a menudo…	*Nunca*	*Rara vez*	*Algunas veces*	*Seguido*	*Siempre*
13. Le dice al niño(a) que coma algún alimento del plato (Por ejemplo, "Comete los frijoles.")	1	2	3	4	5
14. Le advierte al niño(a) que le va a quitar algún alimento si no come. (Por ejemplo, "Si no terminas los vegetales, no comerás fruta.")	1	2	3	4	5
15. Dice algo positivo acerca de la comida que el niño(a) está comiendo durante la cena.	1	2	3	4	5
16. Le da de comer al niño(a) con cuchara para que coma la cena.	1	2	3	4	5
17. Ayuda al niño(a) a comer la cena (por ejemplo, cortando los alimentos en pedazos más pequeños).	1	2	3	4	5
18. Anima al niño(a) a comer algo usando comida como recompensa. (Por ejemplo, "Si terminas los vegetales, te voy a dar frutas.")	1	2	3	4	5
19. Le ruega al niño(a) que coma la cena.	1	2	3	4	5

ACCULTURATION

*Please select the answer **that best applies to you**.*

	1 Almost never	2 Some-times	3 Often	4 Almost always
1. How often do you speak English?	□	□	□	□
2. How often do you speak in English with your friends?	□	□	□	□
3. How often do you think in English?	□	□	□	□
4. How often do you speak Spanish?	□	□	□	□
5. How often do you speak in Spanish with your friends?	□	□	□	□
6. How often do you think in Spanish?	□	□	□	□
7. How often do you watch television programs in English?	□	□	□	□
8. How often do you listen to radio programs in English?	□	□	□	□
9. How often do you listen to music in English?	□	□	□	□
10. How often do you watch television programs in Spanish?	□	□	□	□
11. How often do you listen to radio programs in Spanish?	□	□	□	□
12. How often do you listen to music in Spanish?	□	□	□	□

	1 Very poorly	2 Poorly	3 Well	4 Very well
1. How well do you speak English?	□	□	□	□
2. How well do you read in English?	□	□	□	□
3. How well do you understand television programs in English?	□	□	□	□
4. How well do you understand radio programs in English?	□	□	□	□
5. How well do you write in English?	□	□	□	□
6. How well do you understand music in English?	□	□	□	□
7. How well do you speak Spanish?	□	□	□	□
8. How well do you read in Spanish?	□	□	□	□
9. How well do you understand television programs in Spanish?	□	□	□	□
10. How well do you understand radio programs in Spanish?	□	□	□	□
11. How well do you write in Spanish?	□	□	□	□
12. How well do you understand music in Spanish?	□	□	□	□

ACULTURACION

*Por favor seleccione la respuesta que **mejor se aplica a usted**.*

	1 Casi nunca	2 Algunas veces	3 Frecuente-mente	4 Casi siempre
1. ¿Con qué frecuencia habla usted inglés?	☐	☐	☐	☐
2. ¿Con qué frecuencia habla usted ingles con sus amigos?	☐	☐	☐	☐
3. ¿Con qué frecuencia piensa usted en inglés?	☐	☐	☐	☐
4. ¿Con qué frecuencia habla usted español?	☐	☐	☐	☐
5. ¿Con qué frecuencia habla usted español con sus amigos?	☐	☐	☐	☐
6. ¿Con qué frecuencia piensa usted en español?	☐	☐	☐	☐
7. ¿Con qué frecuencia ve usted programas de televisión en inglés?	☐	☐	☐	☐
8. ¿Con qué frecuencia escucha usted programas de radio en inglés?	☐	☐	☐	☐
9. ¿Con qué frecuencia escucha usted música en inglés?	☐	☐	☐	☐
10. ¿Con qué frecuencia ve usted programas de televisión en español?	☐	☐	☐	☐
11. ¿Con qué frecuencia escucha usted programas de radio en español?	☐	☐	☐	☐
12. ¿Con qué frecuencia escucha usted música en español?	☐	☐	☐	☐

	1 Muy mal	2 No muy bien	3 Bien	4 Muy bien
1. ¿Qué tan bien habla usted inglés?	☐	☐	☐	☐
2. ¿Qué tan bien lee usted inglés?	☐	☐	☐	☐
3. ¿Qué tan bien entiende usted los programas de televisión en inglés?	☐	☐	☐	☐
4. ¿Qué tan bien entiende usted los programas de radio en inglés?	☐	☐	☐	☐
5. ¿Qué tan bien escribe usted en inglés?	☐	☐	☐	☐
6. ¿Qué tan bien entiende usted música en inglés?	☐	☐	☐	☐
7. ¿Qué tan bien habla usted español?	☐	☐	☐	☐
8. ¿Qué tan bien lee usted en español?	☐	☐	☐	☐
9. ¿Qué tan bien entiende usted los programas de televisión en español?	☐	☐	☐	☐
10. ¿Qué tan bien entiende usted los programas de radio en español?	☐	☐	☐	☐
11. ¿Qué tan bien escribe usted en español?	☐	☐	☐	☐
12. ¿Qué tan bien entiende usted música en español?	☐	☐	☐	☐

Appendix D

Coding/Scoring Instructions

U.S. Household Food Security Survey Module: Six-Item Short Form
Economic Research Service, USDA
September 2012

Revision Notes: The food security questions in the 6-item module are essentially unchanged from those in the original module first implemented in 1995 and described previously in this document.

September 2012:

- Added coding specification for "How many days" for 30-day version of AD1a.

July 2008:

- Wording of resource constraint in AD2 was corrected to, "…because there wasn't enough money for food" to be consistent with the intention of the September 2006 revision.

January 2008:

- Corrected user notes for coding AD1a.

September 2006:

- Minor changes were introduced to standardize wording of the resource constraint in most questions to read, "…because there wasn't enough money for food."
- Question numbers were changed to be consistent with those in the revised Household Food Security Survey Module.
- User notes following the questionnaire were revised to be consistent with current practice and with new labels for ranges of food security and food insecurity introduced by USDA in 2006.

Overview: The six-item short form of the survey module and the associated Six-Item Food Security Scale were developed by researchers at the National Center for Health Statistics.

Background: The six-item short form of the survey module and the associated Six-Item Food Security Scale were developed by researchers at the National Center for Health Statistics in collaboration with Abt Associates Inc. and documented in "The effectiveness of a short form of the household food security scale," by S.J. Blumberg, K. Bialostosky, W.L. Hamilton, and R.R. Briefel (published by the *American Journal of Public Health*, vol. 89, pp. 1231-34, 1999). ERS conducted additional assessment of classification sensitivity, specificity, and bias relative to the 18-item scale.

If respondent burden permits, use of the 18-item U.S. Household Food Security Survey Module or the 10-item U.S. Adult Food Security Survey Module is recommended. However, in surveys that cannot implement one of those measures, the six-item module may provide an acceptable substitute. It has been shown to identify food-insecure households and households with very low food security with reasonably high specificity and sensitivity and minimal bias compared with the 18-item measure. It does not, however, directly ask about children's food security, and does not measure the most severe range of adult food insecurity, in which children's food intake is likely to be reduced.

[Begin Six-Item Food Security Module]

Transition into Module :
These next questions are about the food eaten in your household in the last 12 months, since (current month) of last year and whether you were able to afford the food you need.

NOTE: If the placement of these items in the survey makes the transition/introductory sentence unnecessary, add the word "Now" to the beginning of question HH3: "Now I'm going to read you...."

FILL INSTRUCTIONS: Select the appropriate fill from parenthetical choices depending on the number of persons and number of adults in the household.

HH3. I'm going to read you several statements that people have made about their food situation. For these statements, please tell me whether the statement was often true, sometimes true, or never true for (you/your household) in the last 12 months—that is, since last (name of current month).

The first statement is, "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

[ ] Often true
[ ] Sometimes true
[ ] Never true
[ ] DK or Refused

HH4. "(I/we) couldn't afford to eat balanced meals." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

[ ] Often true
[ ] Sometimes true
[ ] Never true
[ ] DK or Refused

AD1. In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?

[ ] Yes
[ ] No (Skip AD1a)
[ ] DK (Skip AD1a)

AD1a. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

[ ] Almost every month
[ ] Some months but not every month
[ ] Only 1 or 2 months
[ ] DK

AD2. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?

[ ] Yes
[ ] No
[ ] DK

AD3. In the last 12 months, were you every hungry but didn't eat because there wasn't enough money for food?

[ ] Yes
[ ] No
[ ] DK

[End of Six-Item Food Security Module]

User Notes

(1) Coding Responses and Assessing Households' Food Security Status:

Responses of "often" or "sometimes" on questions HH3 and HH4, and "yes" on AD1, AD2, and AD3 are coded as affirmative (yes). Responses of "almost every month" and "some months but not every month" on AD1a are coded as affirmative (yes). The sum of affirmative responses to the six questions in the module is the household's raw score on the scale.

Food security status is assigned as follows:

- Raw score 0-1—High or marginal food security (raw score 1 may be considered marginal food security, but a large proportion of households that would be measured as having marginal food security using the household or adult scale will have raw score zero on the six-item scale)
- Raw score 2-4—Low food security
- Raw score 5-6—Very low food security

For some reporting purposes, the food security status of households with raw score 0-1 is described as food secure and the two categories "low food security" and "very low food security" in combination are referred to as food insecure.

For statistical procedures that require an interval-level measure, the following scale scores, based on the Rasch measurement model may be used:

Number of affirmatives	Scale score
0	NA
1	2.86
2	4.19
3	5.27
4	6.30
5	7.54
6 (evaluated at 5.5)	8.48

However, no interval-level score is defined for households that affirm no items. (They are food secure, but the extent to which their food security differs from households that affirm one item is not known.)

(2) Response Options: For interviewer-administered surveys, DK ("don't know") and "Refused" are blind responses—that is, they are not presented as response options but marked if volunteered. For self-administered surveys, "don't know" is presented as a response option.

(3) Screening: If it is important to minimize respondent burden, respondents may be screened after question AD1. Households that have responded "never" to HH3 and HH4 and "no" to AD1 may skip over the remaining questions and be assigned raw score zero. In pilot surveys intended to validate the module in a new cultural, linguistic, or survey context, however, screening should be avoided if possible and all questions should be administered to all respondents.

(4) 30-Day Reference Period: The questionnaire items may be modified to a 30-day reference period by changing the "last 12-month" references to "last 30 days." In this case, item AD1a must be changed to read as follows:

AD1a. [IF YES ABOVE, ASK] In the last 30 days, how many days did this happen?

_____ days

[ ] DK

Responses of 3 days or more are coded as "affirmative" responses.

(5) Self Administration: The six-item module has been used successfully in mail-out, take-home, and on-site self-administered surveys. For self-administration, question AD1a may be presented in one of two ways:

- Indent AD1a below AD1 and direct the respondent to AD1a with an arrow from the "Yes" response box of AD1. In a parenthetical following the "No" response box of AD1, instruct the respondent to skip question AD1 and go to question AD2.
- Present the following response options to question AD1 and omit question AD1a:
  - Yes, almost every month
  - Yes, some months but not every month
  - Yes, only 1 or 2 months
  - No

  In this case, either of the first two responses is scored as two affirmative responses, while "Yes, only 1 or 2 months" is scored as a single affirmative response.

The two approaches have been found to yield nearly equal results. The latter may be preferred because it usually reduces the proportion of respondents with missing information on how often this behavior occurred.

User Notes

(1) Coding Responses and Assessing Households' Food Security Status:

Responses of "often" or "sometimes" on questions HH3 and HH4, and "yes" on AD1, AD2, and AD3 are coded as affirmative (yes). Responses of "almost every month" and "some months but not every month" on AD1a are coded as affirmative (yes). The sum of affirmative responses to the six questions in the module is the household's raw score on the scale.

Food security status is assigned as follows:

 Raw score 0-1—High or marginal food security (raw score 1 may be considered marginal food security, but a large proportion of households that would be measured as having marginal food security using the household or adult scale will have raw score zero on the six-item scale)

 Raw score 2-4—Low food security

 Raw score 5-6—Very low food security

For some reporting purposes, the food security status of households with raw score 0-1 is described as food secure and the two categories "low food security" and "very low food security" in combination are referred to as food insecure.

For statistical procedures that require an interval-level measure, the following scale scores, based on the Rasch measurement model may be used: Number of affirmatives	Scale score
0	NA
1	2.86
2	4.19
3	5.27
4	6.30
5	7.54
6 (evaluated at 5.5)	8.48

Scoring for the Caregiver's Feeding Styles Questionnaire

We have used both typological and dimensional approaches to scoring the CFSQ. As argued by Laurence Steinberg with general parenting measures, both typological and dimensional approaches have merit and are based on different assumptions. In the *typological* approach (used for research purposes), the general pattern, organization, and climate of parental feeding is of primary interest. Using that typology with the CFSQ, two scores are derived demandingness and responsiveness. To score demandingness, a total mean score is calculated across all items; to score responsiveness, a ratio of child-centered items over the total score is calculated. However, with the *dimensional* approach, which can be used as a clinical tool, different aspects of parenting are assessed in order to test specific hypotheses regarding parenting practices and child outcomes. Continuous scores are derived to determine different aspects of feeding such as parent-centered/high control, parentcentered/ contingency management, and child-centered feeding practices. In the typological approach, parents are placed into 1 of 4 categories (authoritative, authoritarian, indulgent, and uninvolved). In the dimensional approach, the parent is given a score for each of 3 subscales (parent-centered/high control, parent-centered/contingency management, child-centered feeding practices).

Typological Approach (used primarily for research purposes):
1. Calculate the two scores of demandingness and responsiveness:
□□Demandingness: the mean of the 19 items
Mean (1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19)
□□Responsiveness: the mean of 7 items (child-centered) over the total mean
Mean (3+4+6+8+9+15+17)/
Mean(1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17+18+19)

2. Calculate median splits for the sample on two dimensions of demandingness and responsiveness. Categorize the sample participants into high and low categories on demandingness and responsiveness.

3. Participants can be categorized into feeding styles based on their scores on demandingness and responsiveness.
Authoritative Feeding Style - high demandingness/high responsiveness
Authoritarian Feeding Style - high demandingness/low responsiveness
Indulgent Feeding Style - low demandingness/high responsiveness
Uninvolved Feeding Style - low demandingness/low responsiveness

Dimensional Approach (used as a clinical tool):
Parent-centered/High Control – Mean (1+16+19)
Parent-centered/Contingency Management – Mean (2+12+18+14)
Child-centered – Mean (3+4+6+9+15+17)

Acculturation Subscales

Hispanic Domain

To score: Average the sum of the responses for the following 12 questions.

- Question:
  (4) How often do you speak Spanish?
  (5) How often do you speak in Spanish with your friends?
  (6) How often do you think in Spanish?
  (10) How often do you watch television programs in Spanish?
  (11) How often do you listen to radio programs in Spanish?
  (12) How often do you listen to music in Spanish?
  (19) How well do you speak Spanish?
  (20) How well do you read in Spanish?
  (21) How well do you understand television programs in Spanish?
  (22) How well do you understand radio programs in Spanish?
  (23) How well do you write in Spanish?
  (24) How well do you understand music in Spanish?

Non- Hispanic Domain

To score: Average the sum of the responses for the following 12 questions.

- Question:
  (1) How often do you speak in English?
  (2) How often do you speak in English with your friends?
  (3) How often do you think in English?
  (7) How often do you watch television programs in English?
  (8) How often do you listen to radio programs in English?
  (9) How often do you listen to music in English?
  (13) How well do you speak English?
  (14) How well do you read in English?
  (15) How well do you understand television programs in English?
  (16) How well do you understand radio programs in English?
  (17) How well do you write in English?
  (18) How well do you understand music in English?

UNIVERSITY OF MINNESOTA
NDSR
NUTRITION DATA SYSTEM FOR RESEARCH

Guide to Creating Variables Needed to Calculate Scores for Each Component of the Healthy Eating Index-2015 (HEI-2015)

Purpose

The purpose of this document is to describe how the variables needed to calculate scores for each component of the Healthy Eating Index-2015 (HEI-2015) may be calculated using data available in NDSR output files. The description provided herein is specific to recall, record, and record-assisted recall record types.

An important note: This document is not appropriate for use with data collected using NDSR 2012 or any earlier version of NDSR. Contact NDSR User Support for assistance if data were collected using these versions of NDSR.

Background on the Healthy Eating Index-2015

The Healthy Eating Index (HEI) is a tool developed by the United States Department of Agriculture and the National Cancer Institute to evaluate the extent to which diets are consistent with the Dietary Guidelines for Americans [1]. Possible index points range from 0-100, with a higher score indicating greater consistency of the diet with the Dietary Guidelines for Americans.

With each release of the new Dietary Guidelines for Americans the HEI is updated. The HEI-2015, which conforms to the 2015-2020 Dietary Guidelines for Americans [2], includes thirteen dietary components (nine adequacy and four moderation components) that reflect key aspects of diet quality. Table 1 lists the components, the optimal (maximum) number of points, and the criteria for assignment of the lowest and highest possible scores for each component. For more detail regarding scoring assignment see information available online on NCI website.

Calculating a HEI-2015 Score using Data Available in NDSR Output Files

In order to calculate a HEI-2015 score, one must have measures for each of the index components, and these measures must conform (be consistent with) the units of measure included in the index. For example, the total fruits component must be in the unit of 'total fruit servings in cup equivalents per 1,000 kcal'. The approach we suggest for creating each of the index components using data available in NDSR output files is described as follows:

Total Fruits Component

Before a score for the total fruits component of the HEI-2015 may be assigned, one must generate an estimate of 'total fruit servings in cup equivalents per 1,000 kcal'. The steps for creating this variable are as follows:

1) Calculate 'total fruits servings in cup equivalents' by totaling the following fruit subgroups in output file 09 and dividing this total by two: [FRU0100 + FRU0200 + FRU0300 + FRU0400 + FRU0500 + FRU0600 + FRU0700]/2*.

   *The total must be divided by two because fruits servings in the NCC Food Serving Count System are in ½ cup rather than 1 cup equivalents (see NDSR User Manual Appendix 10 for detailed information about the NCC Food Serving Count System).

2) Divide total daily energy intake (from output file 04) by 1,000, and then divide 'total fruits servings in cup equivalents' (variable created in step 1) by the result of this calculation.

Whole Fruits Component

Before a score for the whole fruits component of the HEI-2015 may be assigned, one must generate an estimate of 'whole fruits servings in cup equivalents per 1,000 kcal'. The steps for creating this variable are as follows:

1) Calculate 'whole fruits servings in cup equivalents' by totaling the following fruit subgroups in output file 09 and dividing this total by two: [FRU0300 + FRU0400 + FRU0500 + FRU0600 + FRU0700]/2*.

   *The total must be divided by two because fruit servings in the NCC Food Serving Count System are in ½ cup rather than cup equivalents (see NDSR User Manual Appendix 10 for detailed information about the NCC Food Serving Count System).

2) Divide total daily energy intake (from output file 04) by 1,000, and then divide 'whole fruits servings in cup equivalents' (variable created in step 1) by the result of this calculation.

Total Vegetables Component

Before a score for the total vegetables component of the HEI-2015 may be assigned, one must generate an estimate of 'total vegetables servings in cup equivalents per 1,000 kcal'. The steps for creating this variable are as follows:

1) Calculate 'total vegetables servings in cup equivalents' by totaling the following vegetable subgroups in output file 09 and dividing this total by two: [VEG0100 + VEG0200 + VEG0300 + VEG0400 + VEG0800 + VEG0450 + VEG0700 + VEG0600 + VEG0900 + VEG0500]/2*.

   *The total must be divided by two because vegetable servings in the NCC Food Serving Count System are in ½ cup rather than cup equivalents (see NDSR User Manual Appendix 10 for detailed information about the NCC Food Serving Count System).

2) Divide total daily energy intake (from output file 04) by 1,000, and then divide 'total vegetables servings in cup equivalents' (variable created in step 1) by the result of this calculation.

Greens and Beans Component

Before a score for the greens and beans component of the HEI-2015 may be assigned, one must generate an estimate of 'greens and beans in cup equivalents per 1,000 kcal'. The steps for creating this variable are as follows:

1) Calculate 'greens and beans in cup equivalents' by totaling the following vegetable subgroups in output file 09 and dividing this total by two: [VEG0100 + VEG0700]/2.

   The total must be divided by two because vegetable servings in the NCC Food Serving Count System are in ½ cup rather than cup equivalents (see NDSR User Manual Appendix 10 for detailed information about the NCC Food Serving Count System).

2) Divide total daily energy intake (from output file 04) by 1,000, and then divide 'greens and beans in cup equivalents' (variable created in step 1) by the result of this calculation.

Whole Grains Component

Before a score for the whole grains component of the HEI-2015 may be assigned, one must generate an estimate of 'whole grains servings in ounce equivalents per 1,000 kcal'. To generate this estimate:

1) Divide total daily energy intake (from output file 04) by 1,000, and then divide whole grains in ounce equivalents (from output file 04) by the result of this calculation.

Dairy Component

Before a score for the dairy component of the HEI-2015 may be assigned, one must generate an estimate of 'dairy servings in cup equivalents per 1,000 kcal'. The steps for creating this variable are as follows:

1) Calculate 'dairy servings in cup equivalents' by totaling the following dairy subgroups in output file 09: DMF0100 + DMR0100 + DML0100 + DMN0100 + DMF0200 + DMR0200 + DML0200 + DML0300 + DML0400 + DCF0100 + DCR0100 + DCL0100 + DCN0100 + DYF0100 + DYR0100 + DYL0100 + DYF0200 + DYR0200 + DYL0200 + DYN0100 + [DOT0100 / 3*] + DOT0300 + DOT0400 + DOT0500 + DOT0600.

   *DOT0100 (frozen dairy desserts) must be divided by 3 to convert to cup equivalents because 1.5 cups of a frozen dairy dessert is considered to be a cup equivalent in the dairy group, but a ½ cup of frozen dairy dessert counts as a servings in the NCC Food Serving Count System (see NDSR User Manual Appendix 10 for detailed information about the NCC Food Serving Count System).

2) Divide total daily energy intake (from output file 04) by 1,000, and then divide 'dairy servings in cup equivalents' (variable created in step 1) by the result of this calculation.

Total Protein Foods Component

Before a score for the total protein foods component of the HEI-2015 may be assigned, one must generate an estimate of 'total protein foods servings in ounce equivalents per 1,000 kcal'. The steps for creating this variable are as follows:

1) Calculate 'total protein foods servings in ounce equivalents' by totaling the following protein subgroups in output file 09: MRF0100 + MRL0100 + MRF0200 + MRL0200 + MRF0300 + MRL0300 + MRF0400 + MRL0400 + MCF0200 + MCL0200 + MRF0500 + MPF0100 + MPL0100 + MPF0200 + MFF0100 + MFL0100 + MFF0200 + MSL0100 + MSF0100 + MCF0100 + MCL0100 + MOF0100 + MOF0200 + MOF0300 + MOF0400 + MOF0500 + MOF0600 + MOF0700 + [VEG0700 x 2*]

   *VEG0700 must be multiplied by two because ¼ cup legumes and beans are considered an ounce equivalent of protein, but they are in ½ cup servings in the NCC Food Serving Count System (see NDSR User Manual Appendix 10 for detailed information about the NCC Food Serving Count System).

2) Divide total daily energy intake (from output file 04) by 1,000, and then divide 'total protein foods servings in ounce equivalents' (variable created in step 1) by the result of this calculation.

Seafood and Plant Proteins Component

Before a score for the seafood and plant proteins component of the HEI-2015 may be assigned, one must generate an estimate of 'seafood and plant proteins servings in ounce equivalents per 1,000 kcal'. The steps for creating this variable are as follows:

1) Calculate 'seafood and plant proteins servings in ounce equivalents' by totaling the following seafood, nuts, seeds, and soy subgroups in output file 09: MFF0100 + MFL0100 + MFF0200 + MSL0100 + MSF0100 + MOF0500 + MOF0600 + MOF0700 + [VEG0700 x 2*]

   *VEG0700 must be multiplied by two because ¼ cup legumes and beans are considered an ounce equivalent of protein, but they are in ½ cup servings in the NCC Food Serving Count System (see NDSR User Manual Appendix 10 for detailed information about the NCC Food Serving Count System).

2) Divide total daily energy intake (from output file 04) by 1,000, and then divide 'seafood and plant proteins servings in ounce equivalents' (variable created in step 1) by the result of this calculation.

Fatty Acids Component

Before a score for the fatty acids component of the HEI-2015 may be assigned, one must generate a ratio of polyunsaturated fatty acids (PUFAs) and monounsaturated fatty acids (MUFAs) to saturated fatty acids (SFAs). The step for creating this variable is as follows:

1) Calculate the sum of total PUFAs (from output file 04) and total MUFAs (from output file 04),

2) Divide the sum of total PUFAs and total MUFAs (variable created in step 1) by total SFAs (from output file 04).

Refined Grains Component

Before a score for the refined grains component of the HEI-2015 may be assigned, one must generate an estimate of 'refined grains servings in ounce equivalents per 1,000 kcal'. To generate this estimate:

1) Divide total daily energy intake (from output file 04) by 1,000, and then divide refined grains in ounce equivalents (from output file 04) by the result of this calculation.

Sodium Component

Before a score for the sodium component of the HEI-2015 may be assigned, one must generate an estimate of 'sodium intake (grams) per 1,000 kcal'. The steps for creating this variable are as follows:

1) Calculate 'sodium intake in grams' by dividing the sodium variable in output file 04 (sodium intake in milligrams) by 1,000.

2) Divide total daily energy intake (from output file 04) by 1,000, and then divide 'sodium intake in grams' (variable created in step 1) by the result of this calculation.

Added Sugars Component

Before a score for the added sugars component of the HEI-2015 may be assigned, the percent of energy from added sugars must be calculated. The steps for creating this variable are as follows:

1) Using the added sugars (by total sugars) estimate from output file 04, calculate energy from added sugars:

   Added sugars (by total sugars) (g)[3] x 4 kcal/gram = kcal from added sugars

2) Using the total daily energy intake estimate from output file 04, complete the following calculation:

   [kcal from added sugars /total kcal] x 100 = % energy from added sugars

Saturated Fat Component

The variable needed to calculate a score for this component of the index (% of energy from saturated fats) is available in output file 04 (% Calories from SFA).

Table 1: Healthy Eating Index-2015 components and scoring standards[1]

Component	Optimum Score	Standard for Maximum Score	Standard for Minimum Score of Zero
Total Fruits[2]	5	≥0.8 cup eq/1,000 kcal	No fruit
Whole Fruits[3]	5	≥0.4 cup eq/1,000 kcal	No whole fruit
Total Vegetables[4]	5	≥1.1 cup eq/1,000 kcal	No vegetables
Greens and Beans[4]	5	≥0.2 cup eq/1,000 kcal	No dark-green vegetables or legumes
Whole Grains	10	≥1.5 oz eq/1,000 kcal	No whole grains
Dairy[5]	10	≥1.3 cup eq/1,000 kcal	No dairy
Total Protein Foods[6]	5	≥2.5 oz eq/1,000 kcal	No protein foods
Seafood and Plant Proteins[6,7]	5	≥0.8 oz eq/1,000 kcal	No seafood or plant proteins
Fatty Acids[8]	10	(PUFAs+MUFAs)/SFAs ≥2.5	(PUFAs+MUFAs)/SFAs ≤1.2
Refined Grains	10	≤1.8 oz eq/1,000 kcal	≥4.3 oz eq/1,000 kcal
Sodium	10	≤1.1 gram/1,000 kcal	≥2.0 grams/1,000 kcal
Added Sugars	10	≤6.5% of energy	≥26% of energy
Saturated Fats	10	≤8% of energy	≥16% of energy

[1] Intakes between the minimum and maximum standards are scored proportionately.

[2] Includes 100% fruit juice.

[3] Includes all forms except juice.

[4] Includes legumes (beans and peas).

[5] Includes all milk products, such as fluid milk, yogurt, and cheese, and fortified soy beverages.

[6] Includes legumes (beans and peas).

[7] Includes seafood, nuts, seeds, soy products (other than beverages), and legumes (beans and peas).

[8] Ratio of poly- and monounsaturated fatty acids (PUFAs and MUFAs) to saturated fatty acids (SFAs)

References

1. Guenther P, Reedy J, Krebs-Smith J. Development of the Healthy Eating Index-2005. *Journal of the American Dietetic Association.* 2008;108(11):1896-1901.
2. US Department of Health and Human Services, USDA. *2015-2010 Dietary Guidelines for Americans*. 2016. https://health.gov/dietaryguidelines/2015/

Referencing the NCC HEI 2015 Document

In the methods section:
In the Methods section of your manuscript please include the following statements.

The Healthy Eating Index-2015 Score was generated using dietary intake data collected and analyzed with Nutrition Data System for Research software version _____, (date) and an unpublished Guide to Creating Variables Needed to Calculate Scores for Each Component of the Healthy Eating Index-2015 (HEI-2015), (July 2017), both of which were developed by the Nutrition Coordinating Center (NCC), University of Minnesota, Minneapolis, MN.

In the references section:

Nutrition Coordination Center (NCC), University of Minnesota (2017). *Guide to Creating Variables, Needed to Calculate Scores for Each Component of the Healthy Eating Index-2015* (HEI-2015). Retrieved from http://www.ncc.umn.edu/ndsrsupport/hei2015.pdf

Appendix E

Data Analysis Procedures

Note:

- All data analysis will be conducted by principal investigator.
- SPSS will be used to conduct descriptive and inferential statistics.
- *Process* macro will be used to test mediation, moderation, and moderated mediation models.

Apriori criteria:

- t-tests & non-parametric t-test equivalents significance value = $p \leq .05$
- co-variates include child gender, maternal Hispanic acculturation, maternal English acculturation, number of members in household, number of children in household, maternal marital status, employment status, & education level. In initial model, all co-variates are included. However, in final model, only co-variates with a p-value $\leq .1$ will be retained. The other nonsignificant (p-value $\geq .1$) will be dropped
- Previous time period measures of the dependent variable will be controlled in all the mediation, moderation and mediated moderation models
- in mediation testing: direct effect considered significant if confidence interval does not cross over zero, indirect effect considered significant if bootleg confidence interval does not cross over zero
- in moderated mediation testing: interaction term needed to be significant with a p-value $\leq .05$. If this is significant, then conditional direct effect of X on Y at the values of the moderator is significant if LLCI and ULCI does not contain 0. For a conditional indirect effect of X on Y at the values of the moderator to be significant, the bootleg LLCI and ULCI must not contain zero.
- To maximize power, most parsimonious models will be tested.
- No cases will be deleted (Potential outlier in BMI z-score, all HEI were considered plausible). However, if missing data for, then case excluded from SPSS analysis for that specific test.

1. To install Process, need to download macro from http://www.processmacro.org/download.html

2. Complete descriptive analysis including histograms for all variables of interest first.

3. Create a grouping variable to distinguish participants who returned for data collection at time 2 verses those who did not. To do this, select cases if they are missing a time 2 HEI, Food Security Score, or BMI z-score. Create a grouping variable and assign these cases a value of 1 to define this group as missing for Time 2. A value of zero indicates that the participant was retained at time 2.

4. Using the new grouping variable, run a t-test and nonparametric t-test for Food Security Status, BMI z-score, and HEI to determine if there is a difference between the retained group vs. the non-retained group.

5. Run paired t-test, or nonparametric equivalent, to determine if there is a difference across time for Food Security Status, BMIz-score, and HEI.

6. Then run models using *Process* macro models 1, 4, and 59 to test Aims1, 2, and 3.

Appendix F

Study & Communication Log

Study Log

	July 2017	August 2017	Sept 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2017	Feb 2017	March 2017
Permission to access data from parent study	Verbally obtained from Dr. Hughes January 2016.								
IRB approval	Obtained 7/25/2017		Added Aim 3 9/29/17 after reading publication of similar study that found conditional gender effects						
Data analysis (calculation of variables)				Complete					
Data analysis (Run descriptive and inferential statistics)					Error & correction[1]				

Study Log Continued

Review findings with statistician(s)						Complete				
Interpretation of findings & writing of manuscript										
Dissemination of findings (includes manuscript, presentation, publication)										

1: (11/9/2017) Error in calculation of whole fruit timepoint 1 found during frequency checks for total whole fruit. Logic statement to calculate whole fruit was dividing cups of fruit by averaged daily energy intake in place of energy/1000. Whole fruit component logic statement corrected, auto correction of HEI whole fruit component, total cHEI timepoint1 completed. SPSS datafile merged with corrected cHEI. Incorrect cHEI removed to avoid future error. All analysis redone using corrected cHEI timepoint 1. Corrected analysis in output and annotated analysis folders. Folder labeled "corrected".

Communication Log

Date	Dr. Meininger	Dr. Chan	Dr. Hughes	Kirstin	Others
	Bi-weekly communication for updates on study progress				
5/18/2017				Tutorial on HEI calculations	
7/2017					Dr. Lisa Harnack for instructions on HEI-2015 calculation using data collected with NDSR software
8/7/2017		Reviewed final plans of analysis			
8/10, 8/19					Email communication with Dr. Andrew Hayes (author of Process, expert in moderated mediation longitudinal analysis)
8/25/2017			Received child BMIz-scores for all three timepoints		
11/9/2017		Reviewed error, correction, and available findings			

Communication Log Continued

11/30/2017			Review findings		
12/10/17					Per Lisa Harnack, HEI 2015 validity study not yet published.

Appendix G

Kamdar, N. (2017). Child Obesity: Analysis of a Population Health Problem. Journal of Nursing Doctoral Students Scholarship, 5(1), 27-37.

Child Obesity: Analysis of a Population Health Problem

Nipa Kamdar RN, MSN, FNP-BC
University of Texas Health Science Center, Houston
School of Nursing

Abstract
Nearly one out of every three children in the US are either overweight or obese (Ogden et al., 2016) as defined by the Center for Disease Control and Prevention (CDC, 2015b). Overweight and obese children are at increased risk for developing serious chronic illnesses such as type two diabetes, hypertension, and depression.
Efforts to reduce prevalence of child obesity is a challenge. Understanding the contributing factors is critical to effectively approach the problem with viable solutions. The purpose of this article is to present a model that encompasses direct and indirect contributing factors for child obesity. This model could be used by nurses and other clinicians for hypothesis testing, intervention design, and policy reform.

Child obesity is a serious public health issue associated with multiple chronic diseases (World Health Organization, 2015). In children, overweight is defined as a body-mass-index (BMI) between the 85th and 94th percentile for age and sex, and obesity is defined as a BMI greater than the 95th percentile for age and sex (CDC, 2015). Clinicians and public health experts are trying to reduce the prevalence of children who are overweight or obese.

The basic cause of overweight and obesity is an imbalance in which energy consumption is greater than energy expenditure. However, factors leading to energy imbalance are woven in a complex matrix that involves biology, behavior, culture, environment, and economics operating at the individual, family, and community levels (Public Health Agency of Canada, 2015). Identifying key factors to target is a challenging, but essential, component for finding a sustainable solution to reduce the child obesity epidemic. This article will discuss prevalence, disparities, comorbidity, costs, and contributing factors for child obesity.

Prevalence and Disparities of Child Obesity

According to the World Health Organization (2015), in 2013 an estimated 42 million children under the age of five were overweight globally. In the United States, 31.8% of children ages 2 to 19 are overweight or obese (Ogden, Carroll, Kit, & Flegal, 2014). Over the past three decades, prevalence of child obesity has tripled from 5% in the 1970s to 16.9% in 2010 (Fryar, Carroll, & Ogden, 2012).

The results of 2011-2012 National Health and Nutrition Examination Survey (NHANES) indicated improvement in obesity prevalence for preschoolers when compared to 2009-2010 survey results (Ogden, Carroll, Kit, & Flegal, 2012; Ogden et al., 2014). However, the improvement is not consistent across all racial/ethnic groups. In the 2009-2010 NHANES report, non-Hispanic white children ages 2 to 5 had an obesity prevalence of 9.2%. This improved to 3.5% according to 2011-2012 NHANES. In contrast, for Hispanic children ages 2 to 5, there was an increase in prevalence from 16.2% to 16.7%. These statistics demonstrate that child obesity does not affect the population equally.

In fact, per 2011-2012 NHANES, Hispanic children have the highest prevalence of overweight and obesity compared to Asian, African American, and Caucasian children in most age groups (Ogden et al., 2014). African American children rank second in prevalence for overweight and obesity. In both groups, more than a third of children are overweight and more than a fifth are obese.

Just as child obesity is not equally distributed among racial/ethnic groups, it is also not equally spread among income groups. According to the 2011/12 National Survey of Children's Health (NSCH) (2012), 26.6% of children living at 0 to 99% of the federal poverty level (FPL) were obese. As income increases, the prevalence of obesity decreases. Only 9.0% of children living at 400% FPL or higher are obese. A similar trend follows for children who are overweight (The Child and Adolescent Health Measurement Initiative, 2012b).

Comorbidities of Child Obesity

The list of illnesses associated with child obesity is extensive. They included joint problems, asthma, sleep apnea, fatty liver disease, gallstones, and gastro-esophageal reflux (Center for Disease Control and Prevention, 2015a; Must, 1996). Children who are severely obese are also at increased risk for genu valgum, slipped capital femoral epiphysis, and tibia vara (Must, 1996).

However, the greatest health threats for children who are overweight or obese exists in cardiometabolic morbidity. A systematic review identified a number of robust studies that found associations between childhood overweight or obesity and adverse cardiovascular effects later in life (Reilly & Kelly, 2011). One of the studies found that 70% of obese children had at least one cardiovascular risk factor such as high blood pressure or high cholesterol, and 39% of obese children had two or more risk factors (Freedman, Mei, Srinivasan, Berenson, & Dietz, 2007).

The incidence of diabetes has increased parallel to the prevalence of obesity (Crothers, Kehle, Bray, & Theodore, 2009). About 15 years ago only 3% of new onset diabetes in adolescents were type 2 diabetes. (D'Adamo & Caprio, 2011). Now about half of new cases are recognized as type 2 diabetes. At the time of type 2 diabetes diagnosis, over 85% of children are either overweight or obese (Pulgaron & Delamater, 2014).

In addition to the physical issues, obesity is associated with a number of psychological health concerns. Obese children are at increased risk for exclusion and bullying (Crothers et al., 2009). They are more likely to have depression, low self-esteem, and

distorted body image (Crothers et al., 2009; Must & Strauss, 1999). In a study of 244 children ages 8 to 17 entering a weight management program, 36.4% were depressed (Morrison, Shin, Tarnopolsky, & Taylor, 2015). According to the 2011/12 NSCH, 39% of children with one or more reported emotional, behavioral or developmental issues were overweight or obese (The Child and Adolescent Health Measurement Initiative, 2012a).

Costs of the Problem to Society

Childhood prevention programs come at a significant cost. For example, the Robert Wood Johnson Foundation pledged $500 million towards prevention efforts in 2007, and the California Endowment pledged $1 billion towards building health-promoting communities across the state (Finkelstein et al., 2014).

To justify the cost of prevention programs, policymakers need an estimated cost of childhood obesity from health and economic perspectives (Finkelstein, Graham, & Malhotra, 2014). A study in Australia found evidence to support that children who are overweight or obese at four to five years of age have higher prescription and medical care costs over the following five years compared to healthy weight peers (Au, 2012). Researchers estimate $12,660 to $19,000 as the incremental lifetime medical cost of an obese child compared to a healthy weight child (Finkelstein et al., 2014). Additionally, obesity in adolescence is associated with adverse social and economic outcomes such as decreased education attainment and lower income (Reilly et al., 2003).

Contributing Factors for Child Obesity

Obesity is a complex issue with many contributing factors. The primary factors are an imbalance of surplus energy intake and insufficient energy consumption. However, the indirect contributing factors that lead to this energy imbalance ferment from a complex mix of culture, behavior, economics and environment. Figure 1 (page 24) is a model of contributing factors for child overweight and obesity. From left to right, the model depicts how three indirect factors (food industry, parenting, and low socioeconomic neighborhoods) feed into the primary direct factors of increased energy intake and insufficient energy consumption. Research supporting the organization of the model is summarized in Table 1, located in the appendix (on page 35).

Data from the NSCH and Pediatric Nutrition Surveillance System (Center for Disease Control and Prevention, 2015c; The Child and Adolescent Health Measurement Initiative, 2012b) support that children from low income families have increased prevalence of obesity compared to families with higher incomes. Lower income, minority neighborhoods are likely to lack an environment supportive of physical activity (Gordon-Larsen, Nelson, Page, & Popkin, 2006; Moore, Diez Roux, Evenson, McGinn, & Brines, 2008). They are less likely to have recreation facilities and parks which leads to decreased physical activity and increased weight. People living in lower socioeconomic neighborhoods report higher perceptions of unpleasantness of neighborhoods, unattended dogs, neighborhood crime, untrustworthy neighbors, and they were less likely to meet the Center for Disease Control's recommendations for physical activity (Wilson, Kirtland, Ainsworth, & Addy, 2004). Low-income communities also tend to have greater availability of fast food restaurants (Newman, Howlett, & Burton, 2014). Furthermore, these neighborhoods are less likely to have access to healthy foods

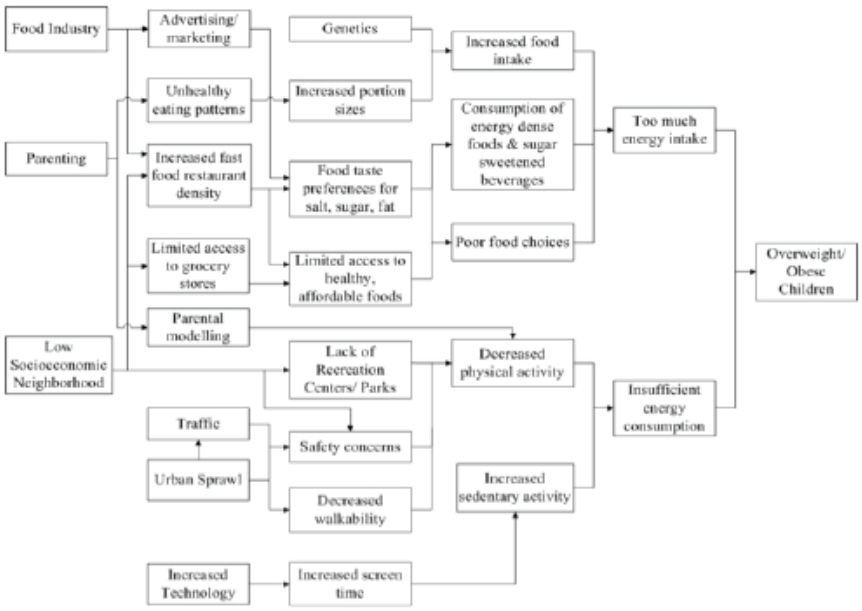

Figure 1: Contributing Factors for Child Obesity

because they lack grocery stores (Treuhaft & Karpyn, 2010). Conversely, individuals with access to healthy food have a lower risk for obesity (Larson, Story, & Nelson, 2009).

The food industry is another significant, indirect contributor to obesity. Energy-dense, nutritionally poor foods and beverages contribute to childhood overweight and obesity (Sonntag, Schneider, Mdege, Ali, & Schmidt, 2015). Food and beverage manufacturers and chain restaurants offer many products that are high in sugar, fat, and salt to satisfy consumer taste preferences (Cornwell & McAlister, 2011). These outlets have lower-priced food and beverage items that appeal to economically disadvantaged consumers.

The food industry also advertises to children who are exposed to many marketing messages, promotional events/displays, trade characters, and packaging (Cornwell & McAlister, 2011). Snack, convenience, fast foods, and sweets account for 83% of advertised foods (Harrison & Marske, 2005). Food preferences and habits set in childhood influence food choice over the lifespan (Cornwell & McAlister, 2011).

Parents are another predominant player in factors contributing to obesity in children. Parents have great influence in shaping their children's attitudes and behaviors (Rodenburg, Kremers, Oenema, & van de Mheen, 2014). They generally have the most control over the home and family environment. If parents have poor dietary habits, their children often model similar patterns (Hood et al., 2000). Parenting styles and practices have strong impact over children's obesogenic behaviors (Patrick, Hennessy, McSpadden, & Oh, 2013)

Many elements contribute to child obesity in complex relationships. It is important to note that Figure 1 does not incorporate all the contributing factors for child obesity. Some contributors to child obesity not mentioned in the model are sleep, breastfeeding, and genetics (Center for Disease Control and Prevention, 2015a).

Recommendations

Efforts to reduce prevalence of child obesity is a challenge. Understanding the contributing factors is critical to effectively approach the problem with viable solutions. The contributing factors model could serve as a map to assist researchers in identifying relationships between factors and potential gaps in knowledge. It can also be used by public health nurses to develop interventions aimed at reducing prevalence of child obesity. Food industry, parenting, and low socioeconomic neighborhoods are presented in the model because these are three areas that have potential for behavioral intervention, environmental change, and policy reform.

Summary and Conclusion

Childhood overweight and obesity is one of the nation's greatest public health concerns. It effects about one third of children (Ogden et al., 2014). As these children develop comorbidities associated with being overweight or obese, they will endure increased healthcare costs along with other burdens.

While the direct contributing factors for child overweight and obesity are easy to identify, indirect contributing factors originate from more complex interactions of behavior and environment. To stop the domino effect of child obesity, it is essential to untangle and address the many indirect contributing factors.

References

Au, N. (2012). The health care cost implications of overweight and obesity during childhood. *Health Services Research, 47*(2), 655-676. doi:10.1111/j.1475-6773.2011.01326.x [doi]

Cecil, J. E., Tavendale, R., Watt, P., Hetherington, M. M., & Palmer, C. N. A. (2008). An obesity-associated FTO gene variant and increased energy intake in children. *The New England Journal of Medicine, 359*(24), 2558-2566. doi:10.1056/NEJMoa0803839

Center for Disease Control and Prevention. (2015a). Childhood Obesity Causes & Consequences. Retrieved from http://www.cdc.gov/obesity/childhood/causes.html

Center for Disease Control and PreventionC. (2015b). Defining Childhood Obesity. Retrieved from https://www.cdc.gov/obesity/childhood/defining.html

Center for Disease Control and Prevention. (2015c). Childhood Obesity Facts. Retrieved from http://www.cdc.gov/obesity/data/childhood.html

Cornwell, T. B., & McAlister, A. R. (2011). Alternative thinking about starting points of obesity. Development of child taste preferences. Appetite, 56(2), 428-439. doi:10.1016/j.appet.2011.01.010

Crothers, L. M., Kehle, T. J., Bray, M. A., & Theodore, L. A. (2009). Correlates and suspected causes of obesity in children. Psychology in the Schools, 46(8), 787-796. doi:10.1002/pits.20417

D'Adamo, E., & Caprio, S. (2011). Type 2 diabetes in youth: Epidemiology and pathophysiology. Diabetes Care, 34 Suppl 2(5), S161-S165. doi:10.2337/dc11-s212

Duncan, D. T., Johnson, R. M., Molnar, B. E., & Azrael, D. (2009). Association between neighborhood safety and overweight status among urban adolescents. *BMC Public Health, 9*(1), 289-289. doi:10.1186/1471-2458-9-289

Finkelstein, E. A., Graham, W. C. K., & Malhotra, R. (2014). Lifetime direct medical costs of childhood obesity. *Pediatrics, 133*(5), 854-862. doi:10.1542/peds.2014-0063

Freedman, D. S., Mei, Z., Srinivasan, S. R., Berenson, G. S., & Dietz, W. H. (2007). Cardiovascular risk factors and excess adiposity among overweight children and adolescents: The Bogalusa Heart Study. *The Journal of Pediatrics, 150*(1), 12-17.e2. doi:http://dx.doi.org.ezproxyhost.library.tmc.edu/10.1016/j.jpeds.2006.08.042

Fryar, C. D., Carroll, M. D., & Ogden, C. L. (2012). Prevalence of obesity among children and adolescents: United States, trends 1963–1965 through 2009–2010. *National Center for Health Statistics, 1960*

Galvez, M. P., Hong, L., Choi, E., Liao, L., Godbold, J., & Brenner, B. (2009). Childhood Obesity and Neighborhood Food-Store Availability in an Inner-City Community. *Academic Pediatrics, 9*(5), 339-343. doi:10.1016/j.acap.2009.05.003

Gordon-Larsen, P., Nelson, M. C., Page, P., & Popkin, B. M. (2006). Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics, 117*(2), 417-424. doi:10.1542/peds.2005-0058

Harrison, K., & Marske, A. L. (2005). Nutritional content of foods advertised during the television programs children watch most. *American Journal of Public Health, 95*(9), 1568-1574. doi:10.2105/AJPH.2004.048058

Hood, M. Y., Moore, L. L., Sundarajan-Ramamurti, A., Singer, M., Cupples, L. A., & Ellison, R. C. (2000). Parental eating attitudes and the development of obesity in children. The Framingham Children's Study. *International Journal of Obesity, 24*(10), 1319-1325. doi:10.1038/sj.ijo.0801396

Kral, T. V. E., Remiker, A. M., Strutz, E. M., & Moore, R. H. (2014). Role of child weight status and the relative reinforcing value of food in children's response to portion size increases. *Obesity, 22*(7), 1716-1722. doi:10.1002/oby.20757

Larson, N. I., Story, M. T., & Nelson, M. C. (2009). Neighborhood environments: Disparities in access to healthy foods in the U.S. American *Journal of Preventive Medicine, 36*(1), 74.

Moore, L. V., Diez Roux, A. V., Evenson, K. R., McGinn, A. P., & Brines, S. J. (2008). Availability of recreational resources in minority and low socioeconomic status areas. *American Journal of Preventive Medicine, 34*(1), 16-22. doi:10.1016/j.amepre.2007.09.021

Morrison, K. M., Shin, S., Tarnopolsky, M., & Taylor, V. H. (2015). Association of depression & health related quality of life with body composition in children and youth with obesity. *Journal of Affective Disorders, 172*, 18-23. doi:10.1016/j.jad.2014.09.014

Must, A. (1996). Morbidity and mortality associated with elevated body weight in children and adolescents. *The American Journal of Clinical Nutrition, 63*(3 Suppl), 445S-447S.

Must, A., & Strauss, R. S. (1999). Risks and consequences of childhood and adolescent obesity. International Journal of Obesity and Related Metabolic Disorders: *Journal of the International Association for the Study of Obesity, 23* Suppl 2, S2-11.

Nelson, M. C., Gordon-Larsen, P., Song, Y., & Popkin, B. M. (2006). Built and social environments associations with adolescent overweight and activity. *American Journal of Preventive Medicine, 31*(2), 109.

Newman, C. L., Howlett, E., & Burton, S. (2014). Implications of fast food restaurant concentration for preschool-aged childhood obesity. *Journal of Business Research, 67*(8), 1573-1580. doi:10.1016/j.jbusres.2013.10.004

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA, 311*(8), 806-814. doi:10.1001/jama.2014.732 [doi]

Ogden, C. L., Carroll, M. D., Lawman, H. G., Fryar, C. D., Kruszon-Moran, D., Kit, B. K., & Flegal, K. M. (2016). Trends in Obesity Prevalence Among Children and Adolescents in the United States, 1988-1994 Through 2013-2014. *Jama, 315*(21), 2292-2299. doi:10.1001/jama.2016.6361

Patrick, H., Hennessy, E., McSpadden, K., & Oh, A. (2013). Parenting styles and practices in children's obesogenic behaviors: Scientific gaps and future research directions. *Childhood Obesity (Print), 9*(s1), S-73-S-86. doi:10.1089/chi.2013.0039

Petrunoff, N. A., Wilkenfeld, R. L., King, L. A., & Flood, V. M. (2014;2012;). 'Treats', 'sometimes foods', 'junk': A qualitative study exploring 'extra foods' with parents of young children. *Public Health Nutrition, 17*(5), 979-8. doi:10.1017/S1368980012005095

Public Health Agency of Canada. (2015). Curbing Childhood Obesity: An FPT Framework for Action to Promote Healthy Weights. Retrieved from http://www.phac-aspc.gc.ca/hp-ps/hl-mvs/framework-cadre/index-eng.php

Pulgaron, E. R., & Delamater, A. M. (2014). Obesity and type 2 diabetes in children: Epidemiology and treatment. *Current Diabetes Reports, 14*(8), 1-12. doi:10.1007/s11892-014-0508-y

Reilly, J. J., Methven, E., McDowell, Z. C., Hacking, B., Alexander, D., Stewart, L., & Kelnar, C. J. H. (2003). Health consequences of obesity. *Archives of Disease in Childhood, 88*(9), 748-752. doi:10.1136/adc.88.9.748

Reilly, J., & Kelly, J. (2011). Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: Systematic review. *International Journal of Obesity, 35*(7), 891-898. doi:10.1038/ijo.2010.222

Rodenburg, G., Kremers, S. P. J., Oenema, A., & Van de Mheen, D. (2014). Associations of parental feeding styles with child snacking behaviour and weight in the context of general parenting. *Public Health Nutrition, 17*(5), 960. doi:10.1017/S1368980013000712

Rollins, J. A. (2004). Kaiser Family Foundation releases report on role of media in childhood obesity. *Pediatric Nursing, 30*(2), 165.

Singh, G. K., Kogan, M. D., Van Dyck, P. C., & Siahpush, M. (2008). Racial/Ethnic, socioeconomic, and behavioral determinants of childhood and adolescent obesity in the United States: Analyzing independent and joint associations. *Annals of Epidemiology, 18*(9), 682-695. doi:10.1016/j.annepidem.2008.05.001

Sonntag, D., Schneider, S., Mdege, N., Ali, S., & Schmidt, B. (2015). Beyond food promotion: A systematic review on the influence of the food industry on obesity-related dietary behaviour among children. *Nutrients, 7*(10), 8565-8576. doi:10.3390/nu7105414

The Child and Adolescent Health Measurement Initiative. (2012a). NSCH 2011/12: Weight status of children based on Body Mass Index for age (BMI-for-age), Nationwide, Emotional, behavioral or developmental issues. Retrieved from http://childhealthdata.org/browse/survey/results?q=2415&r=1&g=463

The Child and Adolescent Health Measurement Initiative. (2012b). NSCH 2011/12: Weight status of children based on body mass index for age (BMI-for-age), nationwide, household income level. Retrieved from http://childhealthdata.org/browse/survey/results?q=2462&r=1&g=458

Thomsen, M. R., Nayga, R. M., Alviola, P. A., & Rouse, H. L. (2016). The Effect of Food Deserts on the Body Mass Index of Elementary Schoolchildren. *American Journal of Agricultural Economics, 98*(1), 1-18. doi:10.1093/ajae/aav039

Treuhaft, S., & Karpyn, A. (2010). The grocery gap: Who has access to healthy food and why it matters. Retrieved from http://www.policylink.org/find-resources/library/the-grocery-gap-who-has-access-to-healthy-food-and-why-it-matters

Wake, M., Nicholson, J. M., Hardy, P., & Smith, K. (2007). Preschooler obesity and parenting styles of mothers and fathers: Australian National Population Study. *Pediatrics, 120*(6), e1520-e1527. doi:10.1542/peds.2006-3707

Wilson, D. K., Kirtland, K. A., Ainsworth, B. E., & Addy, C. L. (2004). Socioeconomic status and perceptions of access and safety for physical activity. *Annals of Behavioral Medicine, 28*(1), 20-28. doi:10.1207/s15324796abm2801_4

World Health Organization. (2015). Global strategy on diet, physical activity and health: Childhood overweight and obesity. Retrieved from http://www.who.int/dietphysicalactivity/childhood/en/

Zarnowiecki, D., Sinn, N., Petkov, J., & Dollman, J. (2012). Parental nutrition knowledge and attitudes as predictors of 5–6-year-old children's healthy food knowledge. *Public Health Nutrition, 15*(7), 1-7. doi:10.1017/S1368980011003259

Table 1. Evidence Table for Contributors to Child Obesity

Citation	Purpose of Study	Research Design *Sample* *Setting*	Method of Investigation *Variable 1* *Variable 2*	Findings from the Study
(Cecil, Tavendale, Watt, Hetherington, & Palmer, 2008)	To examine the relationship between fat mass and obesity-associated (FTO) gene variant & body-mass index (BMI). Also, to explore the role of the FTO variant in energy expenditure and eating behavior	Cross-sectional ***Sample*** *97 prepubertal schoolchildren ages 4 to 10* ***Setting*** *Northeastern Scotland*	Participants recruited from Energy Balance Study. The students were evaluated for adiposity, energy expenditure, & eating behavior. ***Variable 1*** *Food energy intake: calculated using manufacturer information, amount of food consumed at test meal assessed by weighing the food items before and after eating* ***Variable 2*** *Metabolism: Resting metabolic rate assessed by indirect calorimetry, with the use of a ventilated hood*	Increased food intake (energy intake) at test meals was associated with children carrying the FTO gene variation.
(Wake, Nicholson, Hardy, & Smith, 2007)	To examine relationship between child's body mass index (BMI) & parenting styles	Cross-sectional ***Sample*** *4983 children ages 4 - 5* ***Setting*** *Australia*	Trained professional completed 1:1 interviews with primary care givers (usually mom), secondary parent completed questionnaire. Separate statistical analysis performed for mothers, fathers, and combined. ***Variable 1*** *Parenting style: Self-reported behavior using 3 continuous scales for warmth, control, irritability and categorized as being authoritative, authoritarian, permissive, or disengaged* ***Variable 2*** *Child's weight status: classification according to the International Obesity Task Force age- and gender-specific criteria for BMI (kg per meter squared).*	No association between mother's parenting dimension and child BMI status (p-value ≥ 0.69) Strong association between paternal parenting dimension and child BMI status (p-value < 0.001) Children with permissive or disengaged fathers, had increase odds of having higher BMI by 59% & 35%, respectively. *To note: This study used different means to gather parental data, had missing data, and compared data sets using same statistical methods.*
(Rodenburg, Kremers, Oenema, & van de Mheen, 2014)	To study parental feeding styles with child snacking behavior and weight	Cross-sectional ***Sample*** *1275 Parent-child dyads* ***Setting*** *Netherlands* *(Most children about 9 years of age)*	Parents completed questionnaire of feeding style and children's snacking intake. Child's BMI measured. The relation between feeding style, snacking behavior, and BMI completed using linear regression. ***Variable 1*** *Parental feeding style: validated Dutch translation of the Parental Feeding Style Questionnaire that assessed 4 style dimensions (Instrumental Feeding, Emotional Feeding, Encouragement, Control)* ***Variable 2*** *Children's snacking behavior: measured by validated questionnaire.* *Child BMI (kg/meter squared) based on age-gender specific values from 1997 National Growth Study in Netherlands*	Pearson's correlation: negative association between child snacking and child BMI & child sugar sweetened beverage (SSB) intake and child BMI. Negative associations of Instrumental Feeding and Emotional Feeding with child fruit intake and positive associations with energy-dense snack intake.
(Cornwell & McAlister, 2011)	2 studies were conducted Study 1: Develop survey measure of taste preference & learn if child's sugar-fat-salt (SFS) palate relates to food choices. Study 2: Examine how knowledge of certain food & drink brands are related to palate.	Cross-sectional ***Sample*** *108 children aged 3 - 5 years* ***Setting*** *middleclass preschool in a large metropolitan city.*	Focus on Study 2: Children sorted picture cards to create a collage reflecting their knowledge on specific brands. The 21-item taste preference survey was conducted. ***Variable 1*** *Study 2: Brand preference measured using same 21-item taste preference survey* ***Variable 2*** *Study 2: Brand knowledge tested using "brand representation task"*	Study 2: Child SFS palate is significantly predicted by child brand knowledge (β = .65, p < .001). Fast-food and soda brand knowledge is linked to the development of a preference for sugar, fat and salt in food
(Kral, Remiker, Strutz, & Moore, 2014)	To compare energy intake at a meal in normal-weight and obese children	Randomized, crossover design ***Sample*** 25 normal-weight and 25 obese children, ages 8-10 years ***Setting*** Location N/A	Children were given the same meal once a week over 3 weeks. Each time, the meal was increased in portion size. ***Variable 1*** Same meal served with sequentially larger portion sizes ***Variable 2*** Children's relative reinforcing value of food was assessed using a behavioral choice task	Environments that offer large portions of palatable foods affect all children's intake irrespective of their weight status or how reinforcing they find food to be.

Table 1. ***Evidence Table for Contributors to Child Obesity (Continued)***

Citation	Purpose of Study	Research Design *Sample* *Setting*	Method of Investigation *Variable 1* *Variable 2*	Findings from the Study
(Newman, Howlett, & Burton, 2014)	To examine the impact of fast food availability on childhood obesity	Cross-sectional Preschool childhood obesity rates for 2718 U.S. counties	Hierarchical regression analysis examined direct & interactive effects of predictors on preschool obesity rates. ***Variable 1*** *Low-income preschool obesity rate from the Pediatric Nutrition Surveillance System (PedNSS)* ***Variable 2*** *(1) The per capita number of fast food restaurants, (2) The level of urbanization (rural versus urban), and (3) Economic environment (persistent poverty present versus persistent poverty not present) taken from the Food Environment Atlas*	Higher level of fast food restaurant saturation may lead to increased prevalence of childhood obesity in more economically disadvantaged, urban areas ($p<0.01$)
(Petrunoff, Wilkenfeld, King, & Flood, 2014; 2012)	To examine parental perception of everyday foods and differences between low & high socioeconomic status	Cross-sectional ***Sample*** 88 parents of 3-5-year-old ***Setting*** New South Wales, Australia	13 focus groups with discussion questions organized into 4 topic areas: Types of food & context, influences on food provision, "Everyday & sometimes foods", Strategies- what could make it easier to limit 'extra foods" ***Variable 1*** *Focus group questions with framework analysis* ***Variable 2*** *Mix of pre-schools & day care centers to get different social characteristics*	Common themes: Most parents accept juice as "everyday" food but not soda. Both low & high SES rarely mentioned weight status. "Extra" foods can be frequent as long as balance with healthy foods.
(Rollins, 2004)	Assess the role of television as tool for childhood obesity prevention.	Literature Review ***Sample*** 40 studies ***Setting*** Locations varied	Literature review of relationship between television & childhood obesity	Children who spend the most time with media are more likely to be overweight, marketing in the media may be key mechanism
(Zarnowiecki, Sinn, Petkov, & Dollman, 2012)	To investigate extent to which parents' knowledge & attitudes on nutrition & food predict young children's knowledge of healthy foods	Cross-sectional ***Sample*** 216 families of children aged 5-6 years ***Setting*** Adelaide, Australia	192 parental & children data form the Health Food Knowledge Activity compared using structural equation modelling. ***Variable 1*** *Parent questionnaire that measured lifestyle variables, parents' nutrition knowledge and attitudes to food* ***Variable 2*** *Children's nutrition knowledge was measured using the Healthy Food Knowledge Activity*	Parents' nutrition knowledge directly predicted children's nutrition knowledge ($r = 0\text{-}30$, $P < 0\text{-}001$). Parents with lower SES had lower nutrition knowledge.
(Nelson, Gordon-Larsen, Song, & Popkin, 2006)	To identify meaningful patterns of sociodemographic and built features in neighborhood environments and to describe the cross-sectional associations between these neighborhood patterns and adolescent physical activity (PA) and weight status.	Cross-sectional ***Sample*** 20,745 adolescent participants ***Setting*** United States	Using data from National Longitudinal Study of Adolescent Health, cluster analyses identified homogeneous groups of adolescent sharing neighborhood characteristics. ***Variable 1*** *Neighborhood measures on socioeconomic status, crime, road type, street connectivity, PA recreation facilities* ***Variable 2*** *Physically active (five or more bouts/week of moderate to vigorous PA) and overweight (>95)*	Six neighborhood patterns identified: (1) rural working class; (2) exurban; (3) newer suburban; (4) upper-middle class, older suburban; (5) mixed-race urban; and (6) low-socioeconomic-status (SES) inner-city areas. Those living in rural working class & mixed-race urban more likely to be overweight. Older suburban areas were more likely to be physically active.
(Duncan, Johnson, Molnar, & Azrael, 2009)	Evaluate the relationship between perceived neighborhood safety and overweight status, & evaluate validity of neighborhood safety perception	Cross-sectional ***Sample*** 125 high school students ***Setting*** Boston	Students reported their perceptions on neighborhood safety. BMI was calculated using reported height & weight. Chi-square statistics used to compare perceived neighborhood safety with the several associated dimensions ***Variable 1*** *Neighborhood safety measured via survey questions* ***Variable 2*** *Overweight status measured using BMI*	Regression models to estimate the effect of perceived neighborhood safety on overweight/at-risk for overweight status found that those who rarely or never felt safe in their neighborhoods were 1.21 times more likely to be at-risk for overweight or overweight. (95% CI: 1.05, 1.40)

Table 1. ***Evidence Table for Contributors to Child Obesity (Continued)***

Citation	Purpose of Study	Research Design ***Sample*** ***Setting***	Method of Investigation ***Variable 1*** ***Variable 2***	Findings from the Study
(Singh, Kogan, Van Dyck, & Siahpush, 2008)	To examine independent and joint associations between several socioeconomic, demographic, and behavioral characteristics and obesity prevalence	Cross-sectional ***Sample*** 46,707 children aged 10–17 years ***Setting*** United States	Data from 2003 NHANES was used. Logistic regression analysis was used to estimate odds of obesity and adjusted prevalence. ***Variable 1*** *Sociodemographic measures: age, gender, race/ethnicity/ household composition, place of residence, language spoken at home, parental education, poverty status, social capital index, neighborhood safety, school safety* ***Variable 2*** *Behavioral measures: physical activity, recreation computer use, television watching, sports participation*	Factors shown to be independently associated with significantly higher risks of childhood and adolescent obesity include black and Hispanic ethnicity, non-metropolitan residence, lower household education and higher poverty levels, low neighborhood social capital, and increased levels of television viewing and physical inactivity.
(Thomsen, Nayga, Alviola, & Rouse, 2016)	To determine if food deserts are associated with child obesity	Longitudinal ***Sample*** 110,384 school-age students ***Setting*** Arkansas	Used fixed-effects panel data regression models to estimate the effect of residing in a food deserts Food store locations (from Dun and Bradstreet) Child BMI z-scores	Food deserts may be a risk indicator for elevated child BMI
(Galvez et al., 2009)	To determine if the presence of convenience stores and fast-food restaurants near a child's home is associated with increased risk for childhood obesity	Cross-sectional ***Sample*** 323 6- to 8-year-old boys and girls ***Setting*** East Harlem, NY	Calculate odds ratio. Controlled gender, race/ethnicity, and family income. ***Variable 1*** *Food-store data on convenience stores, specialty stores, grocery stores, supermarkets, fast-food restaurants, and restaurants, collected via walking survey of East Harlem zip codes 10029 and 10035 in 2004* ***Variable 2*** *Child BMI*	Children residing near a convenience store had increased odds for elevated BMI.

Appendix H

Kamdar, N., Rozmus, C. L., Grimes, D. E., & Meininger, J. C. (2018). Ethnic/Racial Comparisons in Strategies Parents Use to Cope with Food Insecurity: A Systematic Review of Published Research. Journal of Immigrant and Minority Health, 1-14. https://doi.org/10.1007/s10903-018-0720-y

Journal of Immigrant and Minority Health
https://doi.org/10.1007/s10903-018-0720-y

ORIGINAL PAPER

Ethnic/Racial Comparisons in Strategies Parents Use to Cope with Food Insecurity: A Systematic Review of Published Research

Nipa Kamdar[1,2] · Cathy L. Rozmus[1] · Deanna E. Grimes[1] · Janet C. Meininger[1]

Abstract
Food insecurity in US affects African Americans, Hispanic, and American Indians disproportionately compared to Caucasians. Ethnicity/race may influence the strategies parents use to reduce the effects of food insecurity. The purpose of this review is to compare coping strategies for food insecurity used by parents of different ethnicities/race as reported in published literature. A systematic search on PubMed and Embase yielded 983 studies, of which 13 studies met inclusion criteria and were reviewed. All groups used public and private assistance, social networks, nutrition related, and financial-related strategies. The limited evidence suggests that there are differences in how parents of different ethnicities/race apply these coping strategies. Current evidence is insufficient to confidently determine the extent of these differences. This review is a starting point for exploration of cultural differences in how parents of various ethnicities/race cope with food insecurity and identifies specific areas for further research.

Keywords Coping strategies · Food insecurity · Food security · Ethnic comparisons · Racial comparisons

Introduction

Food insecurity as defined by the USDA is present when "food intake of one or more household members was reduced and their eating patterns were disrupted at times during the year because the household lacked money and other resources for food." [1]. In the US, food insecurity affects one in every six households with children [1]. However, African Americans, Hispanics, and American Indians are disproportionally affected with approximately one out of every four households experiencing food insecurity [1, 2]. In comparison, only 10% of Caucasian households face food insecurity [1].

Food insecurity is associated with several health and social issues. In children, these issues include poor fetal development, iron deficiency anemia, poor school performance, and increased risk of mental health concerns. Food insecure adults are at greater risk for obesity, diabetes, and cardiovascular disease [3].

Many parents adopt strategies to cope with the lack of food. The most commonly used strategies fall into the following categories: use of public and private assistance programs, social networking, nutrition-related, and financial-related strategies [4]. Examples of these strategies include: use of food stamps, food pantries, meal-sharing with extended family, reduced portion sizes, and nonpayment of bills to purchase food.

Although parents can select any strategy to cope with food insecurity, their ethnicity or race may influence which strategies they are more likely to use. According to the socioecological model, factors such as ethnicity and race influence interactions between individuals and their environment [5]. Research indicates that ethnic and racial differences affect multiple facets of daily life such as parenting feeding practices [6], parenting stress [7], and access to social capital [8].

Awareness of ethnic/racial similarities and differences is critical when designing interventions and creating policies that address strategies for coping with food insecurity. If policies or interventions are not culturally acceptable, the program may fail before it even begins. Therefore, the aim of this study is to provide a systematic review of the racial/

✉ Nipa Kamdar
nipa.p.kamdar@uth.tmc.edu

[1] School of Nursing, University of Texas Health Science Center, Houston, TX, USA

[2] Present Address: Cypress, USA

Published online: 16 March 2018

ethnic similarities and differences in strategies parents use to cope with food insecurity.

Method

Inclusion and Exclusion Criteria

Inclusion criteria permitted studies with quantitative, qualitative, or mixed method designs. Studies had to be conducted in the US, available in English, and published in peer-reviewed journals on or after 1995. 1995 is the year that the Food Security Supplement was added to the Current Population Survey and marks the standardization of measuring food security in the US [9]. At least 75% of the study sample needed to be parents. If a study had a lower percentage of parents, but the findings for households with children were distinct, the study was retained. At least 75% of the study sample had to be either African American, Hispanic, American Indian, or Caucasian. However, if a sample consisted of multiple ethnicities/races *and* the findings could be separated by ethnicity/race, the study was retained.

Quantitative studies had to include an operational definition for food insecurity that was consistent with the conceptual definition of a concern, or lack, of access to enough food to meet perceived nutritional needs for each member of a household due to restricted financial resources. They also needed to include variable(s) that represented coping strategies. Qualitative studies needed to include participants at risk for food insecurity and have findings related to coping strategies. Mixed method studies had to meet appropriate quantitative or qualitative criteria for food insecurity and coping strategies.

If studies only examined use of government assistance programs such as Supplemental Nutrition Assistance Program (SNAP), the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), School Breakfast Program (SBP), or National School Lunch Program (NSLP), then the study was excluded. Inclusion of these studies would pull away from the focus of this systematic review. Other exclusion criteria included publications of reviews, conference abstracts, and editorials.

Identification of Studies

Similar search terms or phrases for food insecurity, coping strategies, and ethnicity/race were used on PubMed and Embase databases to locate studies meeting inclusion criteria. Search terms for food insecurity included PubMed MeSH term "food supply", Emtree terms "food insecurity", "food security", and "hunger". A title and abstract search of 12 keywords or phrases for food insecurity were used on PubMed and Embase.

PubMed MeSH terms for coping strategies included "charities", "food assistance", and "Medicaid". Emtree terms were "coping strategy questionnaire", "coping behavior", and "family coping". Forty-seven keywords or phrases for coping strategies were used in a title and abstract search on PubMed and Embase.

PubMed MeSH terms for ethnicity/race were "ethnic groups", "minority groups", and "emigrants and immigrants". Emtree terms were "ethnicity", "Hispanic", "ethnic group", "minority group", "migrant", and "undocumented immigrant". Fifteen keywords or phrases for ethnicity/race were used in a title and abstract search on PubMed and Embase. A manual search for peer-reviewed studies that met inclusion criteria was also performed on Google Scholar. Appendix 1, 2 contains the Boolean logic commands used on Pubmed and Embase.

After removing duplicates, the search yielded 983 articles. Of these, 242 articles had titles that appeared to match the review's aim. Thirty-one of those studies had abstracts that appeared to match the inclusion criteria. After reviewing the full manuscripts, 11 studies met inclusion criteria. Review of the studies' references yielded an additional two studies. The systematic review consists of 13 studies. The flow diagram (Fig. 1) illustrates the results of the search. It also includes a summary of the number of full manuscripts reviewed that did not meet specific inclusion criteria. Databases search was conducted in February 2017.

Assessment of Study Rigor

Each study went through a quality review using criteria recommended by Whittemore [10] and Walsh and Downe [11]. Specifically, studies were assessed for control of sampling bias (quantitative design) or purposeful recruitment (qualitative design). Data collection was assessed for use of reliable and valid measurements (quantitative design) or clear identification of method and use of trained data collectors (qualitative design). Management of threats to validity by controlling for confounders (quantitative design) or use of bracketing (qualitative design) was also evaluated. Table 1 is a summary of each study's quality assessment.

Findings

Overview of Studies

Of the 13 studies included in the systematic review, six are quantitative and three are qualitative. Four studies use mixed method design. All quantitative studies are cross-sectional. Two of the mixed method studies [12, 13] conducted interviews at two different time points; however, in the findings and discussion for both studies, there is no indication that data were analyzed in a longitudinal perspective.

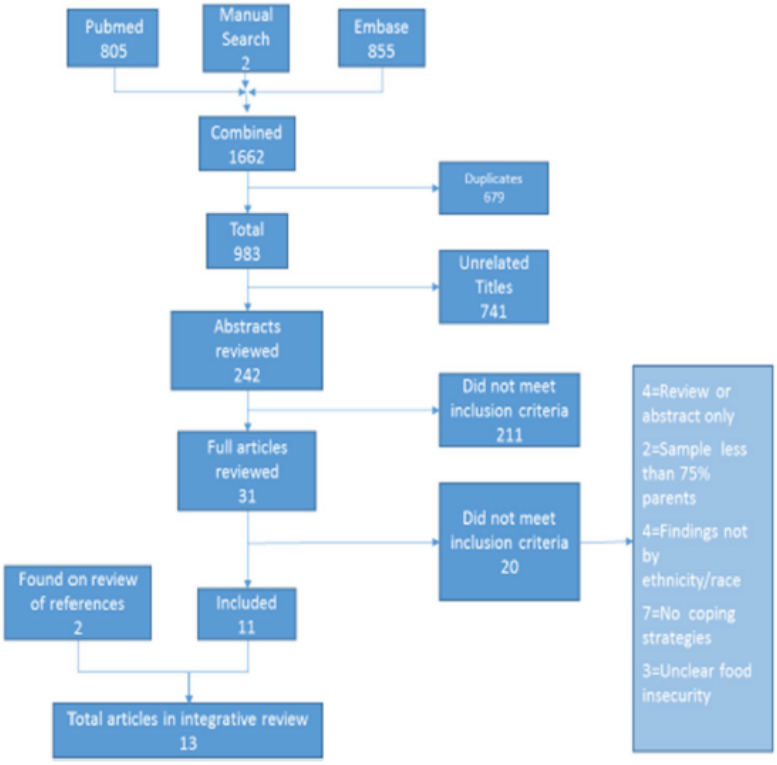

Fig. 1 Flow diagram for integrative review

Only two studies [14, 15] had mixed ethnic/racial samples with findings for coping strategies that could be differentiated by ethnicity/race. The remaining studies examined food insecure parental coping strategies within the context of a specific ethnicity/race.

Two [16, 17] of these studies had samples that were predominately Caucasian. Three [13, 18, 19] predominately studied African Americans. Two studies [20, 21] had only American Indians. The remaining four studies [12, 22–24] had only Hispanics in the samples. Table 2 provides a summary of each of the studies included in this review.

Characteristics of Study Samples

All but one study [15] identified their adult sample as parents. Laraia et al. [19] sampled parents of infants. Two studies [12, 23] sampled parents of preschoolers. Bauer [20] sampled parents of kindergartners and Barnidge et al. [18] sampled parents of school-aged children. The remaining studies only specified that the children were 18 years and younger.

In all the studies, more than half of the sampled parents were female. Borre et al. [12] had the lowest percentage of females in the sample at 52.8%. Three studies [13, 15, 19] had samples that were 100% female. Females constituted between 67.8 and 86% of the samples for the remaining studies. Although Kaufman and Karpati [22] interviewed mothers, the author did not share specific characteristics of study sample.

Recruitment Location and Study Setting

Recruitment for samples occurred at several different sites. Three studies [12, 18, 20] recruited from Headstart centers or schools. One study recruited from public libraries [14]. Calloway [14] also recruited from food pantries, as did two other studies [17, 18]. Three studies recruited from WIC or another food assistance program [16, 18, 19]. Parker et al. [15] recruited from organizations that serve low-income families but did not classify these organizations. Two studies referred to recruiting from the community [13, 24] but did not share additional details. Only one study [22] neglected to share details on recruitment locations or strategy.

Five studies focused on rural areas [13, 20, 21, 23, 24] and three focused on urban areas [14, 17, 22]. Barnidge et al.'s [18] study took place in rural and urban areas. Laraia

Table 1 Summary of study rigor

Study	Purpose/design	Recruitment/sampling strategy	Data collection	Threats to validity	Data Analysis
Quantitative study: points of assessment	1 = Clearly stated purpose 2 = Design matched purpose	1 = Description of recruitment source 2 = Description of recruitment strategy 3 = Stated inclusion/exclusion criteria 4 = Control of sampling bias	1 = Use of reliable and valid Food Security Survey measurement 2 = Use of reliable and valid coping strategy measurement	1 = Control for confounders	1 = Clearly shared findings of descriptive/inferential statistics 2 = Significance value and/or confidence interval share of inferential statistics
Bauer et al. [20]	1 2	1 2 3 4	1 X	1	1 2
Calloway et al. [14]	1 2	1 X 3 4	1 2	1	1 2
Laraia et al. [19]	1 2	1 X 3 X	1 X	1	1 2
Mullany et al. [21]	1 2	1 X 3 4	1 X	X	1 2
Sharkey et al. [24]	1 2	1 X 3 X	1 X	1	1 2
Wood et al. [17]	1 2	1 2 3 X	1 X	X	1 2
Qualitative study: points of assessment	1 = Clearly stated purpose 2 = Design matched purpose	1 = Description of recruitment source 2 = Description of recruitment strategy 3 = Stated inclusion/exclusion criteria 4 = Purposeful sampling	1 = Stated methodology 2 = Interview questions shared 3 = Trained data collector	1 = Bracketing of researcher bias	1 = Elicit approach to data analysis shared 2 = Statement of data saturation 3 = Transparency through shared quotations 4 = Peer debriefing/member check
Parker et al. [15]	1 2	1 X 3 X	X 2 3	X	1 X 3 4
Kaufman and Karpati [22]	1 2	X X X X	1 X 3	X	X X 3 X
Darko et al. [16]	1 2	1 2 3 X	X 2 3	X	1 X 3 4
Mixed method study: points of assessment	1 = Clearly stated purpose 2 = Stated rationale for mixed-method design	1 = Description of recruitment source 2 = Description of recruitment strategy 3 = Stated inclusion/exclusion criteria 4 = Control of sampling bias	1 = Use of reliable and valid Food Security Survey measurement 2 = Use of reliable and valid coping strategy measurement 3 = Stated qualitative methodology 4 = Interview questions shared 5 = Trained data collector	1 = If performed inferential statistics, control for confounders if inferential statistics 2 = Bracketing of researcher bias 3 = Peer debriefing/member checking	1 = Clearly shared findings of descriptive/inferential statistics 2 = Significance value and/or confidence interval share of inferential statistics 3 = Elicit approach to data analysis shared 4 = Statement of data saturation 5 = Transparency through shared quotations 6 = Peer debriefing/member check
Barnidge et al. [18]	1 2	1 2 X X	1 X 3 4 5	_ X X	1 2 3 _5 6
Borre et al. [12]	1X	1 2 3 X	1 X X X X	_ X 3	1 2 3 X X 6
Quandt et al. [23]	1X	1 2 3 4	1 X X X X	_ X X	1 X X X 5 X
Zekeri [13]	1X	1 2 X X	1 X X X X	_ X X	1 X X X X X

"_" indicates that item does not apply to the study

"X" indicates that item is not addressed in study

Table 2 Overview of study findings

Study	Purpose	Design sample size Ethnicity/race %Food insecure	Data gathering method Psychometrics (Yes/No)	Coping strategies				
				Public assistance	Private assistance	Social networks	Nutrition-related	Financial-related
Bauer et al. [20]	To examine prevalence and correlates of FI among Lakota children & their families	Cross-sectional N = 432 American Indian 40% FI	Survey Psychometrics (No)	Food Stamp Food Commodities WIC	N/A	*Ti Ole**	Consume hot or ready-made convenience store food	N/A
Calloway et al. [14]	To examine relationship between monthly SNAP benefit duration and five primary outcomes variables (FS, three hunger-coping behavior scales)	Cross-sectional N = 161 Mixed 80% FI	Hunger-Coping Strategies Scale Psychometrics (Yes)	% Use by ethnicity/race not available	% Use by ethnicity/race not available	N/A	Rationing of food	Trade-off Financial
Laraia et al. [19]	To identify characteristic associated with household food insecurity	Cross-sectional N = 206 African American 47% FI	Survey Psychometrics (No)	N/A	N/A	Living with grandmother	N/A	N/A
(Mullany et al. [21])	To describe sociodemographic factors, family eating patterns and consumer practices associated with food insecurity among AI families with young children	Cross-sectional N = 425 American Indians 45% FI	Survey Psychometrics (No)	N/A	Food bank	N/A	Consumption food from convenience stores and fast food	N/A
Sharkey et al. [24]	To examine child hunger among Mexican-origin families by: 1. Determining prevalence of child hunger 2. Identifying protective & risk factors associated with hunger	Cross-sectional N = 470 Hispanics 58.7% FI	2009-Colonia Household and Community Food Resource Assessment Psychometrics (No)	SNAP WIC School Breakfast Program School Lunch Program NSLP	Emergency food pantries	Food sourced from neighbor/friend Buying food from neighbor/friend associated	N/A	Purchase food from: dollar store, mobile food vendor, Pulga*

Table 2 (continued)

Study	Purpose	Design sample size Ethnicity/race %Food insecure	Data gathering method Psychometrics (Yes/No)	Coping strategies				
				Public assistance	Private assistance	Social networks	Nutrition-related	Financial-related
Wood et al., [17]	To identify patterns of coping strategies, test relationship of factor scores to risk factors & other characteristics	Cross-Sectional N = 100 81% Caucasian 85% FI	48-item coping strategy survey Psychometrics (Yes)	Food Stamps WIC Headstart Free/reduc-ed lunch for children	Use of food pantry = 100%	Use of family/friends' network for food or meals	Food intake limitations, preparing and storing food for leaner times	Sold/pawned items for money, extra work/loan
Darko et al. [16]	To explore food shopping behaviors of low-income household in relation to the ebb and flow of economic resources over the course of a month	Qualita-tive N = 72 75% Caucasian N/A% FI	Focus groups	SNAP WIC Free/reduced lunch SNAP dollars surplus for some, insufficient for others	Used local food pantry	N/A	Consumption of carbohydrate-rich, canned, packaged food	Purchase from dollar store Use coupons Sale/Price matching/shopping at lowest price stores Purchase with credit card Preplan meals & shop with list Buy in bulk & store for when finances low
Kaufman and Karpati [22]	To explore how adults and children participate in and perceive food acquisition, exchange, and eating amidst fluctuating and often scarce resources	Qualita-tive N = 12 (families) Hispanic N/A %FI	Ethnographic approach, interviews	SNAP, WIC, other government assistance programs	Food pantries	Food sharing with other family Grandmother stops by with meals Shop with friends and family to split cost of cheaper, bulk items	Purchase food from bodegas	"Taking credit" from local bodegas Monthly grocery store shopping trip at start of month when benefits replenished

Table 2 (continued)

Study	Purpose	Design sample size Ethnicity/race %Food insecure	Data gathering method Psychometrics (Yes/No)	Coping strategies				
				Public assistance	Private assistance	Social networks	Nutrition-related	Financial-related
Parker et al. [15]	To examine the ethnic differences and similarities in food purchase and consumption behaviors of limited resource women during perceived periods of food shortage	Qualita-tive N = 64 Mixed N/A % FI	Focus groups	AI: use of commodity foods AI, AA, C: school feeding program All ethnicities: food stamp program	H: relied on food pantries & churches C: use food banks AI: used churches, food pantries	AA: dropped children at relative's home for meals AI: relied on extended family (especially mother), especially mother, during food shortages H: had less extended family in the US to depend on for help C: support from friends/neighbors	All ethnicities would: eat less, eat cheaper foods, select filling foods if money limited	H: women looked for work outside of homes, men would work extra, borrow money
Barnidge et al. [18]	To identify factors that community felt are important for addressing child hunger in summer, rural and urban	Mixed-Method N = 52 African American 69 % FI	Survey, Focus groups Psychometrics (No)	WIC SNAP School breakfast programs School lunch programs Summer food service program	Food pantry	Rural AA relied more heavily on help from relatives	Adults reduce food intake so children may have sufficient	Urban AA faced more trade off challenges compared to rural Work more hours
Borre et al. [12]	To determine if FI is linked to obesity among adults and children and how conditions that underlie FS contribute to chronic health conditions	Mixed method N = 36 Hispanic 63.8% FI	Interviews, focus groups	Used of WIC, Headstart	Used emergency food banks and local churches If legal documents required, assistance/program avoided	All depended on social networking to reduce vulnerability important for sharing experiences, knowledge, and resources	Consume surplus farm or blemished crop Buy cheapest food, even if not desired or healthy option	Regular work Careful budgeting Some unaware of preplanning grocery shopping or food budgets

Table 2 (continued)

Study	Purpose	Design sample size Ethnicity/race %Food insecure	Data gathering method Psychometrics (Yes/No)	Coping strategies				
				Public assistance	Private assistance	Social networks	Nutrition-related	Financial-related
Quandt et al. [23]	To provide baseline information on food security among migrant and seasonal Latino farmworkers in NC, characterize levels of FS, describe strategies farmworkers use to cope with FI	Mixed methods N = 102 Qualita-tive n = 25 Hispanic 56.4% FI (household with children)	Survey, interviews Psychometrics (No)	Food stamps = WIC Migrant head start Free reduced lunch	Used private food pantries Food Pantry/ Churches/Community agencies	N/A	Wild game, fishing, gardening Adults skip meals Eat same item repeatedly	Work Trade-off strategy Informal borrowing from friends, employers, extended family without interest Limited purchasing of food
Zekeri [13]	To examine how food-insecure, poor, single mothers get food for themselves and children	Mixed-methods N = 100 86% AA N/A %FI	Survey, interviews Psychometrics (No)	Food stamps	Food banks and Churches Eating at Senior Meal Program=	Cash assistance from relatives and friends Cohabitating with relative/friend	Eat cheaper, smaller meals	Work

N/A not available/not applicable, *FI* Food Insecurity, *H* Hispanic, *C* Caucasian, *AA* African American, *AI* American Indian, *Ti Ole* practice of borrowing food from friends/family, *Pulga* similar to a flea market

**Ti ole* is a meal sharing practice in the Lakota community

et al. [19] and Borre et al.'s [12] studies took place in North Carolina; however, it is unclear if these studies were in rural or urban locations. The remaining two studies [15, 16] did not specify their geographical location.

Food Security Status

Most of the studies [12, 13, 19–21, 23, 24] cited a version of the USDA's definition for food insecurity and used a version of the USDA Household Food Security Survey (HFSS). Six studies used the 6-item HFSS [13, 14, 17, 19–21]. Three studies [12, 18, 23] used the 18-item HFSS. Only one study [24] used the 12-item Radimer/Cornell measure for food insecurity. All three instruments have undergone psychometric testing that indicate validity and reliability in the racial/ethnic groups being studied [9, 25–27]. The Spanish version of the 6-item HFSS also has evidence of reliability and validity [26]. The remaining three qualitative studies sampled low-income families that described themselves as food insecure or had concerns of food insecurity.

The range of food insecurity was between 34 and 85%. The median percentage of food insecurity was 58.7%. Table 2 has the reported percentage of food insecurity by study.

Coping Strategies

Studies used different methods to assess coping strategies. Qualitative studies assessed coping strategies through interview and focus groups. Nine [13, 14, 17–21, 23, 24] of the quantitative and mixed method studies used surveys to measure coping strategies. Only two [14, 17] of those nine studies presented psychometric evidence.

Coping strategies were grouped into five categories: public assistance, private assistance, social networks, nutrition-related, and financial-related strategies.

Public Assistance

Nearly all the studies reference a government program as a coping strategy used by parents to ease food insecurity. Seven [13, 16–18, 20, 23, 24] of the 13 studies reported use of food stamps or SNAP. A study examining American Indians reported that 83.3% of families with very low food security were receiving food stamps [20]—the highest prevalence of food stamp use among the different ethnic/racial groups. For Hispanics, the use of food stamps was highly variable with use ranging from 19.4% [23] to 63.4% [24]. Studies involving predominately African Americans reported use of food stamps ranging from 44 to 50% [13, 18]. In Caucasian-predominant studies, 31–56% of the samples received food stamps [16, 17]. Regardless of their percentage of use, all ethnic/racial groups stressed the inadequacy of the food stamp program in meeting their family's needs [15–17, 20, 22–24].

Hispanics had the greatest use of WIC with approximately 70% of the samples reporting enrollment [23, 24]. Approximately 30–50% of American Indians and Caucasians reported use of WIC [16, 17, 20]. Barnidge et al. [18] reported African Americans participation in WIC at only 17%; however, that study specified parents of school-aged children and did not necessarily include younger children.

With respect to the school breakfast and lunch programs, the percentage of use appears to be similar among ethnic/racial groups with approximately 55–60% of African Americans, Hispanic, and Caucasian samples participating [16–18, 23, 24]. Neither of the American Indians studies [20, 21] reported on the use of free or reduced school breakfast or lunch programs.

Factors influencing use of government programs varied across ethnic/racial groups. Amongst Hispanics, parents reported immigration status as a barrier to use of food stamps [22, 23]. African Americans mentioned that stigma associated with use of government programs was sufficient to prevent their enrollment [13]. Conversely, in a Hispanic study, stigma was mentioned; however, it was not a barrier to accepting available services [22].

Private Assistance

10 of the 13 studies shared findings regarding use of food banks, pantries, or local churches for sources of food. Mullany [21] reported use of food banks by 44% of the sample of American Indians. The two primarily Caucasian studies [16, 17] did not report percentage of sample using private assistance programs; however, both recruited participants from food banks or pantries.

Within the Hispanic and African Americans studies there is discrepancy regarding use of private assistance. Sharkey et al.'s [24] study of Hispanic families living in the colonias along the Texas-Mexico border reported only 1.9% of the sample sourcing food from emergency assistance programs. However, the remaining four studies with Hispanics [12, 15, 22, 23] consistently reported use of food banks, pantries, or churches- although they did not quantify the use of this strategy.

Of the three studies that sampled African Americans, two studies reported use of food banks at 25% [18] and 43% [13]. However, in Parker's [15] study, the African American sample did not list food banks, pantries, or churches as a coping strategy for food insecurity.

Social Networks

Each of the four ethnic/racial groups listed food sharing or borrowing from friends and family as a strategy to lessen

food insecurity [15]. African Americans, Hispanics, and American Indians specifically referenced grandmothers as being a resource [15, 19, 22]. Hispanic and African American parents who used social networks significantly reduced their odds of food insecurity [19, 24]. However, newly migrated Hispanic families may not have not established a strong social network [12, 15]. American Indian families that sought food from friends and family were significantly more likely to be food insecure ($p < 0.001$) [20].

Nutrition-Related Strategies

Nutrition-related strategies are tactics that either compromise, or protect, the dietary quality for food insecure families. All ethnic/racial groups reported reducing, rationing, or skipping meals [13–15, 17, 18, 23]. There is no statistically significant difference in rationing of food among the ethnic/racial groups [14]. All groups also consumed lower-cost, carbohydrate-rich diets [15]. Food insecure American Indians frequently consumed foods purchased from convenience stores and gas stations [20, 21]. Hispanic parents purchased food from dollar stores and bodegas [22, 24]. They also obtained surplus or blemished crops, gardened, and hunted [12, 23].

Financial-Related Strategies

Trade-off is a strategy in which parents must choose between paying for food or paying bills or other household expenses [14]. Although all ethnic/racial groups reported trade-off decisions, African American parents had statistically significant higher scores on trade-off compared to Caucasian parents [14].

African Americans and Hispanics tried to find additional work [12, 13, 15, 18, 23].

Caucasians and Hispanics reported using credit to purchase food. However, Caucasians used credit cards [16] whereas Hispanic families used less formal means of borrowing money without interest or purchasing food with store credit [22, 23]. Caucasian [16] and Hispanic [22] parents also described in-store purchasing strategies, such as couponing, to stretch their food budgets.

Discussion

Summary of Findings

The 13 studies identified in this review examined similarities and differences in strategies used by African American, American Indian, Hispanic, and Caucasian parents to cope with food insecurity. The limited evidence suggests that although the ethnic/racial groups share common coping strategies, there are nuances in their application of these strategies. Table 3 highlights coping strategies for food insecurity among these groups as reported in the published literature.

Similarities among the ethnic/racial groups include concerns regarding the adequacy of the food stamp program in providing households with sufficient food. Parents from each of the groups also dealt with food insecurity by reducing, rationing, or skipping meals and consuming low-cost, carbohydrate-rich diets. These coping strategies could contribute to negative health outcomes such as malnourishment and obesity. Food sharing, another common coping strategy, reduces parent's ability to determine what their children eat [22].

Although limited, the evidence suggests that there are differences in how parents of different ethnicities/race apply the coping strategies to meet their needs. For example, Hispanic parents who are undocumented may not be able to, or may fear, participating in government-sponsored food assistance programs [22]. They may also be reluctant to patron food banks that require documentation [12]. In addition, Hispanic parents depend heavily on social networks as a coping strategy. Grandmothers and familiarity with owners of local bodegas are examples of this networking [22]. However, those who are new arrivals to the US may not have a strong network thus further increasing their vulnerabilities to food insecurity [12, 15]. The only study to mention gardening and hunting as a coping strategy was a Hispanic study [23].

Within African American parent groups, stigma with respect to accepting food stamps was mentioned in one study [13]. In Parker et al.'s [15] focus group study, they did not list use of food banks, pantries, or churches as a source of food although other studies indicate that African Americans did participate in these program [13, 18]. According to one of the two studies that did a direct comparison among ethnic/racial groups, African American parents were significantly more likely to direct their money towards food in place of other bills [14].

Studies involving American Indian parents with food insecurity suggest that they frequently use convenience store meals to feed their children [20, 21]. The extent of this use and how it compares to the use of bodegas by Hispanic families cannot be determined using current evidence.

Most of the studies in the review did not allow direct comparison on use of the coping strategies by ethnicity/race. Therefore, the comparisons are only suggestive and call for a need for additional study.

Limitations of the Studies

The studies used in this review have several limitations. One limitation is risk of sampling bias because of recruitment from Headstart centers, food banks, and WIC offices. The

Table 3 Coping strategies for food insecurity categorized by ethnicity/race as reported in the published literature

Coping strategies	African American	American Indian	Caucasian	Hispanic
Public assistance	Food stamps [13, 15, 18] WIC [18] School Breakfast & Lunch Program [15, 18] Barriers to use: Stigma [13]	Food stamps [15, 20, 21] WIC [20] School Breakfast & Lunch Program [15] Food commodities [15, 20]	Food stamps [15–17] WIC [16, 17] School Breakfast & Lunch Program [15–17]	Food stamps [15, 23, 24] WIC [12, 23, 24] School Breakfast & Lunch Program [12, 15, 23, 24] Barriers to use: Immigration [22]
Private assistance	Food banks [13, 18]	Food banks [15]	Food banks [15–17]	Food banks [12, 15, 22–24]
Social networks	Food sharing/borrowing [13, 15, 18] Grandmother's support [19]	Food sharing/borrowing [15, 20] Grandmother's support [15]	Food sharing/borrowing [15, 17]	Food sharing/borrowing [12, 22–24] Grandmother's support [22]
Nutrition-related strategies	Reducing, rationing, or skipping meals [13–15, 18] Consume lower-cost, carbohydrate-rich diets [15]	Reducing, rationing, or skipping meals [14, 15] Consume lower-cost, carbohydrate-rich diets [15] Consume meals from convenience stores/gas stations [20, 21]	Reducing, rationing, or skipping meals [14, 15, 17] Consumed lower-cost, carbohydrate-rich diets [15, 16] Proactively prepare and store foods [17]	Reducing, rationing, or skipping meals [14, 15, 23] Consume lower-cost, carbohydrate-rich diets [12, 15] Consume meals from bodegas [22] Hunt/Garden [12, 23]
Financial-related strategies	Report trade-off decisions [14, 18] Increase work [13, 18]	Report trade-off decisions [14]	Report trade-off decisions [14] Increase work [17] Purchase on credit [16] In-store purchasing strategies [16] Dollar store food purchases [16]	Report trade-off decisions [14, 23] Increase work [12, 15] Purchase on credit [15, 22] In-store purchasing strategies [22, 23] Dollar store/Bodegas food purchases [22, 24]

coping strategies used by these individuals may be different from those who are food insecure but do not use these programs. Recruiting from a university setting [16] also is not representative given that most food insecure individuals only have high school education or less [1]. The studies also did not uniformly control for covariates such as acculturation, age of children, and rural versus urban settings. Additionally, statistical analysis of coping strategies was primarily limited to descriptive statistics. Because many of the studies in this review have sampling bias, the results of the descriptive statistics may have limited generalizability.

The most critical limitation in the quantitative studies is lack of reliability and validity for measurements of coping strategies. Only two studies [14, 17] provided psychometric evidence for their coping strategies measurement. The qualitative studies share a similar lack of confidence for credible findings given the lack of clear methodology and analysis.

Strengths and Weaknesses of the Review

A strength of this review is the integration of quantitative, qualitative, and mixed method studies. The quantitative designs provided descriptive and some inferential statistics. However, the qualitative designs give additional information to help understand the context in which parents select certain strategies. The use of the Household Food Security Survey as the operational definition for food insecurity in nearly all studies strengthened the review by providing a common ground from which comparisons could be made with respect to food security status. Finally, most studies appear to have collected data between 2002 and 2014. The passage of the 2002 Farm Bill impacted the eligibility of SNAP for legal immigrants [28] and WIC food packages changed in 2014 [29]. Both policy changes could have influenced the strategies parents used for food insecurity; however, because data were collected between these years, the influence these policy changes may have been minimized.

This systematic review focused on African Americans, American Indians, Hispanics, and Caucasians. However, the groups have unequal representation in the total sample size and the number of studies representing their ethnicity/race. Furthermore, the US has other ethnic/racial minorities, such as African, Middle Eastern and Southern Asian groups that may include recent immigrants and refugees who are also vulnerable to food insecurity. Their exclusion from this review because of lack of studies widens the gap in knowledge.

Addition to Current Knowledge

To some extent, all ethnic/racial groups studied in this review used similar coping strategies. Issues such as social stigma, immigration status, use of credit, and accessibility to grocery and convenience stores are factors that appear to influence the choices in coping strategies used by parents of different ethnic/racial groups. Additional research will hopefully clarify to what extent these issues play a role in directing coping strategies used by parents. This knowledge will assist in development of culturally acceptable and practical programs and policies to address food insecurity in vulnerable populations.

A basis for a culturally acceptable program may be through social networking, a coping strategy used by parents in each of the ethnic/racial groups. Community discussions through social networks could help reduce stigma associated with use of government aid for African Americans. Through social networking, a safety net program could be shared with Hispanic families that have immigrated to US so that they may identify sources for meals/food that they would feel safe accessing. Another example of a culturally acceptable program could be an intervention delivered through grandmothers to help African American, American Indian, and Hispanic parents develop skills in budgeting, strategic grocery shopping, and proper storage of food to maximize families' food resources.

Implications for Future Research

This review uncovers a gap in knowledge with respect to the ability to determine if certain strategies are culturally preferred. Additionally, most of the studies that were used in this systematic review suffered from serious threats to validity with respect to measurements of coping strategies, which weakened the credibility of their findings. Therefore, determining similarities and differences in food insecurity coping strategies by ethnicity/race needs robust studies that: (1) have a specific aim to examine coping strategies, (2) sample representative groups, (3) control for covariates, (4) use valid, reliable quantitative measures or explicit qualitative methods.

Findings from studies in this review also suggest the need to examine how other factors such as geographic location and acculturation affect coping strategies used by parents. Studies also need to include other groups vulnerable to food insecurity such as refugees and immigrants from countries outside of North and Central America.

Families immigrating to the US may have an increased risk for food insecurity [30]; however, they also have a delay in eligibility for programs such as SNAP and decreased social safety nets. Therefore, an awareness of how parents of different cultures apply coping strategies may help in the development of community-based programs that will lessen their risk for food insecurity and its consequences.

Conclusion

Although parents of different ethnic/racial backgrounds use similar strategies to cope with food insecurity, how they use these strategies varies. Current evidence is insufficient to confidently determine the extent of these differences. This review is a starting point for exploration cultural nuances in coping strategies used by food insecure parents of various ethnic/racial backgrounds. The review also lists specific recommendations for further research.

As the US population continues to diversify, identification of the similarities and differences in coping strategies among ethnicities/races using strong research methods will help to develop culturally acceptable policies and programs that may reduce food insecurity and associated negative outcomes.

Compliance with Ethical Standards

Conflict of Interest The authors declare that she has no conflict of interest.

Research Involving Human and Animal Participants This article does not contain any studies with human participants or animals performed by any of the authors.

Appendix 1

Pubmed Boolean logic command

Search performed 2/6/2017

Search limit from 01/01/1995 through 02/01/2017

Search results 805 articles

("Food Supply"[Mesh] OR "Food security"[tiab] OR "Food insecurity"[tiab] OR "Food patterns"[tiab] OR "Access to Food"[tiab] OR Hunger[tiab] OR "Food insufficiency"[tiab] OR "Food scarcity"[tiab] OR "Food choice"[tiab] OR "Food Hardship"[tiab] OR "Food Supplies"[tiab] OR "Food Insecurities"[tiab] OR "Food Supply"[tiab])

AND

("Charities"[Mesh] OR "Food Assistance"[Mesh] OR "Medicaid"[Mesh] OR "coping ability"[tiab] OR "coping behaviour"[tiab] OR "coping strategy"[tiab] OR "Coping strategies" [tiab] OR "Maternal Buffering"[tiab] OR Buffering[tiab] OR Sharing[tiab] OR Adapt*[tiab] OR "Coping Behavior"[tiab] OR "Coping Behaviors"[tiab] OR "Coping Skills"[tiab] OR "Coping Skill"[tiab] OR "Adaptive Behavior"[tiab] OR"Adaptive Behaviors"[tiab]

OR "Food Assistance Programs"[tiab] OR "Food Assistance Program"[tiab] OR "Food Aid Program"[tiab] OR "Food Aid Programs"[tiab] OR "Supplemental Nutrition Assistance Program"[tiab] OR "SNAP Program"[tiab] OR "SNAP Programs"[tiab] OR "Food Stamps"[tiab] OR "Food Stamp"[tiab] OR Medicaid[tiab] OR "Special Supplemental Nutrition Program"[tiab] OR "WIC"[tiab] OR "Social Support"[tiab] OR Coupon*[tiab] OR Shopping[tiab] OR Gardening[tiab] OR Reducing[tiab] OR "Cutting meals"[tiab] OR "Food Bank"[tiab] OR "Soup kitchen"[tiab] OR Sharing[tiab] OR Heat*[tiab] OR Electricity[tiab] OR Water[tiab] OR Utilit*[tiab] OR Network*[tiab] OR Social[tiab] OR Steal*[tiab] OR "Hunger-coping"[tiab] OR Compromis*[tiab] OR Manag*[tiab] OR Deal*[tiab] OR Handl*[tiab])

AND

("Ethnic Groups"[Mesh] OR "Minority Groups"[Mesh] OR "Emigrants and Immigrants"[Mesh] OR Minorit*[tiab] OR ethnic*[tiab] OR "African americans"[tiab] OR "African american"[tiab] OR Mexican*[tiab] OR hispanic*[tiab] OR latino*[tiab] OR latina*[tiab] OR migrant*[tiab] OR immigrant*[tiab] OR "Asian american"[tiab] OR "Asian americans"[tiab] OR "Low-income"[tiab] OR "low income"[tiab] OR undocumented[tiab]).

Appendix 2

Embase Boolean logic command

Search performed 2/7/2017

Search limit from 01/01/1995 through 02/01/2017

Search results: 855 articles

('food insecurity'/exp OR 'food security'/exp OR 'hunger'/exp OR 'food security':ti,ab OR 'Food insecurity':ti,ab OR 'Food patterns':ti,ab OR 'Access to Food':ti,ab OR 'Hunger':ti,ab OR 'Food insufficiency':ti,ab OR 'Food scarcity':ti,ab OR 'Food choice':ti,ab OR 'Food Hardship*':ti,ab OR 'Food Supplies':ti,ab OR 'Food Insecurities':ti,ab OR 'Food Supply':ti,ab)

AND

('Coping Strategy Questionnaire'/exp OR 'coping behavior'/exp OR 'family coping'/exp OR 'coping ability':ti,ab OR 'coping behaviour':ti,ab OR 'coping strategy':ti,ab OR 'Coping strategies':ti,ab OR 'Maternal Buffering':ti,ab OR 'Buffering':ti,ab OR 'Sharing':ti,ab OR Adapt*:ti,ab OR 'Coping Behavior':ti,ab OR 'Coping Behaviors':ti,ab OR 'Coping Skills':ti,ab OR 'Coping Skill':ti,ab OR 'Adaptive Behavior':ti,ab OR 'Adaptive Behaviors':ti,ab OR 'Food Assistance Programs':ti,ab OR 'Food Assistance Program':ti,ab OR 'Food Aid Program':ti,ab OR 'Food Aid Programs':ti,ab OR 'Supplemental Nutrition Assistance Program':ti,ab OR 'SNAP Program':ti,ab OR 'SNAP Programs':ti,ab OR 'Food Stamps':ti,ab OR 'Food Stamp':ti,ab OR 'Medicaid':ti,ab OR 'Special Supplemental Nutrition Program':ti,ab OR 'WIC':ti,ab OR 'Social Support':ti,ab OR Coupon*:ti,ab OR 'Shopping':ti,ab OR 'Gardening':ti,ab OR 'Reducing':ti,ab OR 'Cutting meals':ti,ab OR 'Food Bank':ti,ab OR 'Soup kitchen':ti,ab OR 'Sharing':ti,ab OR 'Heat':ti,ab OR 'Electricity':ti,ab OR 'Water':ti,ab OR Utilit*:ti,ab OR Network*:ti,ab OR 'Social':ti,ab OR Steal*:ti,ab OR 'Hunger-coping':ti,ab OR Compromis*:ti,ab OR Manag*:ti,ab OR Deal*:ti,ab OR Handl*:ti,ab)

AND

('ethnicity'/exp OR 'Hispanic'/exp OR 'ethnic group'/exp OR 'minority group'/exp OR 'migrant'/exp OR 'undocumented immigrant'/exp OR Minorit*:ti,ab OR ethnicit*:ti,ab OR 'African americans':ti,ab OR 'African american':ti,ab OR Mexican*:ti,ab OR hispanic*:ti,ab OR latino*:ti,ab OR latina*:ti,ab OR migrant*:ti,ab OR immigrant*:ti,ab OR 'Asian american':ti,ab OR 'Asian americans':ti,ab OR 'Low-income':ti,ab OR 'low income':ti,ab OR 'undocumented':ti,ab)

References

1. Coleman-Jensen A, Rabbitt MP, Gregory CA, Singh A. Household Food Security in the United States in 2015; 2016.
2. Jernigan VBB, Huyser KR, Valdes J, Simonds VW. Food insecurity among American Indians and Alaska Natives: a national profile using the current population survey food security supplement. J Hunger Environ Nutr. 2017;12(1):1–10.
3. Gundersen C, Ziliak JP. Food insecurity and health outcomes. Health Aff (Millwood). 2015;34(11):1830–9.
4. Chilton M, Rabinowich J, Breen A, Mouzon S. When the systems fail: individual and household coping strategies related to child hunger. Paper commissioned for the Workshop on Research Gaps and Opportunities on the Causes and Consequences of Child Hunger, convened by the National Academy of Sciences Committee on National Statistics and Food and Nutrition Board, on April; 2013.
5. Glanz K, Rimer BK, Viswanath K. Health behavior: theory, research, and practice. 5th ed. San Francisco: Jossey-Bass & Pfeiffer Imprints, Wiley; 2015.
6. Hughes SO, Power TG, O'Connor TM, Orlet Fisher J, Chen T. Maternal feeding styles and food parenting practices as predictors of longitudinal changes in weight status in Hispanic preschoolers from low-income families. J Obes. 2016;2016:1–9.
7. Franco L, Pottick K, Huang C. Early parenthood in a community context: neighborhood conditions, race-ethnicity, and parenting stress. J Community Psychol. 2010;38(5):574–90.
8. Martin KS, Rogers BL, Cook JT, Joseph HM. Social capital is associated with decreased risk of hunger. Soc Sci Med. 2004;58(12):2645–54.
9. Hamilton WL, Cook JT, Thompson WW, Buron LF. Household food security in the United States in 1995: Summary report of the Food Security Measurement Project. Abt Associates; 1997.
10. Whittemore R. Combining evidence in nursing research: methods and implications. Nurs Res. 2005;54(1):56–62.
11. Walsh D, Downe S. Appraising the quality of qualitative research. Midwifery. 2006;22(2):108–19.

12. Borre K, Ertle L, Graff M. Working to eat: vulnerability, food insecurity, and obesity among migrant and seasonal farmworker families. Am J Ind Med. 2010;53(4):443–62.
13. Zekeri AA. Livelihood strategies of food-insecure poor, female-headed families in rural Alabama. Psychol Rep. 2007;101(3 Pt 2):1031–6.
14. Calloway EE, Fricke HE, Pinard CA, Smith TM, Yaroch AL. Monthly SNAP benefit duration and its association with food security, hunger-coping, and physiological hunger symptoms among low-income families. J Appl Res Child 2015;6:5.
15. Parker S, Pinto V, Kennedy T, Phelps JA, Hermann JR. Food choices and coping strategies during periods of perceived food shortage: perspectives from four racial/ethnic groups. J Ext 2007;45:5FEA6
16. Darko J, Eggett DL, Richards R. Shopping behaviors of low-income families during a 1-month period of time. J Nutr Educ Behav 2013;45(1):20–9.
17. Wood DK, Shultz JA, Butkus SN, Ballejos ME. Patterns of food coping strategies among food pantry clients. J Hunger Environ Nutr. 2009;4(2):185–202.
18. Barnidge EK, Chapnick M, Sawicki M, Baker EA, Huang J. Food insecurity in the summer: a rural-urban comparison of African American households with children. J Hunger Environ Nutr 2016;12:1–16.
19. Laraia BA, Borja JB, Bentley ME. Grandmothers, fathers, and depressive symptoms are associated with food insecurity among low-income first-time African-American mothers in North Carolina. J Am Diet Assoc. 2009;109(6):1042–7.
20. Bauer KW, Widome R, Himes JH, Smyth M, Rock BH, Hannan PJ, et al. High food insecurity and its correlates among families living on a rural American Indian reservation. Am J Public Health. 2012;102(7):1346–52.
21. Mullany B, Neault N, Tsingine D, Powers J, Lovato V, Clitso L, et al. Food insecurity and household eating patterns among vulnerable American-Indian families: associations with caregiver and food consumption characteristics. Public Health Nutr. 2013;16(4):752–60.
22. Kaufman L, Karpati A. Understanding the sociocultural roots of childhood obesity: food practices among Latino families of Bushwick, Brooklyn. Soc Sci Med. 2007;64(11):2177–88.
23. 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(6):568–76.
24. Sharkey JR, Dean WR, Nalty CC. Child hunger and the protective effects of Supplemental Nutrition Assistance Program (SNAP) and alternative food sources among Mexican-origin families in Texas border colonias. BMC Pediatr. 2013;13:143.
25. Blumberg SJ, Bialostosky K, Hamilton WL, Briefel RR. The effectiveness of a short form of the Household Food Security Scale. Am J Public Health. 1999;89(8):1231–4.
26. 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(4):1192.
27. Marques ES, Reichenheim ME, de Moraes CL, Antunes MML, Salles-Costa R. Household food insecurity: a systematic review of the measuring instruments used in epidemiological studies. Public Health Nutr. 2015;18(5):877–92.
28. Capps R. Assessing implementation of the 2002 farm bill's legal immigrant food stamp restorations: Final Report to the United States Department of Agriculture Food and Nutrition Service; 2004.
29. USDA: USDA finalizes changes to the WIC program, expanding access to healthy fruits and vegetables, whole grains, and low-fat dairy for women, infants, and children; 2014.
30. Chilton M, Black MM, Berkowitz C, Casey PH, Cook J, Cutts D, Jacobs RR, Heeren T, De Cuba SE, Coleman S, Meyers A, Frank DA. Food insecurity and risk of poor health among US-born children of immigrants. Am J Public Health. 2009;99(3):556–62. https://doi.org/10.2105/AJPH.2008.144394.

CURRICULUM VITAE

Nipa Kamdar, PhD, RN, FNP-BC

EDUCATION

Institution and Location	Degree	Completion Date	Field of Study
University of Michigan, Ann Arbor	BSN	5/2000	Nursing
University of NC, Chapel Hill	MSN	5/2003	Family Nurse Practitioner
University of Texas Health Science Center, Houston	PhD	Anticipate 5/2018	Nursing

PROFESSIONAL POSITIONS

University of Texas Health, School of Nursing March '15 to Current
Clinical Instructor

- Create clinical experiences for communtiy health
- Design and implement an evidence-based intervention with undergraduate students every semester
- Teach nursing process
- Teach and evaluate clinical progress of graduate students in Family Nurse Practitioner Program

CHRISTUS School Based Clinic Aug '10 to Jan '15
Family Nurse Practitioner

- Created and executed programs focused on health eating and physical activity
- Installed and maintained school vegetable gardens
- Redesigned school lunches and snacks
- Developed marketing material for school based clinics
- Participated in research studies with the American Lung Association, Rice University, and University of Houston
- Evaluate and manage primary care issues in children and adults
- Manage 15 school health clinics

Lone Star Community College Sep '10 to Dec '11
Nurse Educator

- Taught medical-surgical skills as a lab instructor
- Supervised as clinical instructor for medical surgical rotation

Minute Clinic Feb '08 to Aug '10
Family Nurse Practitioner

- Diagnosed and treated primary care issues in a convenient-care clinic.
- Practiced in an autonomous setting.
- Managed daily business duties (accounting, inventory)

Rehabilitation Medical Specialists May ‘06 to Nov ’07
Detroit Receiving/ Harper University Hospitals Detroit, MI
Family Nurse Practitioner

- Performed physical medicine and rehabilitation consultations
- Managed potential medical and social issues that could hinder patient progress in rehab recovery
- Coordinated patient care and transfers with multiple health teams and specialties

University Internal Medicine Specialists Jul ‘04 to May ‘06
Detroit Receiving Hospital- Hospitalist Division, Detroit, MI
Family Nurse Practitioner

- Manged acute care for patients with complex illnesses.
- Modified treatment plans to address social issues such as substance abuse, lack of insurance, lack of finances, and homelessness.

Center for Physical Medicine and Rehabilitation, Warren, MI Aug ‘03 to Jul ‘04
Family Nurse Practitioner

- Evaluated and managed of subacute rehabilitation clients.
- Monitored and manage pain issues.
- Adjusted care and instructions to meet client’s level of cognition and physical limitations.
- Organized and lead team discussions to address challenges hindering patient progress.

Children’s Hospital of North Carolina, Chapel Hill, NC Jul ‘00 to Aug ‘01
General Medicine Pediatric Nurse

- Provided comprehensive inpatient bedside care to pediatric patients.

PROFESSIONAL MEMBERSHIPS

Sigma Theta Tau Honor Society 2000- present
Southern Nursing Research Society 2018-present

PUBLICATIONS

Kamdar, N., Rozmus, C., Meininger, J., Grimes, D. (2018). Ethnic/Racial Differences in Strategies Parents Use to Cope with Food Insecurity: An Integrative Review of Published Research. Journal of Immigrant and Minority Health, 1-14. https://doi.org/10.1007/s10903-018-0720-y

Kamdar, N. (2017). Child Obesity: Analysis of a Population Health Problem. Journal of Nursing Doctoral Students Scholarship, 5(1), 27-37.

Kinariwala, N (2003). Tighter regulation needed for dietary supplements in USA. Lancet, 361(9368).

PRESENTATIONS

Kamdar, N.; Hernandez, D.C., Thompson, D.I., Hughes, S.O. **(**2018). Influence of Food Security on Food Parenting Practices in Parents of Children Ages 2-10 in English-Speaking, Developed Countries: An Integrative Review. Poster session presented at the Texas Academy of Nutrition and Dietetics Annual Conference, Houston, TX.

Aljawarneh, Y., **Kamdar**, N., Lewis, M., Vincent, H. (2017, May). Behavior Predictive of Texting While Driving in American Adolescents. Poster session presented at the Texas Children's Hospital Advanced Practice Providers Conference, Houston, TX.

AWARDS & RECOGNITIONS

1996-2000	Shipman Scholar, University of Michigan
2000	Graduated Summa cum Laude, University of Michigan
2001-2003	Johnston Scholar, University of North Carolina
2003	Master of Science Outstanding Student Achievement, University of North Carolina
2015-2018	Robert Wood Johnson Future of Nursing Scholar