Investigating the Complexity of Childhood Obesity within Multilevel Environments in a Hispanic Sample Using Structural Equation Modeling

by

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ABSTRACT

The trend of obesity among Hispanic children is impacted by multiple factors working jointly. The current study aimed to explore the associations among factors at different ecological levels with child's anthropometric outcomes in a Hispanic sample.

The sample consisted of 309 children (5-9 years) who were enrolled in the *Transformacion Para Salud* (Transformation for Health) project, an 18-month community-based intervention project in West Texas. Baseline data were used for this study. Measured factors included: child daily sugar-sweetened beverage intake and fruit/vegetable intake, TV viewing time, parent's nutrition knowledge, support for physical activity, family meal and fast food frequency, acculturation, and participation in food assistance program(s). The outcomes were child's body mass index percentile, waist circumference, and body fat percentage.

Effects of all these factors on anthropometric outcomes were tested by structural equation modeling. For all three anthropometric outcomes, the models fit the data adequately: CFI is 0.921-0.940 and RMSEA is 0.040-0.042. Child daily sugar-sweetened beverage was positively impacted by daily TV viewing and fast food frequency. Child fruit and vegetable intake was negatively related to fast food frequency and positively related to parent's support physical activity and participation in food assistance programs. Parent's nutrition knowledge had a negative effect on child weight status. Acculturation was positively associated with fast food frequency, parent's nutrition knowledge, and physical activity support.

The significant factors associated with overweight and obesity may provide a basis for future prevention and intervention strategies targeting Hispanic children.

Key words: childhood obesity, Hispanics, multilevel environments, Bronfenbrenner's ecological theory, structural equation modeling.

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CHAPTER I

INTRODUCTION

The prevalence of overweight and obesity has been increasing over the past three decades (BeLue, Francis, Rollins, & Colaco, 2009). Specifically, the rate of obesity among children has been on the rise: the number of children who are overweight has been doubled among 2- to 5-year-old children (Nicklas & Hayes, 2008); more than 25% of preschool children being classified as overweight or obese (Ciampa et al., 2010). The number of children who are overweight has tripled among 6- to 11-year-old children in the past 3 decades (Nicklas & Hayes, 2008). Prevalence among adolescents has been doubled over the past thirty years (BeLue et al., 2009). Overweight children are likely to be more overweight in adulthood (Würbach, Zellner, & Kromeyer-Hauschild, 2009). In addition, overweight children and adolescents have a higher risk of suffering cardiovascular disease and type 2 diabetes, and their families have to bear considerably higher disease burdens and costs related to these diseases (BeLue et al., 2009). The prevalence of obesity has been increasing in all ages, races, socioeconomic levels, and geographic areas, but Hispanic children are at greater risk for being overweight or obese (Bowie, Juon, Cho, & Rodriguez, 2007; Lutfiyya, Garcia, Dankwa, Young, & Lipsky, 2008).

A range of personal, familial, community, and cultural factors have been identified as predictors in the development of obesity in children. Several indicators have been related to the prevalence of obesity among Hispanic children: dietary habits (Allen et al., 2007; Bowie et al., 2007), low socioeconomic status (SES), including low education level, unemployment, poverty (Gordon-Larsen, Harris, Ward, & Popkin, 2003;

Kaplan, Huguet, Newsom, & McFarland, 2004), low physical activity (Bowie et al., 2007), high television viewing time (Timperio et al., 2008), parental physical activity support (Sallis et al., 1993), and acculturation to Westernized lifestyle (Gordon-Larsen et al., 2003; Hubert, Snider, & Winkleby, 2005).

A Review for Ecological Theory

The development of childhood weight and obesity is impacted jointly by multiple factors. According to recent reviews of childhood obesity programs, the majority of prevention/ intervention programs have been mainly conducted in schools with children and adolescents (American Dietetic Association, 2006; Birch & Ventura, 2009). However, schools are only one of several settings that may influence child health. Therefore, the efforts to control the spread of childhood obesity require an understanding the relationships among different levels of risk factors.

These levels can be conceptualized using Bronfenbrenner's (1977) ecological systems theory. The theory highlights the importance and influences of several nested contexts in which individuals develop. The traditional Bronfenbrenner's ecological systems theory was chosen as the foundation for the current study.

Bronfenbrenner (1979) argued that the study of human development demands examination of interaction between (a) the human being and (b) dynamic environments. He defined the ecology of human development as "the scientific study of the progressive, mutual accommodation between an active, growing human being and the changing properties of the immediate setting in which the developing person lives, as this process is affected by relations between these settings, and by the larger contexts in which the settings are embedded (Bronfenbrenner, 1979, p. 21)." The ecological environment is not

limited to a single, immediate setting. Instead, it indicates broader and more differentiated systems. Bronfenbrenner defined four levels of systems: (a) microsystem; (b) mesosystem; (c) exosystem; and (d) macrosystem.

Bronfenbrenner (1977) originally conceptualized the micorsystem as the complex relationships between the person and immediate setting in which person resides. A setting is defined as "a place with particular physical features in which the participants engage in particular activities in particular roles for particular periods of time (Bronfenbrenner, 1977, p.514)." All the direct transactions that take place between individuals and environment are part of the microsystem. The microsystems for adults can be home, work, and social life. For children, the microsystems are typically schools, home, day care centers, camps, play groups, and hospitals (Bronfenbrenner, 1976, 1977). The mesosystem includes the interrelations among the major settings in which individuals participate. The mesosystem reflects the potential reference of individual family members' knowledge and experiences upon their interactions with each other. This knowledge is gained from environments in which family members do not interact simultaneously (Eamon, 2001a). For example, a parent's workplace is a mesosystem to a child. Similarly, a child's school is a mesosystem to a parent. The exosystem includes one or more settings that do not contain the person, but impact his/her development (by interacting with some structure in his/her microsystem). The exosystem can include the site of local decision-makers/services in communities (e.g. Hong & Garbarino, 2012). These decision-makers define the quality, degree and requirements for family members' access to services. For example, administrators might determine criteria for utilization of food services. These decisions impact a family's access to food, even though family

members and administrators have no contact with each other. The macrosystem refers to the overarching institutions of the culture or subculture. Culture provides meaning to rules for normative behaviors. For example, child-feeding practices and preferences for physical activity are found to be influenced by culture (Airhihenbuwa, Kumanyika, Agurs, & Lowe, 1995; Bruss et al., 2005). A different culture may define which types of food are healthy and which are unhealthy very inconsistently. Culture can also contribute to how people perceived ideal body size. For instance, Latinas tend to prefer a plump figure for their children and serve larger food portions than children need (Contento, Basch, & Zybert, 2003).

From Bronfenbrenner's (1979) perspective, traditional research designs only investigated individuals' behaviors and development in one setting at a time. However, the ecological approach takes the joint impact of multiple settings or their elements into consideration. Thus, the ecological theory has been used to guide research in diverse areas of child development, such as human rights (Bruyere & Garbarino, 2010), developmental risks (Garbarino & Ganzel, 2000), effects of poverty (Eamon, 2001a), and obesity (Birch & Ventura, 2009; Davison & Birch, 2001). Davison and Birch (2001) adapted Bronfenbrenner's traditional theory to create a conceptual framework for studying childhood obesity. According to this model, childhood obesity is associated with risk factors at different levels (e.g. individual, familial, and societal). Consistent with Bronfenbrenner (1979) and Division and Birch (2001), children's dietary intake (e.g. sugar-sweetened beverage and fruit and vegetable intake) and activity patterns (e.g. daily TV viewing time) of children can be categorized into microsystems. Parenting styles, parent's dietary habits (e.g. family meal and fast food frequency) and physical activity

patterns, nutritional knowledge, parent's physical activity support, and sibling interactions can be mesosystem factors. Exosystems can be composed of factors such as socioeconomic status, school lunch programs, accessibility of convenience foods, and restaurants. Culture (e.g. beliefs, values, and acculturation) should be considered as macrosystem level factors.

Microsystem Level Factors

Sugar-sweetened Beverage and Fruit and Vegetable Intake

Several studies have found that increased consumption of sugar-sweetened drinks is associated with excessive weight and child overweight (Berkey, Rockett, Field, Gillman, & Colditz, 2004; Gibson, 2008; Gillis & Bar-Or, 2003; Ludwig, Peterson, & Gortmaker, 2001; Malik, Schulze, & Hu, 2006; Nicklas, Yang, Baranowski, Zakeri, & Berenson, 2003). Cross-sectional and longitudinal studies suggest a positive trend between the intake of sugar-sweetened beverages and children and adolescents overweight or obesity (Ariza, Chen, Binns, & Christoffel, 2004; Berkey et al., 2004; Ludwig et al., 2001; Striegel-Moore et al., 2006). Nevertheless, other studies have found non-significant positive relations or no associations (Andersen et al., 2005; Rajeshwari, Yang, Nicklas, & Berenson, 2005). Diets high in fruits and vegetables are associated with lower body weight due to the high level of water and fiber and low level of energy density (Lin & Morrison, 2002; Tohill, Seymour, Serdula, Kettle-Khan, & Rolls, 2004). Fruit and vegetable consumption is expected to negatively relate to weight status (Howard et al., 2006; Ledoux, Hingle, & Baranowski, 2011; Sartorelli, Franco, & Cardoso, 2008). However, findings are not consistent. Some studies didn't significantly

predict changes in BMI, but predicted the inverse associations (Field, Gillman, Rosner, Rockett, & Colditz, 2003; Whybrow, Harrison, Mayer, & James Stubbs, 2006).

Daily TV Viewing Time

Sedentary behaviors, such as watching television and playing electronic games, may contributed to obesity (Rodríguez-Oliveros et al., 2011). It has been reported that overweight children (grades 4-5 and 8-9) participated in less physical activity and spent on average more time watching television than the nonobese children (Bernard, Lavallée, Gray-Donald, & Delisle, 1995). Several cross-sectional studies have reported significant positive associations between TV viewing time and weight status in children and adolescents (Kautiainen, Koivusilta, Lintonen, Virtanen, & Rimpelä, 2005; Lowry, Wechsler, Galuska, Fulton, & Kann, 2002; Stettler, Signer, & Suter, 2004). A meta-analysis on the effect of sedentary behavior on body composition, however, concluded that the effects of television and electronic games on BMI are small and unlikely to be of clinical relevance (Marshall, Biddle, Gorely, Cameron, & Murdey, 2004).

Television viewing is one of the factors that contribute to the development of dietary habits. Television viewing may encourage children's consumption of highly advertised foods rather than fruits and vegetables. Previous studies have found that television watching is associated with adverse dietary behaviors among older children and adolescents; longer TV viewing time is associated with higher sugar-sweetened beverage consumption (Kremers, van der Horst, & Brug, 2007; Miller, Taveras, Rifas-Shiman, & Gillman, 2008; Phillips et al., 2004), and fewer fruit and vegetable intake (Barr-Anderson, Patricia, Neumark-Sztainer, & Story, 2008; Boynton-Jarrett et al., 2003; Miller et al., 2008). Other studies have linked family meals and television watching to

dietary intake in children and adolescents, but research is limited to mainly adolescents (Boutelle, Birnbaum, Lytle, Murray, & Story, 2003; Feldman, Eisenberg, Neumark-Sztainer, & Story, 2007) and non-Hispanics (Befort et al., 2006; Cooke et al., 2004). To address these gaps, the current study focused on Hispanic children from 5 to 9 years old.

Mesosystem Level Factors

Family Meal and Fast Food Frequency

An increasing amount of literature has studied the relations between family meal and obesity. Family meals have been related to prevention and correction of childhood overweight (Sen, 2006). Several cross-sectional studies have found that children who have family meals more frequently tend to have higher intakes of fruit, vegetables, and several nutrients, including fiber, several minerals, and vitamins (Berge, 2009; Larson, Neumark-Sztainer, Hannan, & Story, 2007) and lower intakes of soft drinks (Berge, 2009; Neumark-Sztainer, Hannan, Story, Croll, & Perry, 2003; Woodruff & Hanning, 2008) and saturated fat (Larson et al., 2007; Videon & Manning, 2003). Family meal frequency is positively related to consumption of high diet quality and negatively related to unhealthy food choices (Gillman et al., 2000; Hammons & Fiese, 2011; Taveras et al., 2005). The researchers of a longitudinal study (participants aged from 9 to 21) have found that the odds of being overweight one year and three years later as well as soft drinks significantly reduced with higher family meal frequency (Berge, 2009). Parents can provide nutritious and healthy eating patterns by providing regular family meals so that their children will be able to develop healthy eating habits in the future even when they do not eat with the family (Sen, 2006). Previous studies have concentrated on the

study the effects of family meal on adolescents (Berge, 2009; Larson et al., 2007; Videon & Manning, 2003).

Although study results have suggested that family meals can be a protective factor for unhealthy dietary habit (infrequent use of vegetables and fruit, and frequent use of sweets, soft drink, and fried food), findings have been inconsistent with some studies that discovered no relations to health outcomes, such as being overweight and obese (Fulkerson, Neumark-Sztainer, Hannan, & Story, 2008; Mamun, Lawlor, O'Callaghan, Williams, & Najman, 2005). The American Medical Association (AMA) Expert Committee on the Assessment, Prevention, and Treatment of Child and Adolescent Overweight and Obesity has identified a couple of dietary habits that contribute to obesity, including frequently consuming fast food and large volumes of sweet beverages (e.g., fruit juices and soft drinks) (Rao, 2008). Several studies have tested the associations between fast food frequency and sugar-sweetened beverage consumption, and between fast food frequency and fruit and vegetable consumption. Frequent consumption of fast food in adults was associated with a high level of sugar-sweetened beverage consumption and low fruit and vegetable intake (Sharkey, Johnson, & Dean, 2011). Collison and colleagues (2010) also found that fast food meal intake was positively correlated with sugar-sweetened beverage intake among participants age from 10 to 19. Children and adolescents (4 to 19 years old) who eat fast food, compared with those who do not, consumed more sugar-sweetened beverages and fewer fruits and vegetables (Bowman, Gortmaker, Ebbeling, Pereira, & Ludwig, 2004). Therefore, fast food frequency may affect child's weight status indirectly.

Parent's Physical Activity Support and Subjective Nutrition Knowledge

Children's activity patterns may also be associated with risk of being overweight and obese. Previous research has shown that an inactive lifestyle is likely to contribute to the increasing prevalence of obesity in youth (Fogelholm, Nuutinen, Pasanen, Myöhänen, & Säätelä, 1999; Hills, King, & Armstrong, 2007). Parents have a fundamental role in influencing their children's eating, physical activity practices, and sedentary behaviors. Children's activity patterns can be shaped within their family. Parents' participation in physical activity has a positive influence on youth's activity preferences (Steinbeck, 2001; Vilhjalmsson & Thorlindsson, 1998; Wold & Anderssen, 1992). Previous studies have suggested that parental support is an important factor associated with physical activity among children and adolescents; a significant positive relationship was also reported for parent's physical activity support and children's physical activity (Adkins, Sherwood, Story, & Davis, 2004; Hoefer, McKenzie, Sallis, Marshall, & Conway, 2001; Sallis et al., 1993; Wilson, Lawman, Segal, & Chappell, 2011). A negative association between physical activity and TV viewing time has been reported in young children (Burdette, Whitaker, & Daniels, 2004; Montgomery et al., 2004). Parents who are supportive to their children's physical activity may play a central role as they determine children's TV viewing time. Previous research has suggested that individuals practice combinations of health behaviors rather than only one health behavior at a time (Berrigan, Dodd, Troiano, Krebs-Smith, & Barbash, 2003; Krick & Sobal, 1990; Sobal, Revicki, & DeForge, 1992). A moderate relation was found between physical activity and eating behaviors (Johnson, Nichols, Sallis, Calfas, & Hovell, 1998). O'Halloran and colleagues (2001) tested how groupings of health lifestyle patterns impact dietary change

using a nationally representative sample. Their results reported that dietary intervention had strongest influences on individuals who were in the most physically active group; these findings indicate that it might be easier to promote healthy behaviors to those who are already practicing one or more healthy behaviors, such as physical activity. Parents who are supportive of their children's physical activity may be more likely to realize the benefits of other healthy behaviors, such as eating healthfully and encouraging their children to practice healthy dietary patterns. Thus, the current study will explore the potential associations between parent's physical activity support, child's daily fruits/vegetable, sugar-sweetened beverage intake, and TV viewing time.

The knowledge-attitude-behavior model suggests that increasing knowledge in health will lead to changes in attitude and may result in changes in behavior (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003; Contento, 2008). Knowledge can enrich individuals' understanding of the critical issues and encourage them to evaluate their beliefs and behaviors. Obesity prevention should not only concentrate on the dietary and physical activity behaviors of children, but also pay attention to parents' involvement. Olstad and McCargar (2009) found that improved nutrition knowledge and dietary behaviors of parents could improve children's dietary quality and reduce overweight among young children. Another study (Variyam, 2001) based on the analyses of national data also found that greater parental nutrition knowledge generally, or on obesity prevention specifically, was associated with lower prevalence of overweight children.

Exosystem Level Factor

Food Assistance Program Participation

Policymakers have been seeking effective strategies to fight against the increasing prevalence of obesity in the U.S. Several U.S. domestic food assistance programs [e.g. Food Stamp Program (FSP, now known as the Supplemental Nutrition Assistance Program [SNAP]) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)] have been designed to reduce problems associated with undernutrition and poor nutrition among the low-income households. However, questions have been raised whether U.S. food assistance programs contribute to the problems of overweight and obesity (Besharov, 2002). Previous studies have evaluated the relations between food assistance program participation and the weight of children used cross-sectional and longitudinal data (Bhattacharya & Currie, 2002; D. Gibson, 2004; Jones, Jahns, Laraia, & Haughton, 2003; Leung & Villamor, 2011; Ver Ploeg, Mancino, Lin, & Guthrie, 2008).

VerPloeg and colleagues (2008) did not find significant associations between FSP participation and adolescent obesity after controlling for family income and parent's education. Gibson (2004) reported mixed results for the long-term participants in FSP. There was a 42.8% increase for young girls (5–11 years old) and a 28.8% decrease for young boys (5–11 years old) in the predicted probability of overweight during the previous 5 years of the study, comparing with girls and boys whose families did not participate in the FSP during the same time. Long-term FSP participation was not significantly related to overweight in older children (12–18 years old). Results in another

study (Schmeiser, 2012) showed no systematic relationship over time between FSP and WIC participation and weight status.

Although these food assistance programs have promoted the benefits of consuming fruit and vegetables during nutrition education classes, average fruit and vegetable intake among infants and toddlers is low (Gerstein et al., 2010; Ponza, Devaney, Ziegler, Reidy, & Squatrito, 2004). Thus, these food assistance programs developed classes and programs (e.g. Finding the Teacher Within and 5-A-Day Promotion Program) to increase fruit and vegetable consumption in several states in the U.S. Previous studies have examined the associations between participation in food assistance programs and dietary consumption (e.g. fruit and vegetable and sugar-sweetened beverage). For instance, Gerstein and colleagues (2010) suggested that compared with participant from comparison groups, intervention groups identified more value, importance, and relevance of the fruit and vegetable information and adopting new fruit and vegetable practices after attending the class. Findings from another study (Havas et al., 1998) indicated a significant higher daily consumption of fruit and vegetable two months later in intervention participants than control participants. The current study predicts a positive relation between food assistance program participation and child daily fruit and vegetable intake.

Food assistance programs, including WIC, SNAP, and the Expanded Food and Nutrition Education Program (EFNEP) provide nutrition education messages to children and their parents via print materials and in-home education sessions. Nutrition programs are considered as an efficient approach to influence diets and improve children's health (Kenny, 1996). Previous research has evaluated the impact of nutrition program provided

by food assistance program on participants' nutrition knowledge (Arnold & Sobal, 2000; DeVault et al., 2009; Dollahite et al., 1998). However, findings are inconsistent. Dollahite and colleagues (1998) reported significant nutrition knowledge gain for children who were enrolled in food assistance programs, but not for parents. Arnold and Sobal (2000) found significant improvements of nutrition knowledge in participants who graduated from EFNEP. The only significant result found in DeVault and colleagues' study was the improvement in knowledge of which food had more fat. The current study will examine the association between food assistance programs and parent's nutrition knowledge in Hispanic populations.

Macrosystem Level Factor

Acculturation

Culture has a marked influence on choice of foods consumed and meal patterns (De Castro, 1997). Acculturation refers to the process by which a racial group (e.g., Latin American) acquires and exchanges cultural elements and patterns (e.g., beliefs, religion, language) of another culture (e.g., Anglo American)(Morales, Lara, Kington, Valdez, & Escarce, 2002; Satia-Abouta, Patterson, Neuhouser, & Elder, 2002; Sussner, Lindsay, & Peterson, 2009). Meanwhile, immigrants can experience both positive and negative changes in personal lifestyle and environment, including diet and physical activity (Satia-Abouta et al., 2002).

An increasing number of studies have examined the impacts of acculturation on the development of obesity. Acculturation has been related to shifts from traditional diets to Western food that are popular and easily available (Unger et al., 2004). These shifts can include both healthful and unhealthful dietary changes. Adoption by Hispanics of a

dietary pattern that is high in fat and calories and low in fruits and vegetables is of concern since this pattern can contribute to increased risk of obesity and increased risk factors for several major, chronic diseases (Satia-Abouta et al., 2002; Unger et al., 2004). On the other hand, less highly saturated fat consumption and more use of milk and salads are considered a healthful change (Morales et al., 2002; Satia-Abouta et al., 2002). Duerksen and colleagues (2007) reported that increased levels of acculturation may lead to higher rates of overweight among Mexican American families by eating more fast food rather than their traditional, authentic Mexican food.

Acculturation is also closely associated with physical activity. The relationship between acculturation and physical activity is complex. Overall, Hispanics live more sedentary lifestyles than whites (Morales et al., 2002). According to the study conducted by Jurkowski, Mosquera and Ramos (2010), the results showed that Latinas who were more acculturated to the American culture were more likely to engage in more physical activity than those less acculturated Latinas. However, other researchers have found inconsistent results. For instance, Crespo and other scholars (2001) reported that acculturation is related to a lower prevalence of physical inactivity. The findings in another study (Singh, Yu, Siahpush, & Kogan, 2008) also indicated that more acculturated immigrant children are less likely to participate in regular physical activity and sports and more likely to be physically inactive. Inactivity and low intensity and frequency of physical activity are increased with length of U.S. residence among Hispanics (Gordon-Larsen et al., 2003; Unger et al., 2004). As stated above, parent's physical activity support may be associated with children's physical activity positively.

This study evaluates the relation between acculturation and parent's physical activity support.

The association between acculturation and nutrition knowledge in Hispanic population has not been well examined. A positive relation was found between acculturation to Western culture and nutrition knowledge in a study that assessed the level of nutrition knowledge of young women (early 20s) with and without eating disorders in a Western (Australia) and non-Western country (Singapore) (Soh et al., 2009). A qualitative study (Franzen & Smith, 2009) reported that acculturation (years lived in the US and birth place) might play an important role in stature and BMI, food and physical activity habits, cooking and food preparation knowledge, and perceptions of health in Hmong children in the U.S. Thus, the current study focuses on the associations between acculturation and family's eating patterns, parents' physical activity support, and nutrition knowledge in Hispanic populations.

The associations among factors at different ecological levels and childhood obesity are complicated. Many studies have focused on factors at one level due to the complexity. Previous research has found a number of significant determinants of children's obesity risk, but a coherent model studying these factors jointly is not well developed. Such conceptual models need to include multilevel factors within the familial and societal environments. Structural equation modeling is likely to provide better understanding of the complex network of risk factors in childhood obesity. Guided by previous research, the current study aimed to explore the associations among factors at different levels (microsystem, mesosystem, exosystem, and macrosystem) with children's

body mass index percentile (BMI percentile), waist circumference (WC), and body fat percent (BF%) in Hispanic populations.

CHAPTER II

METHODS

Participants and Procedure

Transformacion Para Salud (Transformation for Health) Data Set

Data were obtained from the USDA funded project *Transformacion Para Salud (Transformation for Health)*. The project was implemented by the School of Nursing at the Texas Tech University Health Sciences Center. This 18-month community-based intervention study aimed at prevention and control of childhood overweight among Hispanic children aged from 5 to 9 years in two urban cities in West Texas (Lubbock and El Paso). The intervention program was implemented in public elementary schools from 2007 to 2008. Major components of the program include using nutrition education (e.g. Bienestar nutrition curriculum, food, fun &fitness newsletter), exercise programs (e.g. martial arts exercise), and gardening programs. A quasi-experimental design was adopted to evaluate this multi-component intervention program. Families with children classified as "overweight" (body mass index [BMI] between the 85th and 95th percentile) or "obese" (BMI greater than the 95th percentile) (CDC, 2009) were given an intensive at-home intervention. Five waves of data were collected before, during, and after the intervention to evaluate the efficacy of the program (pre-intervention baseline [T1], intra-intervention period [T2, T3, T4, roughly 6 month intervals], and T5 which is about 24 months after the initiation of the interventions).

The Study Sample of the Secondary Analysis

The current study is a secondary data analysis, using baseline data from both the intervention and control groups in order to understand the risk factors of obesity. Since

the present study focuses on Hispanic population, 309 kindergarten through second grade students were eligible. Anthropometric variables such as BMI percentile, waist circumference, and body fat percentage in young children were measured. The study was approved by the Internal Review Board of Texas Tech University Health Sciences Center. Consent forms and assent forms were obtained from all parents and children.

Measures

Anthropometric.

Transformacion Para Salud evaluated the height, weight, age-and-gender adjusted BMI percentile, waist circumference, and body fat percentage of its participants to determine the physical efficacy of the program. Using a stadiometer, subjects' height was measured with the child facing away from the stadiometer, feet placed hip-width apart. The child was instructed to stand tall while maintaining flat feet on the surface of the scale. Shoes were removed for both height and weight measurements. The head stick was moved to sit level on the child's head. Height was recorded to the nearest 0.1 centimeter in triplicate. Weight was also measured with participants in light clothing using an electronic scale with a 0.1 kilogram level of accuracy (Model – Tanita body composition analyzer TBF 300A). Weight was obtained from an electronic balance (Tanita) and measured to the nearest half-pound. Height and weight values provided variables to calculate BMI through the formula:

$$BMI = \frac{Weight\ (kg)}{Height^2 (m^2)}$$

Based on the updated growth charts from the Centers for Disease Control and Prevention, BMI percentiles identified subjects who were overweight (BMI between the 85th and 95th percentile) or obese (BMI greater than the 95th percentile) (CDC, 2009). Those with a BMI below the 85th percentile were considered normal weight and at a low risk of weight-related comorbidities.

Waist circumference was measured in triplicate at the top of the hipbone at the narrowest point between the lower border of the ribs and ilium. Units were recorded in centimeters. Body fat percent was measured using the Tanita Scale and the bioelectric impedance method described above.

Survey Development.

The Family Survey was developed by research team members, using brief targeted questions that were previously used and/or validated in other studies. The Family Survey was reviewed for face validity by the research team members in the university and by teachers who were parent coordinators in participants' schools. Additionally, the Family Survey was pretested with 37 Hispanic low-income mothers who had children in similar age to the sample in this study to improve face validity with the target population (Reed et al., 2008). Some wording and format changes were made. Examples related to the response options were provided to help respondents understand the questions.

Sugar-sweetened Beverage Intake. The Family Survey asked "How many ounces of sugar-sweetened beverages does your child drink a typical weekday (Monday through Friday)," and the same questions for "a typical weekend day" to capture total sugar-sweetened beverage intake. The number of ounces separately for soda, fruit drink, sports drink, tea and lemonade was reported by parents. These values were summed and calculated into average sugar-sweetened beverage intake.

Fruits and Vegetable Intake. Parents were asked to provide the number of cups of fruits and vegetable eaten each day. One question "how many total fruit/vegetable does your child usually eat a day?" was used to estimate intake of fruits and vegetables, respectively. Parents were also promoted to include fresh, frozen, dried, canned, and 100% juice in their responses. The average daily fruit and vegetable intake was calculated.

Family Meals and Fast Food frequency. A single question was used to measure the frequency of family meals: "In a typical week, how many times does your family eat a meal together?" Similarly, parents were asked child's intake of fast food by one item "In a typical week, how many times does your child eat food from a fast food restaurant like McDonald's, Sonic, KFC, Taco Bell, etc." Responses to these two questions are rated on a Likert scale (0 = Never, 1 = Less than once a week, 2 = Once a week, 3 = A few times a week, 4 = Every day). The frequency of having family meals was dummy coded into everyday vs. not every day.

Daily TV Viewing Time. The Family Survey asked parents to report how many hours a day the participating child watch TV on a typical weekday and weekend day, respectively. The average daily TV viewing time was calculated.

Parent's Physical Activity Support. Parent's physical activity support was asked to assess the home environment which can encourage or discourage physical activity based on the significant positive relationship reported for parent's physical activity support and children's physical activity (Hoefer et al., 2001; Sallis et al., 1993). An 8-item scale was created. The scale was adapted from the Girls health Enrichment Multi-site Studies (GEMS) (Story et al., 2003) and included such questions as "When the weather is nice, I go for a walk with my child" and "I encourage my child to be physically active instead of watching TV." Items were rated on a 4-point Likert scale (0 = never, 3 = always). A higher scale score indicated a higher level of parent's physical activity support. These values were summed up and the average was calculated. In the current study, the internal consistency reliability (Cronach's α) was .711 for parent's physical activity support.

Parent's Nutrition Knowledge. Parents were asked to report his/her subjective knowledge about nutrition. Items included "I am aware of the recommended amounts" and "I need more information on the recommended amounts of food that my child should eat." Items were rated on a 3-point scale (0 = no, 1 = sometimes, 2 = yes). Negative items were reverse-coded. A higher scale score indicated a higher level of subjective knowledge. In the current study, the internal consistency reliability (Cronach's α) was .738.

Food Assistance Programs. Parents were asked if s/he or his/her child received one of the following programs: Head Start, TANF, Food Stamps(now known as Supplemental Nutrition Assistance Program or SNAP), Special Supplemental Nutrition

Program for Women, Infants, and Children (WIC), Child Nutrition (Free or Reduced School Meals), Temporary Emergency Food/Commodity Foods/Food Bank, etc.

Acculturation. An abbreviated version of the Acculturation Rating Scale for Mexican-Americans II (ARSMA-II) (Bauman, 2005; Cuellar, Arnold, & Maldonado, 1995), which has been tested to show adequate reliability and validity, was used in the current study. The 12-item instrument has two subscales: the Mexican Orientation Subscale (MOS) and the Anglo Orientation Subscale (AOS) and measures three main factors: language, cultural identity, and ethnic interaction. Examples of items in the MOS include: "I speak Spanish; I enjoy Spanish TV; my thinking is done in Spanish". Likewise, items on the AOS are "I enjoy speaking English; I write letters in English; my friends are of Anglo origin." Response categories to all items are based on a five point Likert scaling format ("1" being "Not at all" and "5" being "Almost always/Extremely often") evaluating frequency and intensity. The means of AOS and MOS were used in the study instead of the five categories divided by Bauman. Cronach's α was .902 for MOS and .89 for AOS subscales in the current study.

Demographics.

Demographic (e.g. children's and parents' age, gender, race) and socioeconomic data (e.g. income, education, and marital status) were collected.

Generally, the model was built based on Bronfenbrenner's traditional ecological theory. However, several paths were included while others were not so that the structural equation model can be testable. Based on the theory, paths should be drawn from factors in distal systems to factors in inner systems level by level. For instance, there should be a structural path from fast food frequency, a mesosystem level factor to child's daily TV

viewing time, a microsystem level factor. However, the traditional ecological theory does not provide specific guidance for studies that investigate the development of childhood obesity. It is unrealistic to examine the relations between factors in all systems. Therefore, based the conceptual model proposed by Davison and Birch (2001) and findings of previous studies, associations between factors in systems that are not adjacent (e.g. exosystem to microsystem) and paths from distal systems (e.g. mesosystem and exosystem) to outcomes were examined; paths from systems that are next to each other were removed (e.g. macrosystem to exosystem and exosystem to mesosystem).

Based on the ecological framework and evidence from previous research on factors influencing children's weigh status, the following research question and hypotheses were tested.

Research question: are microsystem, mesosystem, exosystem, and macrosystem level factors associated with child's weight status (body mass index percentile [BMI], waist circumference [WC], and body fat percent [BF%])?

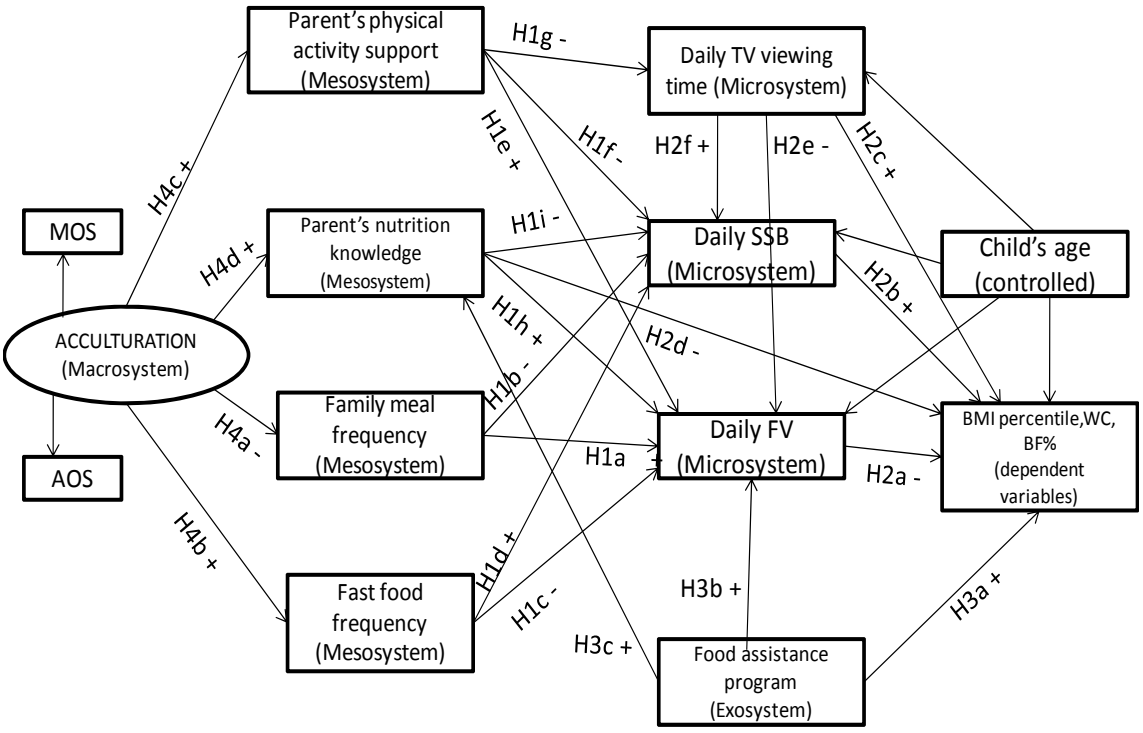

Figure 1 Hypotheses

Hypotheses

Hypothesis 1: Children's daily sugar-sweetened beverage, fruit/vegetable intake, and TV viewing time (Microsystem) are affected by family meal and fast food frequency (Mesosystem), parent's physical activity support (Mesosystem), and parent's nutrition knowledge (Mesosystem).

H1a- Higher family meal frequency is associated with higher children's daily fruit/vegetable intake.

H1b- Higher family meal frequency is associated with lower children's daily sugar-sweetened beverage intake.

H1c- Higher fast food frequency is associated with lower children's daily fruit/vegetable intake.

H1d- Higher fast food frequency is associated with higher children's daily sugar-sweetened beverage intake.

H1e- Higher parent's physical activity support is associated with higher daily fruit/vegetable intake.

H1f- Higher parent's physical activity support is associated with lower daily sugar-sweetened beverage intake.

H1g - Higher parent's physical activity support is associated with less daily TV viewing time.

H1h- Higher parent's nutrition knowledge is associated with higher daily fruit/vegetable intake.

H1i- Higher parent's nutrition knowledge is associated with lower sugar-sweetened beverage intake.

Hypothesis 2: Each anthropometric outcome is affected by children's daily sugar-sweetened beverage intake (Microsystem), fruit/vegetable intake (Microsystem), daily TV viewing time (Microsystem), and parent's nutrition knowledge (Mesosystem). TV viewing time (Microsystem) is associated with sugar-sweetened beverage and fruit/vegetable intake (Microsystem).

H2a- Higher daily fruit/vegetable intake is associated with lower BMI percentile, lower body fat percent, and smaller waist circumference.

H2b- Higher daily sugar-sweetened beverage intake is associated with higher BMI percentile, higher body fat percent, and larger waist circumference.

H2c- Higher daily TV viewing time is associated with higher BMI percentile, higher body fat percent, and larger waist circumference.

H2d-Higher parent's nutrition knowledge is associated with lower BMI percentile, lower body fat percent, and smaller waist circumference.

H2e- Higher children's daily TV viewing time is associated with lower daily fruit/vegetable intake.

H2f- Higher children's daily TV viewing time is associated with higher daily sugar-sweetened beverage intake.

Hypothesis 3: Participation in food assistance programs (Exosystem) is associated with each anthropometric outcome, fruit and vegetable intake (Microsystem), and parent's nutrition knowledge (Mesosystem).

H3a- Participation in food assistance programs is associated with higher BMI percentile, lower body fat percent, and smaller waist circumference.

H3b- Participation in food assistance programs is associated with higher fruit and vegetable intake.

H3c- Participation in food assistance programs is associated with higher parent's nutrition knowledge.

Hypothesis 4: Acculturation (Macrosystem) has effects on parent's physical activity support (Mesosystem), parent's nutrition knowledge (Mesosystem), family meal frequency (Mesosystem), and fast food frequency (Mesosystem).

H4a- Higher acculturation is associated with lower family meal frequency.

H4b- Higher acculturation is associated with higher fast food frequency.

H4c- Higher acculturation is associated with higher parent's physical activity support.

H4d- Higher acculturation is associated with higher parent's nutrition knowledge.

Analytical Strategy

The Statistical Package for the Social Sciences (SPSS) Statistics 20.0 (SPSS Inc, Chicago, IL) and AMOS 20.0 (Arbuckle, 2006) were used to perform the statistical analyses. Only baseline data were analyzed. Descriptive statistics were conducted on all data. Structural Equation Modeling (SEM) was used to examine the model. The analysis was run using the Full Information Maximum Likelihood extraction method by AMOS. This method calculates the means and intercepts to correct for any missing data. One structural equation modeling was used for each of the three anthropometric measures (body mass index percentile [BMI], waist circumference [WC], and body fat percent [BF%]). In order to determine the sample size and power for SEM, four factors should be considered: 1) model misspecification, 2) model size, 3) departures from normality, and 4) estimation procedure (Hair, et al., 2006). The absolute minimum for sample size must be greater than the number of covariances or correlations in the input data matrix. There should be a minimum ratio of at least 5 respondents for each estimated parameter, with a ratio of 10 respondents per parameter considered appropriate (Hair, et al., 2006; Schumacker & Lomax, 2004; Bentler & Chou, 1987). The power for SEM was calculated, and the current sample size of 309 is adequate for the SEM analyses. Every hypothesis testing is two-tailed. Multiple fit indices were reported.

CHAPTER III

RESULTS

Sample Descriptives

The descriptive statistics of the children are presented in Table 1. The average age of the children was 6.67 years (SD = 0.858). Slightly more girls were enrolled in the study. There are more children in first and second grades than kindergarten in the sample. BMI percentile assessment indicated that 34.3% of the children were either at risk of overweight or overweight. The children's average waist circumference and body fat percent was 59.39 and 14.09 centimeters, respectively. Child's daily sugar-sweetened beverage intake, fruit and vegetable intake, and daily TV viewing time are also shown in Table 1. The participating parents' demographic characteristics are presented in Table 2. The majority of the parents were female and married, had less than college educations and very low income, participated in at least one food/nutrition assistance program. Most families had meals together every day, and 78% of families had fast food at least once a week. The mean scores for parent's physical activity support was 1.41 and for parent's subjective knowledge about nutrition was 1.30.

Table 1 *Characteristics of Hispanic children ages 5-9 years from West Texas (N = 309)*

Characteristic	Value
Child's sex, No. of girls (%)	173 (56)
Child's age, y, mean ± SD (range)	6.67 ± 0.858 (5-9)
Child's grade, No. (%)	
Kindergarten	50 (16.2)
First grade	162 (52.4)
Second grade	97 (31.4)
BMI percentile status, No. (%)	
< 85th	203 (65.7)
85th-94th	46 (14.9)
≥ 95th	60 (19.4)
WC, mean ± SD (range)	59.39 ± 9.49 (1.2-79.6)
Body Fat %, mean ± SD (range)	14.09 ± 11.12 (45.85-97.25)
Daily SSB intake, ounces, mean ± SD (range)	19.45 ± 15.4 (0-82.29)
Daily FV intake, cups, mean ± SD (range)	2.72 ± 1.51 (0-9)
Daily TV hours, mean ± SD (range)	3.25 ± 1.88 (0.5-10.71)

BMI indicates body mass index; WC indicates Waist circumference; Body Fat % indicates body fat percent; SSB indicates sugar-sweetened beverages; FV indicates fruits and vegetables.

Table 2 *Characteristics for Participating Parent (N = 309)*

Characteristic	Value
Parent/guardian gender, No. of females (%)	264 (85.4)
Parent/guardian age, y, mean ± SD (range)	33.3 ± 7.38 (19-61)
Relationship to child, No. (%)	
Mother	264 (85.4)
Father	23 (7.4)
Grandmother	2 (0.6)
Marital status, No. (%)	
Single, never married	52 (16.8)
Married	168 (54.4)
Divorced/separated	53 (17.2)
Widowed	4 (1.3)
Education, No. (%)	
Some high school or less	125 (40.5)
High school diploma	73 (23.6)
Some college or higher	76 (24.6)
Annual household income, No. (%)	
$0-$15,000	103 (33.3)
$15,001-$30,000	98 (31.7)
$30,001-$45,000	24 (7.8)
$45,001-$60,000	12 (3.9)
$60,001-$75,000	3 (1.0)
> $75,000	17 (5.5)
Acculturation,	
MOS mean ± SD (range)	3.72 (1.13)
AOS mean ± SD (range)	3.08 (1.22)
Family meal, yes, No. (%)	118 (60.8)
Fast food, No. (%)	
Every day	1 (0.3)
Few times per week	61 (19.7)
Once per week	140 (45.3)
Less than weekly	86 (27.8)
Never	15 (4.9)
Participating in food/nutrition assistance program(s), No. (%)	195 (63.1)
Parent's PA support, mean ± SD (range)	1.41 ± 0.53 (0.13-3)
Parent's subjective knowledge about nutrition, mean ± SD (range)	1.30 ± 0.56 (0-2)

PA indicates physical activity; MOS indicates Mexican Orientation Subscale; AOS indicates Anglo Orientation Subscale.

The findings of our study suggest significant associations between factors (e.g. parent's nutrition knowledge) in some system (mesosystem) and child's anthropometric outcomes, but not for factors at other systems (microsystem and exosystem). Significant associations between factors at different system levels are also reported. For instance, fast food frequency significantly predicts more sugar-sweetened beverage intake and fewer fruit and vegetable intake.

Hypotheses Testing

Structural Equation Modeling was used to test the main hypotheses. Anglo Orientation Subscale (AOS) and Mexican Orientation Subscale (MOS) subscales scores were computed and used as manifest variables in the model. The model evaluated the associations among factors at multiple levels and anthropometric outcomes (BMI percentile, WC, and BF%). According to Kenny (2008), a good model fit should have the Comparative Fit Index (CFI) between .90 and 1.0 and the Root Mean Square Error of Approximation (RMSEA) below .05. Thus, the models fit the data adequately: CFI are .921, .940, and .933, and RMSEA are .041, .040, and .042, for BMI percentile, WC and BF%, respectively (Table 3). Standardized coefficients of each hypothesis are reported in Table 4. Significant paths were highlighted in Figure 2.

Table 3 *Fit indices for Model Testing*

	χ^2	*df*	CFI	RMSEA
BMI percentile	56.469	37	.921	. 041
Waist circumference	55.226	37	.940	.040
Body fat percentage	56.901	37	.933	.042

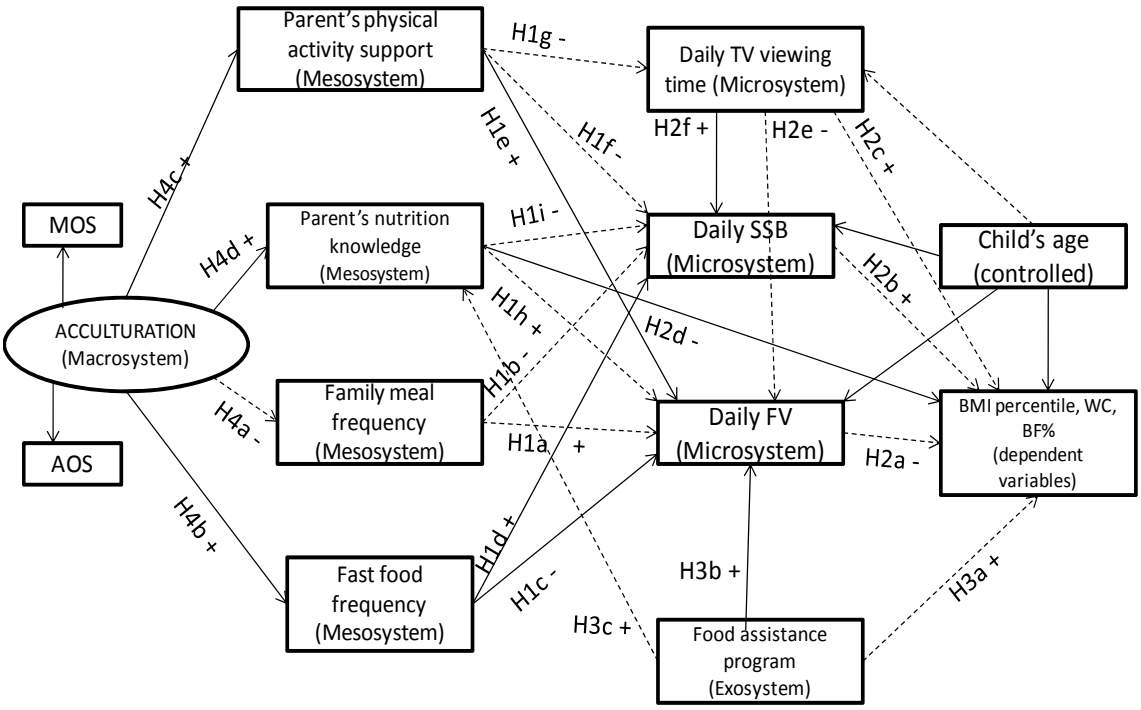

Figure 2 Hypotheses with significant paths

Three pathways were significant for all anthropometric outcomes tested in the first set of hypothesis "Children's daily sugar-sweetened beverage, fruit/vegetable intake, and TV viewing time (Microsystem) are affected by family meal and fast food frequency (Mesosystem), parent's physical activity support (Mesosystem), parent's knowledge about nutrition (Mesosystem)". No matter which outcome variable was tested, fast food frequency negatively predicted children's daily fruits/vegetable intake (H1c) (β =-0.121, p<.05) and positively predicted children's daily sugar-sweetened beverage intake (H1d) (β = 0.15, p< .05); parent's physical activity support (H1e) positively predicted children's daily fruits/vegetable intake (β = 0.221, p< .01).

Two paths were significant for all anthropometric outcomes tested in the second set of hypotheses "Each anthropometric outcome is affected by children's daily sugar-

sweetened beverage intake (Microsystem), fruit/vegetable intake (Microsystem), daily TV viewing time (Microsystem), and parent's nutrition knowledge (Mesosystem). TV viewing time (Microsystem) was associated with sugar-sweetened beverage and fruit/vegetable intake (Microsystem)." Parent's nutrition knowledge (H2d) negatively predicted children's anthropometric outcome variables (β = -0.287, p< .001, for BMI percentile, β = -0.421, p< .001, for WC and β = -0.397, p< .001, for BF%). Children's daily TV viewing time (H2f) positively predicted children's daily sugar-sweetened beverage intake (β = 0.117, p< .05, for three outcomes).

Only one path was significant for three anthropometric outcomes in the third set of hypotheses "Participation in food assistance programs (Exosystem) is associated with child's anthropometric outcomes, sugar-sweetened beverage intake (Microsystem), and fruit and vegetable intake (Microsystem)". Participation in food/nutrition assistance program(s) (H3b) positively predicted children's daily fruit and vegetable intake (β = 0.122, p< .05, for BMI percentile, β = 0.121, p< .05, for WC and BF%).

Three paths were significant for the three anthropometric outcomes in the fourth set of hypotheses "Acculturation (Macrosystem) has effects on parent's physical activity support (Mesosystem), parent's nutrition knowledge (Mesosystem), family meal frequency (Mesosystem), and fast food frequency (Mesosystem)." No matter which outcome was tested, acculturation was positively associated with fast food frequency (H4b) (β = 0.171, p< .01), parent's support of physical activity (H4c) (β = 0.204, p< .001), and parent's nutrition knowledge (H4d) (β = 0.180, p< .01).

Other significant paths were: child's age positively predicted their daily sugar-sweetened beverage intake (β = 0.183, p< .01, for BMI percentile, β = 0.182, p< .01, for

WC and BF%) and negatively predicted their daily fruit and vegetable intake (β = -0.161, p< .01, for three outcomes). Children's age positively predicted their waist circumference (β = 0.228, p< .001) and body fat percentile (β = 0.221, p< .001). Age was a controlled variable.

In summary, factors in the microsystem are not significantly related to children's anthropometric outcomes. Several mesosystem level factors are associated with microsystem level factors and outcomes. Exosystem level factor is related to microsystem level factor. Macrosystem level factor is related to mesosystem level factor. All significant relationships in the models were in the expected direction. Children's daily TV viewing time was positively related to their sugar-sweetened beverage intake. Parent's physical activity support was positively associated with children's daily fruit and vegetable intake. Parent's nutrition knowledge was negatively related to children's anthropometric outcomes. Fast food frequency was positively associated with children's daily sugar-sweetened beverage intake and negatively associated with fruit/vegetable intake. Food assistance program participation was positively related to children's daily fruit and vegetable intake. Acculturation was positively related to parent's physical activity support, parent's nutrition knowledge, and fast food frequency.

Table 4 Standardized Estimates of Hypotheses

Hypotheses	BMI percentile	Waist circumference	Body fat percentage
H1a Family meal→TV	.027	.027	.027
H1b Family meal→ SSB	.087	.087	.087
H1c Fast food→FV	-.121*	-.121*	-.121*
H1d Fast food→SSB	.150**	.150**	.150**
H1e Parent's PA support→FV	.221***	.221***	.221***
H1f Parent's PA support→ SSB	-.012	-.011	-.010
H1g Parent's PA support→ TV	-.008	-.008	-.008
H1h Nutrition knowledge→ FV	.062	.062	.062
H1i Nutrition knowledge→SSB	-.058	-.059	-.059
H2a FV→Anthropometrics	-.013	-.031	-.025
H2b SSB→ Anthropometrics	-.042	-.031	.001
H2c TV→ Anthropometrics	.010	-.048	-.037
H2d Nutrition knowledge→Anthropometrics	-.287***	-.421***	-.397***
H2e TV→FV	.101	.101	.102
H2f TV→SSB	.117*	.117*	.117*
H3a Food assistance programs→Anthropometrics	-.026	-.062	-.058
H3b Food assistance programs→ FV	.122*	.121*	.121*
H3c Food assistance programs→ Nutrition knowledge	.001	.001	.001
H4a Acculturation→ Family meal	.002	.002	.002
H4b Acculturation→ Fast food	.171**	.171**	.171**
H4c Acculturation→ Parent's PA support	.204***	.204***	.204***
H4d Acculturation→ Nutrition knowledge	.180**	.180**	.180**

Notes: * $p < .05$ ** $p < .01$ *** $p < .001$

CHAPTER IV

DISCUSSION

Structural equation modeling allowed the current study to examine the research question: "Are microsystem, mesosystem, exosystem, and macrosystem level factors associated with child's weight status (body mass index percentile [BMI], waist circumference [WC], and body fat percent [BF%])?" The study was able to investigate the interactions between factors at microsystem, mesosystem, exosystem, and macrosystem levels and examine their influences on children's anthropometric outcomes. In the model, children's BMI percentile, waist circumference, and body fat percentage were related to the following factors: three at the microsystem level, including children's daily fruit and vegetable intake, sugar-sweetened beverage intake, and daily TV viewing time; four mesosystem level characteristics (parent's physical activity support, parent's nutrition knowledge, family meal and fast food frequency); one exosystem factor (food assistance program participation), and one macrosystem factor (acculturation). The standardized coefficients within the model represent the strength of the relationships between factors and the outcomes.

Link Back to Bronfenbrenner's Ecological Theory

The model is partially fit Bronfenbernner's ecological theory. It investigates the associations between multiple systems simultaneously. The findings confirm the belief that immediate settings and larger environments are critical for development of human beings. Parent's characteristics and behaviors (mesosystem) were related to children's dietary patterns and sedentary behaviors (microsystem). Significant relations were reported between how frequently parents take their children to fast food restaurants

(microsystem) and children's daily sugar-sweetened beverage and fruit/vegetable intakes (microsystem).

The findings are not strictly consistent with Bronfenbrenner's ecological theory. Ecological perspectives suggest that a factor at one level should be most strongly related to the system next to it. The associations between two systems that are not adjacent should have been weaker. Theoretically, the factors at the microsystem level should have the most salient impact on individuals. Specifically within the current study, children's anthropometric outcomes should be strongly related to the indicators closest to them, such as daily sugar-sweetened beverage intake and TV viewing time. However, the paths from these microsystem level factors were not significantly related to child's weight status.

Bronfenbrenner also suggested that exosystem is composed by one or more settings that do not contain the person, but impacts his/her development by interacting with some structure in his/her microsystem. According to the theory, children are expected to be influenced by the assistance provided through the programs. Parents access to the resources and use these resources to support their children. Therefore, the path from food assistance program (exosystem) participation and parent's nutrition knowledge (mesosystem) was drawn. The path from program participation was also drawn to children fruit and vegetable intake (microsystem), based on the rationale provided by previous research. Theoretically, it was expected that exosystem level factors should have a stronger impact on mesosystem factors than factors in the microsystem. However, food assistance program participation was significantly related to children's fruit and vegetable intake, but not parent's nutrition knowledge. Recent

studies (Frank, Andresen, & Schmid, 2004; Sallis & Glanz, 2006) have indicated that the built environment (e.g. neighborhood, workplace, transportation systems) has an increasing impact on health outcomes, including childhood obesity. This trend suggests potentially strong associations between individuals and systems that are not directly connected to the individuals. Our findings have a few inconsistencies with the theory, but it does not necessarily indicate that the current study fits Bronfrebrenner's theory poorly.

Based on the findings, the current study has several implications for Bronfenbrenner's ecological theory. Generally speaking, the current study supports the premise of Brofenbrenner's ecological theory (1977). In order to understand the development of human beings, researchers should examine the interactions of multiple settings at multiple levels with multiple persons rather than simply observe behaviors of the individual in a single setting.

Bronfenbrenner defined a microsystem setting as "a place where people can readily engage in face-to-face interaction (1979, p.22)." He further explained that it is the activity, role, and interpersonal relations constitute the elements of the microsystem (1979). It is plausible to advocate that parent-reported child daily fruit and vegetable intake indicates parents' perception, which can be classified into mesosystem level instead of microsystem. Social welfare is identified as an exosystem level factor. However, it could be argued that it is a parent's decision to access to public resources (e.g. food assistance program to support their children) can be a mesosystem factor. It leads to the question how to classify one factor into various systems (exosystem or mesosystem).

The results of this study highlight concerns about the ambiguity for the boundary of each system. In the traditional theory, Bronfenbrenner (1977) did not specify any criteria for determining the limits of a system (e.g., microsystem, mesosystem). Bronfenbrenner (1979) did not identify under what conditions it would be clear that a boundary violation has occurred. In the more recent version of the ecological theory, the four systems were collapsed into a single category titled context (Tudge, Hatfield, & Karnik, 2009). This version provided less clarity about boundary issues.

This study also highlights the issues surrounding the system definitions. Bronfenbrenner (1977) provided a definition for each of the four systems, but each definition is somewhat broad and abstract. Conceptually, it is possible that colleagues (e.g., service providers [educators, therapists], researchers, theoreticians, policymakers) might use the same system terms (e.g., exosystem), but have entirely different interpretations of it's the terms' meanings. They might be unaware of these differences, which can slow down effective dialogues. This can hinder progress in many areas (e.g., refining ecological theory, allocating resources in the community, solving social problems, conducting research).

Bronfenbrenner was not actively involved in gathering empirical data at the early stage of his theory development (Tudge, Gray, & Hogan, 1997). It is unrealistic to examine each element in all systems. Therefore, researchers have to select what elements will be included in studies and how these elements can be placed at each system level. Conceptual frameworks adapted Bronfenbrenner's traditional theory for studying specific areas can be created to provide the criteria for selecting and placing each element in various systems.

The traditional theory also indicates a hierarchy of the ecological systems. Ecological perspectives suggest that factors at macrosystem level should be directly and strongly related to factors at exosystem level. Exosystem level factors should have an indirect impact on microsystem level factors. However, this original ecological theory may not be able to specify the mechanisms by how factors at each system level and their interrelatedness shape human development. The current study has suggested (a) an association between a factor at mesosystem level and outcomes of interested and (b) an association between a factor at exosystem level to a factor at microsystem level. Thus, (a) potential associations between distal systems and outcomes and (b) interactions between levels that are not adjacent should not be eliminated.

Bronfenbrenner's ecological theory provides social scientists with powerful theoretical propositions. However, the theory is too broad and abstract when used as a theoretical framework for researchers to conduct empirical studies. The current study has raised a few problems of the theory, such as selection and placement of parameters at each system level and ambiguity of system boundaries, as well as possible directions for revisions of Bronfenbrenner's ecological theory. However, this study did not test associations among variables in a manner that was entirely consistent with Bronfenbrenner's theory. Thus, the implications of this study for the theory should be considered with caution.

Discussion for Findings of the Study

In 2007-2008, the prevalence of high body mass index (BMI, at or above the 85th percentile of BMI for age) among children and adolescents aged 2 to 19was 31.7% for all races and38.2%for Hispanics (Ogden, Carroll, Curtin, Lamb, & Flegal,2010).The current

study reported that 34.3% of the children were either at risk of overweight or obese. In 2010, the USDA published dietary guidelines for children and adolescents recommending that "sweetened beverages and naturally sweet beverages, such as fruit juice, should be limited to4 to 6 oz per day for children 1 to 6 years old, and to 8to 12 oz per day for children 7 to 18 years old." The results of a study that used data from the National Health and Nutrition Examination Survey (NHANES, 1999-2004) found that children aged 2-5 and 6-11 years old had 15.5 and 20.5 ounces sugar sweetened-beverage, respectively (Wang, Bleich, & Gortmaker, 2008). For the current study, the average daily sugar-sweetened beverage intake is 19.45 (SD 15.4) ounces, which is much higher than the recommended amount. "Fruit and vegetable intake recommendations for the 2,000 calorie diet in the 2010 USDA Food Patterns were maintained at 2 cups and 2½ cups daily, respectively (Evolution of the Dietary Guidelines for Americans, 2011)." A study reported the average fruit intake and vegetable intake of children aged 2 to 18 years old from NHANES (1999-2002) were 1.03 and 1.04 cup equivalents, respectively (Lorson, Taylor, & Melgar-Quinonez, 2009). For the current study, daily fruit and vegetable intake is 2.72 (SD 1.51) cups. The average intake is similar to the findings of national representative data, but lower than the recommended amount. The American Academy of Pediatrics (2001) recommends no more than 2 hours per day of TV/screen time for children over two. The findings of a study that based on NHANES (2001–2006) data indicated that the total proportion of children aged 2 to 15 years old engaged in more than 2 hours daily TV/video viewing time was 33.0% (Sisson, et al., 2009). For the current study, daily TV viewing time is 3.25 (SD 1.88) hours; 30.1% of the children spent more than 2 hours watching TV daily. Generally, the findings of the current study are

similar to the findings of national representative data in terms of child daily sugar-sweetened beverage intake, fruit and vegetable intake, and TV viewing time.

Microsystem Level

No variables within the microsystem were significant related to children's anthropometric outcomes. This is surprising, given the importance placed on children's sugar-sweetened beverage (Ludwig et al., 2001; Malik et al., 2006) and fruit and vegetable intake (Ledoux et al., 2011; Tohill et al., 2004) on the development of childhood obesity. These results fail to support the hypotheses that there are (a) positive association between sugar-sweetened beverage intake and child's weight status, and (b) negative association between fruit and vegetable intake, TV viewing time and child's weight status. The effects of dietary patterns on obesity are complex and not well understood. One possible explanation is that parents may have under-reported their children's intake of sugar-sweetened beverage. Another possibility can be that parents may have deliberately restricted children's intake of sugar-sweetened beverage consumption in order to control weight. Fruit and vegetable consumption is considered to have preventive effects on overweight and obesity. However, fruit and vegetable consumption was not significant related to child's weight status in the current study. It is possible that children's fruit and vegetable intake was lower than the recommended amount. Therefore, a protective effect of fruits and vegetables can't be seen when few children are consuming the recommended levels. Future studies may examine the percentage of children who consume the recommended amount of fruit and vegetable. It is also possible that children consume fruits and vegetables, as well as diets that are high

in fat and calories in large portions of food. Fruit and vegetable consumption alone may not be effective enough healthy weight.

More TV and computer/video game exposure time in children was expected to be associated with weight gain and being obese (Crespo et al., 2001; Proctor et al., 2003). One possible mechanism to explain the relation between TV viewing and obesity is the combination of reduced physical activity and adoption of unhealthy food intakes. Time spent watching TV or playing computer or video games could have been spent on physical activities. Being exposed to food advertising during TV time, children may ask for advertised foods, especially fast food (Wiecha et al., 2006). Children may also consume snacks and drinks while watching TV or playing video games (Campbell, Crawford, & Ball, 2006). Children may choose cookies or cake rather than fruit or vegetable while watching TV. Studies have reported negative relationship between TV viewing time and fruit and vegetable intake (Boynton-Jarrett et al., 2003; Miller et al., 2008).

The current study has suggested a significantly and moderately positive association between daily TV viewing time and sugar-sweetened beverage intake of Hispanic children in kindergarten through second grade students (aged 5 - 9 years old). Our result supported the findings of previous studies: longer TV viewing time is documented to associate with higher sugar-sweetened beverages consumption (Kremers, van der Horst, & Brug, 2007; Miller, Taveras, Rifas-Shiman, & Gillman, 2008; Phillips et al., 2004). It is possible that parents underreported children's TV viewing time, resulting in no associations between daily TV viewing time, fruit and vegetable intake, children's anthropometric outcomes and only a moderate positive relation to sugar-

sweetened beverage. Nevertheless, our findings indicate an indirect path from TV viewing time to childhood obesity through excessive sugar-sweetened beverage intake. Our findings suggest that TV viewing time can impact sugar-sweetened beverage intake at an early age in Hispanic populations. Future obesity interventions and treatment programs that target on TV viewing time should also target on sugar-sweetened beverage intake.

Mesosystem Level

At the mesosystem level, parent's nutrition knowledge was a protective factor that prevents children from being overweight or obese. This result supports previous research findings: the more nutrition knowledge parents have, the lower prevalence of childhood obesity is (Variyam, 2001). The knowledge-attitude-behavior model (Baranowski et al., 2003) may explain the protective effects. As knowledge in health behavior accumulates, attitudes begin to change which will lead to behavioral changes. It is possible that parents are motivated to change their attitudes toward nutrition and physical activity due to accumulated nutrition knowledge, resulting in healthy behaviors at some point. The absence of significant relationships between parent's nutrition knowledge, fruit/vegetable and sugar-sweetened beverage intake can be explained by following reasons. It is possible that good scores on nutrition questions measured by the current study do not necessarily indicate good knowledge in all domains of nutrition knowledge. Problems in dietary habits can be attributed to imbalances in knowledge. Also, the current study only examines impact of nutrition knowledge on fruit/vegetable and sugar-sweetened beverage intake, which may not be sufficient to reflect how parents practice their nutrition knowledge. Another possibility is that knowledge does not always stop parents serving

poor quality diets or preventing children taking unhealthy food. Parents may not be able to prepare healthy food due to insufficient time, demanding work schedules, inaccessibility of grocery stores, or financial capability to afford healthful diets, such as fresh fruit and vegetable. Thus, parents who are knowledgeable about healthy foods can still find it challenging to follow healthy eating patterns for their children.

Parent's physical activity support, another mesosystem level factor is negatively associated with fruit and vegetable intake but not related to daily TV viewing time or daily sugar-sweetened beverage. Health behaviors may cluster together (Berrigan et al., 2003; Krick & Sobal, 1990; Sobal et al., 1992). Parent-child associations in physical activity support and children's fruit and vegetable intake may be explained by the fact that parents who are supportive to children's physical activity are more likely to believe in the benefits of having fruits and vegetables. Parents with such beliefs may be more likely to create an environment that protects children from being overweight and obese by encouraging their children to eat more fruits and vegetables. The current study failed to suggest any association between parent's physical activity support and children's sugar-sweetened beverage intake. It is plausible that parents who are supportive to children's involvement in physical activity are also aware of the undesirable influences of sugar-sweetened beverage on child physical development. However, it is also possible that children who are physically active may take more drinks, such as soda, sweet tea, and energy drinks after exercising. The impact of parent's physical activity support can be better understood if children's physical activity is measured in future studies.

Family meal frequency is not significantly associated with sugar-sweetened beverage or fruit and vegetable intake. It is possible that family meals may be more

nutritionally beneficial for older children because adolescents believe that they could eat healthier if they share more meals with their families (Neumark-Sztainer, Story, Ackard, Moe, & Perry, 2000). Hammons and Fiese (2011) also reported shared family mealtimes have a larger effect on unhealthy and healthy (marginally significant) eating among older children than younger children. In a health-promotion program, adolescents stated that they would most like their parents to prepare healthy meals at home when asked about their interest in having parents participate with them in that program(Kelsey, Campbell, & Vanata, 1998). Another possible reason is that eating together at home does not necessarily mean eating less unhealthy food. Parents may provide unhealthy diets that are high fat and calories, such as frozen pizza, potato chips, and meat from grocery stores rather than cook themselves. Thus, foods and ingredients used in family meals need to be asked for future studies. More research is needed with younger children, especially longitudinal studies to determine if family meal is a protective factor against childhood obesity.

The findings of this study suggest that fast food frequency has a significantly negative relation to fruit and vegetable intake and a positive relation to sugar-sweetened beverage intake. These results support previous research. Busy working schedules may foster needs for fast and convenient meals. Fast food may affect body weight by promoting unhealthy diets and precluding healthy food options. Compared with individuals who did not eat fast food, individuals who consumed more servings of added sugars, sugar-sweetened beverages and fewer servings of milk, fiber, fruits and nonstarchy vegetables (Bowman et al., 2004; Rao, 2008; Sharkey et al., 2011). Fast-food restaurants have been found to supply over 20% of soft drinks consumed by youth (aged

6-17) (French, Lin, & Guthrie, 2003). The current study has provided evidence for the impact of fast food frequency on sugar-sweetened beverage and fruit/vegetable intake among Hispanic children.

Exosystem Level

At the exosystem level, food assistance program participation indicated a positive relationship to fruit and vegetable consumption, but not for child's weight status or parent's nutrition knowledge. These results suggest that children who participated in food assistance programs (e.g. Head Start, TANF, Food Stamps, WIC, Child Nutrition, Temporary Emergency Food/Commodity Foods/Food Bank) were no more likely to be overweight than non-participants. Some scholars (Frongillo, 2003; Nord, 2001) suggest that food assistance program participation may be associated with child weight status as a result of the impact of family food insecurity. The influences of potential mediation effects are complicated. The current study only asked parents if their children were participating in any of the programs listed. We cannot deny or confirm the relationships between food assistance program participation and development of childhood obesity. To better understand the impact of food assistance program participation, future studies may use longitudinal data that allow multiple measurements of program participation and weight status for the same children over time.

In the current study, food assistance program participants did not report higher nutrition knowledge scores, which is consistent with previous research (Dollahite, Rodibaugh, Holmes, Hosig, & White, 1998). It is possible that non-participants who are eligible for the programs may score lower than participants, but non-participants who are not eligible (e.g. individuals with high income or education) may score higher than

participants. Therefore, the impact of participating food assistance programs could have been cancelled out. Future studies could compare nutrition knowledge in three groups: participants, eligible non-participants, and not eligible individuals.

However, our findings do offer some insight into how food assistance program participation relates to children diets, such as fruit and vegetable intake. The positive relation can be attributed to the healthful diet packages and nutrition education offered by these programs. This is consistent with previous studies (Gerstein et al., 2010; Havas et al., 1998). For instance, the WIC provides vouchers for participants to purchase fresh fruit and vegetable and reduce the amount of some foods for children. Additionally, classes and programs, such as Finding the Teacher Within and 5-A-Day Promotion Program were developed to increase fruit and vegetable consumption as part of the food assistance programs in several states. Thus, changes in the programs, such as providing nutrition education components and promoting fruit and vegetable consumption could play important roles in reducing the risk of obesity by encouraging children to eat more fruits and vegetables rather than unhealthy food. The current study did not ask parents if they attended nutrition education classes as part of their enrollment in food assistance programs; thus, the mediating factor between food assistance programs and fruit and vegetable intake is not known.

Macrosystem Level

At the macrosystem level, acculturation was significantly and positively associated with fast food frequency, parent's nutrition knowledge, and parent's physical activity support. But the relation between acculturation and family meal frequency was not significant. Fast food is known to be high in calories and fat, which can contribute to

the increased risk of obesity (Bowman et al., 2004; Duerksen et al., 2007). The current study has suggested that higher acculturation level is positively associated with frequency of visiting fast food restaurants, which is consistent with previous findings (Unger et al., 2004). One possible explanation for the positive relation is that Hispanic children try to fit in with their American peers by increasing their involvement in activities identified as American, such as watching TV and eating fast food. It is also possible that families who are less acculturated might be more likely to live in low-income neighborhoods where fast-food restaurants are more prevalent, and healthy foods are less available (Unger et al., 2004).

The current study found acculturation to be moderately and positively associated with parent's physical activity support. Previous studies (Gordon-Larsen et al., 2003; Singh et al., 2008; Unger et al., 2004) have focused on examining the relation between acculturation and physical activity levels, and mixed findings were reported. Several researchers (Gordon-Larsen et al., 2003; Singh et al., 2008) have suggested a lower frequency of physical activity participation among more acculturated Hispanics, but Unger and colleagues (2004) found converse results. The discrepancy between the previous findings may be explained by methodology. However, our study evaluated the possible relation between acculturation and parent's physical activity support rather than children's physical activity. This result cannot be easily explained. The rationale to hypothesize such a path is that parent's physical activity support has been positively associated with children's physical activity; that is, children are more physically active if their parents are more supportive for their physical activity (Adkins et al., 2004; Hoefer et al., 2001; Sallis et al., 1993; Wilson et al., 2011). Acculturation can indirectly impact

children's physical activity levels through their parent's support. But the current study was unable to examine the possible association of acculturation with parent's physical activity support and child physical activity due to unmeasured variables. Future studies can explore this association further.

A positive relation was found between acculturation and parent's nutrition knowledge in this study. Previous research (Franzen & Smith, 2009; Soh et al., 2009) suggested similar findings in Asian immigrants in the U.S. The current study has shed new light on the relationship between acculturation and parent's nutrition knowledge in Hispanic populations. One possible explanation for the positive association is that more acculturated Hispanics may have higher education and better financial sources to afford healthful dietary patterns and physical activity. These individuals may have better knowledge of basic nutrition and food preparation and knowledge of how food and nutrition affect health. The positive relations between acculturation and parent's physical activity support, and parent's nutrition knowledge, respectively provide some suggestions for practitioners to emphasize the important influences of parents on the development of childhood obesity in future prevention and intervention programs.

Acculturation was not significantly associated with family meal frequency in the current study. This hypothesis was based on the idea that as families become more acculturated they will adopt the behavioral practices and values of the larger society (Morales et al., 2002; Satia-Abouta et al., 2002; Sussner et al., 2009). The larger society (U.S. environment) encourages a excess fast food intake. Therefore, more acculturated families may be more likely to replace family meals with fast food. However, this was not supported by the findings of this study. One possible explanation is that acculturated

individuals have adopted American concepts while maintaining some traditional beliefs. For instance, parents may still keep family normative rituals to maintain Hispanic eating patterns and keep having meals together as a routine due to the benefits of having meals together, such as a sense of family solidarity and unity. Participants in the current study were asked how many times their family ate a meal together each week. It is also possible that some factors are influencing family meal frequency but were not measured in the current study, such as family structure, maternal employment, parental education, and socioeconomic status (Bauer, Neumark-Sztainer, Fulkerson, & Story, 2011; Neumark-Sztainer et al., 2003; Story, Neumark-Sztainer, & French, 2002).

Acculturation plays an important role in impacting parents' health behaviors, such as their physical activity support, nutrition knowledge, and how frequently they take their children to fast food restaurants. Children's dietary patterns and weight status are influenced by parents' health behaviors. Social welfare, such as food assistance programs, can be beneficial by increasing the accessibility of more fruits and vegetables in low income Hispanic families. These findings also suggest that the development of childhood obesity is attributed to factors from multiple levels that interact with each other. This multilevel context can be effectively evaluated by the ecological system theory. These factors are not isolated, but work together to determine the risk of being overweight or obese for children.

Strengths and Limitations

Our study has several strengths. The ecological model presented in the current study highlights some relatively not well explored factors and relationships for obesity prevention and intervention programs, such as the associations of parent's nutrition

knowledge and parent's physical activity support with child weight status, respectively. The model also reflects the complex and dynamic systems in which risk factors for childhood obesity develop by adopting a broader contextual approach. The majority of participants in the current study are low income Hispanic parents. Our findings offer some insight into this "hard-to-reach population" regarding the development of childhood obesity.

The current study also has several limitations. Some of them may have compromised the findings of the present study. One limitation is that the current study is a secondary data analysis. The study did not measure children's actual physical activity, which could have been an important factor for the development of childhood obesity. The utilization of baseline data of this study allows only for the associations between factors at different levels and outcomes; yet cannot be used to imply causality. The limitations of measurements also prevent further understandings of possible mechanisms of childhood obesity development. For instance, the participants were not asked detailed diet records or diet recalls for family meals. Additionally, these surveys were completed by the parents, not the child. Inaccuracies in measurement of study variables could weaken or obscure associations between variables. There are some ambiguities in the assignment of variables to specific system levels. It could be argued that parent-reported child daily fruit and vegetable intake reflects parents' perception, which can be classified into mesosystem level. The results of this study cannot necessarily be generalized because the majority of the participants were from low income families and not randomly chosen. These participants may not be representative of the Hispanics in the community or Hispanic populations in other areas.

Implications for Future Study

It has been recommended that obesity is a complex problem that needs multidisciplinary assessments and solutions (ADA, 2006). Complex ecological models of obesity should be developed to ensure that potentially significant risk factors are not overlooked. The findings of the current study highlight the importance of an ecological model to assess the risk factors for childhood obesity. Davison and Birch (2001) advocated such a model not only evaluates multilevel system levels, but involves parents, schools, and community members in developing, implementing, and evaluating childhood obesity prevention and intervention programs.

Our study also suggests that when developing and implementing obesity prevention and intervention programs for Hispanic children, health practitioners should encourage parental involvement with their children. For instance, parents should encourage their children (and model the desired behavior) to participate in physical activity, should restrict fast food accessibility, and should monitor children's TV viewing time. Our findings emphasize that parents, as role models should be aware their significant influences on establishing healthful lifestyles for their children at an early age. Theory-driven, evidence-based approaches are required for future research to explore the mechanisms by which individual behaviors and familial and social determinants influence the development of childhood obesity.

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APPENDIX A

EXTENDED LITERATURE REVIEW

Introduction

The prevalence of overweight and obesity has been increasing over the past three decades (BeLue, Francis, Rollins, & Colaco, 2009). Specifically, the rate of obesity among children has been on the rise: the number of children who are overweight has been doubled among 2- to 5-year-old children (Nicklas & Hayes, 2008); more than 25% of preschool children being classified as overweight or obese (Ciampa et al., 2010). The number of children who are overweight has been tripled among 6- to 11-year-old children in the past 3 decades (Nicklas & Hayes, 2008). Prevalence among adolescents has been doubled over the past thirty years (BeLue et al., 2009). The 2003-2004 National Health and Nutrition Examination Survey (NHANES) has indicated that 33.6% of individuals aged 2 to 19 were at risk of overweight, and 17.1 % were overweight, while the rates were only 28.2% and 13.9% in 1999-2000, respectively (Ogden, Flegal, Carroll, & Johnson, 2002). Numerous studies have found that childhood obesity is very likely to persist into youth and adulthood (BeLue et al., 2009; Ciampa et al., 2010; Würbach, Zellner, & Kromeyer-Hauschild, 2009). Although the prevalence of overweight is increasing for all children in the United States, Texas has the sixth highest prevalence of obesity in the United States and is number one in childhood obesity (Texas Department of State Health Services, 2006). Hispanics are expected to compose 25% of the U.S. population by 2050 (U.S. Department of Commerce, 2009). Data released by 2010 Census show that Hispanics make up about 38% of the total population in Texas, which accounted for 65% of the state's growth since 2000 (Ennis, Ríos-Vargas, & Albert,

2011). Some evidence has suggested that Hispanic children are at greater risk for being overweight or obese (Lutfiyya, Garcia, Dankwa, Young, & Lipsky, 2008).

The trend of obesity among Hispanic children is impacted by multiple factors working jointly, including genetic, psychosocial and environment (Satia-Abouta, Patterson, Neuhouser, & Elder, 2002). Therefore, in order to test the effects of multiple factors on childhood obesity, it is important to study the risk factors collectively.

Thesis Components

This thesis was a secondary data analysis, using baseline data from the USDA funded program *Transformacion Para Salud (Transformation for Health)*. Only Hispanic participants were included in this study. Primary data analyses were used to describe the sample's demographics, dietary behavior, lifestyle practices, anthropometric measurements, and acculturation status. Associations between different ecological levels and anthropometrics were also explored. Structural equation modeling was used to identify any existing relationships among data. The model was tested by AMOS 18 program Full Information Maximum Likelihood (FIML) (Arbuckle, 2006).

Conclusion

Given the increasing population of Hispanics in the United States and the significant impact of overweight and obesity on the health of Hispanic children, a deeper study of what contributes to overweight and obesity can help health care practitioners, researchers, and the community develop culturally appropriate and comprehensive based interventions to improve physical and psychosocial well-being of Hispanic children and their families. Previous research has found a number of significant determinants of children's obesity risk, but a coherent model studying these factors jointly is not well

developed. Such conceptual models need to include multilevel factors within the familial and societal environments. Structural equation modeling is likely to provide better understanding of the complex network of risk factors in childhood obesity. Guided by previous research, the current study aimed to explore the associations among factors at different ecological levels (microsystem, mesosystem, exosystem, and macrosystem) with children's body mass index percentile (BMI percentile), waist circumference (WC), and body fat percent (BF %) in Hispanic populations.

REVIEW OF LITERATURE

The following review of literature addresses the issue of obesity and the relevant factors of obesity. Included are findings that focus on multilevel risk factors contributing to the unhealthy weights of the Hispanic populations. Bronfenbrenner's (1977) ecological theory is used as the theoretical framework of the current study. A brief review of his theory is presented.

Background

Obesity

Overweight and obesity are of great public health concern in the United States. Overweight individuals are at higher risk for chronic diseases, including cardiovascular disease, diabetes, hypertension and cancers (Malik, Schulze, & Hu, 2006), which are four of the ten leading causes of death in the United States (Videon & Manning, 2003). Over the past three decades, overweight and obesity rates have increased dramatically in children and adolescents in the United States. Data from the 2003-2004 National Health and Nutrition Examination Survey (NHANES) suggest that 14% of children (aged 2-5) and 19% (aged 6-11) are overweight (Kral et al., 2008). Overweight children are likely

to be more overweight in adulthood (Würbach et al., 2009). Overweight children and adolescents have higher risk of suffering cardiovascular disease and type 2 diabetes, and their families have to bear considerably burden and costs related to these diseases (BeLue et al., 2009). Also, overweight children are more likely to experience negative metabolic and psychosocial problems, engaging in more risky behaviors such as tobacco and alcohol use (Branscum & Sharma, 2011).

Youth obesity is caused by multiple factors collectively (BeLue et al., 2009; Reed, Patterson, & Wasserman, 2011). Influential factors include but not restricted to individual, family and community level, such as genetic, physiological, environmental, and cultural/traditional perspectives (BeLue et al., 2009; Birch & Davison, 2001; M. von Deneen, Wei, Tian, & Liu, 2011). Findings from previous studies associate weight status with demographic factors such as ethnicity (Ogden et al., 2002), gender (Field, Gillman, Rosner, Rockett, & Colditz, 2003), socioeconomic status (Haas et al., 2003; Wang, 2001), sugar-sweetened beverages (SSB) intake (S. Gibson, 2008; Malik et al., 2006), and family meal frequency (Rollins, Belue, & Francis, 2010; Taveras et al., 2005).

Obesity among Hispanic Children

According to the U.S. Census Bureau in 2009, Hispanics are expected to compose 25% of the U.S. population by 2050, becoming the fastest growing minority group in the United States (U.S. Department of Commerce, 2009). The prevalence of obesity has been increasing in all ages, races, socioeconomic levels, and geographic areas, but Hispanics have experienced some of the largest increases: from 12% in 1991 to 21% in 1998 (Bowie, Juon, Cho, & Rodriguez, 2007). Previous studies, for example, the 1988-1994 NHANES III and the 2001 California Health Interview Survey (CHIS 2001), and

the 1999-2006 NHANES have sampled Mexican Americans and other Hispanic groups (Bowie et al., 2007; Ogden et al., 2002). Although the prevalence of overweight is increasing for all children in the United States, there is some evidence to suggest that Hispanic children are at greater risk for being overweight or obese (Lutfiyya et al., 2008).

Hedley and colleagues (2004) presented their findings based on the analyses of the NHANES 1999-2002 data: for children aged 6 to 19 years, 31% were either at risk for overweight or overweight; the prevalence of overweight among Mexican American, boys and girls between 6 to 19 years old, was significantly higher than non-Hispanic white counterparts. Another study that also used NHANES 1999-2002 data (Forrest & Leeds, 2007) found that for children aged 6 to 18, non-Hispanic whites had a prevalence of overweight at 28.2% and a prevalence of obesity at 13.65%, while the prevalence of overweight and obesity of Mexican American was 39.9% and 22.2%, respectively. Although it is not clear what factors contribute to obesity among Hispanic children and adolescents, several indicators are associated to the prevalence of obesity among Hispanics: dietary habits (Allen et al., 2007; Bowie et al., 2007), low socioeconomic status (SES), including low education level, unemployment, poverty (Gordon-Larsen, Harris, Ward, & Popkin, 2003; Kaplan, Huguet, Newsom, & McFarland, 2004), lack of health insurance coverage and lack of access to health care services related to overweight and obesity (Bowie et al., 2007), low physical activity (Bowie et al., 2007), and acculturation to Westernized lifestyle (Gordon-Larsen et al., 2003; Hubert, Snider, & Winkleby, 2005).

Overview of Bronfenbrenner's Ecological Theory

Bronfenbrenner (1979) argued that the study of human development demands examination of the interactions between (a) the human being and (b) dynamic environments. The ecological environment encompasses four interrelated systems: (a) microsystems, (b) mesosystems, (c) exosystems, and (d) macrosystems.

Microsystems are the immediate settings in which individuals live (Bronfenbrenner, 1977). They have the most direct influences on individuals (Bronfenbrenner, 1977). A setting is defined as "a place with particular physical features in which the participants engage in particular activities in particular roles for particular periods of time (Bronfenbrenner, 1977, p. 154)." Individuals spend a large amount of time involved in activities and interactions within microsystems. For adults, microsystems are home, work, and social life; for children, they are schools, home, day care centers, camps, play groups, and hospitals (Bronfenbrenner, 1976, 1977, 1979). Mesosystems include the interrelations among the major settings in which individuals participate (Bronfenbrenner, 1977). Mesosystems reflect the potential reference of individual family member's knowledge and experiences upon their interactions with each other. This knowledge is gained from environments in which family members do not interact simultaneously (Eamon, 2001a) For example, a parent's workplace is a mesosystem to a child. Similarly, a child's school is a mesosystem to a parent. Mesosystems refer to the connections between a child's home and school, home and health service agencies, and home and parent's workplace. In contrast to microsystems and mesosystems, individuals do not directly engage in the activities of each environment in the exosystem. Exosystems include one or more settings that do not contain the

person, but impact his/her development (by interacting with some structure in his/her microsystem). The exosystem can include the site of local decision-makers/services in communities (Frieden et al., 2005; Hong & Garbarino, 2012). Public policies can be very effective in regulating individuals' behaviors. For instance, aggressive increases cigarette taxation and smoke free air legislation dramatically reduced the number of smokers and adult smoking prevalence from 2002 to 2004 in the U.S. (Frieden et al., 2005). These decisions impact individuals access to tobacco, even though they have no contact with legislators. Bronfenbrenner (1977) referred to the macrosystem as the cultural blueprint for the ecology of human development, which determines the structures and activities in microsystems, mesosystems and exosystems. Culture provides meaning to rules for normative behaviors. For example, child-feeding practices and preferences for physical activity are found to be influenced by culture (Airhihenbuwa, Kumanyika, Agurs, & Lowe, 1995; Bruss et al., 2005). A different culture may define which types of food are healthy and which are unhealthy very inconsistently. Culture can also contribute to how people perceived ideal body size. For instance, Latinas tend to prefer a plump figure for their children and serve larger food portions than children need (Contento, Basch, & Zybert, 2003). Changes of original cultural patterns (e.g. acculturation) can affect individuals to abandon traditional perceptions and practices of particular behaviors and adopt new beliefs and habits.

The ecological approach takes the joint impact of multiple settings or their elements into consideration. Thus, the ecological theory has been used to guide research in diverse areas of child development, such as human rights (Bruyere & Garbarino, 2010), developmental risks (Garbarino & Ganzel, 2000), effects of poverty (Eamon,

2001a), and obesity (Birch & Ventura, 2009; Davison & Birch, 2001). Davison and Birch (2001) adapted Bronfenbrenner's traditional theory to create a conceptual framework for studying childhood obesity.

Bronfenbrenner's (1977) model has been used as a theoretical framework to guide (a) conceptual analyses of social issues and/or (b) empirical studies. A brief overview of sample conceptualization and research is provided. Purposes, classifications of factors in each system, and key findings of each article are presented.

Hong and Garbarino (2012) used Bronfenbrenner's ecological theory as a conceptual framework to understand the phenomenon of homophobic bullying in school. Within this framework, they identified sex and sexual orientation as the two major individual level factors. Family, peers, and school are the primary microsystems for most adolescents. Peer group members, school characteristics and climate, and social support from teachers and school personnel are the frequently examined risk and protective factors at the microsystem level. Exosystem level factors include community environment and mass media. Gender-role conformity, law, and policies, especially school policies are important risk and protective factors within the macrosystems. Based on this application of Bronfenbrenner's (1977) theory, recommendations and intervention strategies for school practitioners and policy-makers were drawn. For instance, (a) school practitioners need to assess the quality of peer relationships; (b) homophobic bullying needs to be included in bullying prevention and intervention programs; (c) school practitioners and officials need to create a safe school climate; (d) social work professionals need to advocate for policies in the school districts by gaining support from legislators; and (e) school officials should enforce the existing anti-bullying policies.

Hong and Eamon (2011) examined the microsystem, mesosystem, and exosystem level factors associated with students' (10 to15 years old) perceptions of unsafe school environments. Parent–child interactions within the home and school, and social and physical environments within the school are perceived as microsystem level factors. To be specific, those factors are adolescents' attachment levels with their parents (parent-child interactions), peer associations, school size, and presence of gangs and drug dealers (social environment), disorderly classrooms and presence of physical objects such as weapons (physical environment). At the mesosystem level, parental involvement in adolescents' academic and school social life (e.g. attending school events) was identified as one factor related to students' perceptions of school safety. Neighborhood quality, such as crime rate and poverty level, and the area in which adolescents live or attend school (rural or urban areas) are considered exosystem level factors. Youth (age, race/ethnicity, and gender) and family (marital status, parental education, and financial resources) socio-demographic characteristics were also tested in the study. The significant factors related to students feeling unsafe in school are (a) students' age and gender (socio-demographic characteristics), (b) parent-youth discussions of school activities/events and school environment variables (ease of making friends, teacher involvement, school rule enforcement, and observed a weapon microsystem level factors), and neighborhood variables (safe neighborhood and area of residence exosystem level factors). Parental school involvement (mesosystem level factors) was not significantly predictors of unsafe environments.

Hong and Eamon (2009) also applied Bronfenbrenner's (1979) theory to conceptualization of peer victimization in South Korean schools. Three types of

interactions related to peer victimization in at the microsystem level are parenting practices, family violence, and peer relationships. For instance, parenting behaviors such as over protectiveness, needlessly interfering in children's daily activities, yelling and using profanity, witnessing family violence, and peer rejection can increase children's vulnerability to peer victimization. Two mesosystems have been discussed by Hong and Eamon: (a) interactions between the child-teacher (e.g. teacher's perception and reaction of peer victimization); and (b) child-peers (e.g. peer relationships) and interrelations between violent media exposure (e.g. TV programs, movies, computer games) in family and the youths' interactions with peers in the school. Parents' employment schedule is classified as an exosystem level factor because parents' working hours may affect the amount of time that parents monitor and form attachments with their children. School policies (lack of relevant programs and corporal punishment) and cultural values are considered macrosystem level factors. Specifically, three cultural paradigms contribute to the peer victimization in schools. Functionalism paradigm refers to the different roles and behaviors that comply with the needs of society. The peer victimization is considered as a function maintaining group. Institutionalization paradigm is designed to develop a norm or custom within an organization. Being aggressive to the victims is not perceived as a major problem, but a reflection of normal group dynamics. The ideological paradigm refers to perpetrators striving for power and authority by dominating victims.

Based on this conceptualization, Hong and Eamon (2009) offered implications for assessing, preventing, and treating peer victimization in South Korean schools at each level. Child-parent, parent-parent, and child-peer interactions should be included for the

assessment of peer victimization. At the microsystem level, practitioners can assist parents and schools by becoming involved in children's lives and parenting education. Prevention and friendship improvement programs should be developed to help children obtain social skills and beneficial relationships with peers. At the mesosystem level, practitioners can establish interventions that model positive teacher-student and peer interaction by emphasizing the importance of teachers' support and cooperation. Monitoring time spent viewing media violence should also be implemented as part of the interventions. Practitioners can guide parents to determine alternative work schedules and reduce stress. Implementing and evaluating policies that support school-based programs is one method for practitioners to prevent peer victimization at the macrosystem level. In order to change school cultures (macrosystem level) practitioners can engage teachers and administrators in interventions that educate students to identify and learn appropriately functional social skills (e.g. verbal persuasion).

Garbarino and Ganzel (2000) addressed the conceptual application of Bronfenbrenner's (1977) ecological theory to psychological, social, and cultural forces in early developmental risks and improvements. Developmental risk at the microsystem level can be patterns of child abuse and neglect, and stress that occur in homes and child-care centers. The mesosystem factors encompass interactions between (a) an infant's child care group and his or her home, and (b) a hospital and the home. In exosystems, parents' working experience (e.g. low pay, unemployment, long or inflexible hours, traveling) and public policies (e.g. health service policy) can be treated as factors that affect child's development. Ideology (e.g. collective versus individual orientation), and social and economic climate are considered macrosystem level factors. The authors

identified the sources of development risk in the human ecology of the young child: economic impoverishment [e.g. poverty (microsystem), unemployment (mesosystem), and economic deprivation (exosystem)] and social impoverishment [e.g. single motherhood (microsystem) and being deprived of social support services (exosystem)]. They also gave two suggestions to decrease development risks: (1) to establish a strong system of prenatal, maternal and child health care, and (2) to make the system easy access and the health care services difficult to avoid.

Davison and Birch (2001) adapted Bronfenbrenner's (1977) ecological theory and created a conceptual model to assess predictors of childhood obesity. The authors emphasized the importance of addressing characteristics of the child, familial and societal contexts in order to understand the development of childhood obesity. Child behavioral patterns such as dietary intake, physical activity, and sedentary behavior are categorized into microsystems. Mesosystem level factors include but are not restricted parenting styles, child feeding practices, parents' dietary intake, activity patterns, weight status, nutritional knowledge, parent encouragement of child activity, monitoring of child TV viewing, and peer and sibling interactions. Community, demographic, and societal characteristics are classified as exosystem factors, such as school environment (e.g. dietary quality of school lunch and physical education programs), parents' employment experiences (e.g. working hours and leisure time), and community environment (e.g. crime rates, neighborhood safety, accessibility of recreational facilities, convenience foods and restaurants).

They conceptualized the ways in which diffuse health and social characteristics fit into the ecological model. More specifically, they categorized (a) dietary intake, activity

patterns, and sedentary behavior as microsystem factors related to child weight status, (b) parenting styles and family characteristics as mesosystem factors, and (c) community and demographic characteristics as exosystem factors. Previous research has shown complex findings regarding the associations between children's dietary patterns and weight status. At the mesosystem level, children's dietary practices are found to be shaped by several factors, including parent nutritional knowledge, the types of foods parents make available to children, parental modeling of particular eating behaviors, and parent child-feeding practices. For example, mothers' nutritional knowledge is (a) positively related to children's fruit and vegetable intake and (b) negatively associated with children's total energy and fat intake. Increased levels of caloric intake is positively associated with encouragement to eat, excessive parental control of children's food intake and child feeing practices when children are not hungry. Research has rarely been conducted to assess the influence of siblings on children's dietary patterns. However, peer interactions have effects on shaping children's food preferences and dietary patterns. Factors at the exosystem level are found to affect children's weight status directly and indirectly. Parents' time availability for food preparation is influenced by their number of hours at work, which in turn decreases the consumption of fruit, vegetables and increases the use of convenience food (including eating out). Frequent consumption of convenience food is associated with higher weight status. Children from lower SES groups have less diverse diets than children from upper SES groups, which in turn shape parents feeding practices. School environment (school lunch programs) is also an important factor since children have a substantial proportion of daily food intake at school.

Davison and Birch (2001) also applied ecological concepts to children's physical activity. Children's physical activity is also associated with risk factors of obesity at different levels. Children's gender and age (microsystem) influence the likelihood of engaging in physical activity. Boys are more physically active than girls. Physical activity decreases as age increases. Parent and peer participation in physical activity (mesosystem) are positively associated with activity among children and adolescents. At the exosystem level, a higher level of activity is associated with being (a) non-Hispanic white and (b) in higher SES groups for children.

In contrast to high levels of activity, sedentary behaviors are positively related to the likelihood of being overweight for children. Girls tend to have higher rates of sedentary behaviors (especially TV viewing) than boys. Higher rates of sedentary behavior are reported in non-Hispanic black and Hispanic children, and lower SES groups.

Birch and Ventura (2009) provided a literature review on food intake in infancy and childhood and offered recommendations for promising, but untested intervention strategies based on the ecological framework (Davison & Birch, 2001). Similarly to Davison and Birch, child behavior (child eating, physical activity, and sedentary behaviors) were classified as microsystem factors. Parenting (e.g. encouragement of activity and monitoring TV hours), feeding (e.g. food available for child), and parent characteristics (e.g. weight status, eating and activity patterns, and nutritional knowledge) were at the mesosystem level. Exosystem level factors are ethnicity, socioeconomic status, school lunch programs, school PE programs, parents' work demands. The authors stated that children' dietary intake habits, such as preference for sweetness and saltines

and rejection to new foods (microsystem) can make it difficult for parents to provide healthful foods to children. Additionally, based on a growing body of evidence, the use of traditional feeding practices (e.g. feeding children frequently, offering preferred food, mesosystems factors) in the obesogenic environments indicated higher weight status in children. The strategy of selecting and refining the intervention components that focused on parents, families, and childcare settings was proposed.

Another article (Reed et al., 2011) expanded Davison and Birch's (2001) ecological model for childhood obesity by (a) describing the prevalence and challenges of obesity prevention among rural youth and (b) identifying emergent, nontraditional contributing factors. Based on the factors identified by Davison and Birch's model, excessive weight gain during pregnancy, smoking during pregnancy, teen pregnancy, and child abuse were classified as mesosystem level factors. Rurality was reported as a new factor in exosystems. These emerging, nontraditional contributing factors highlight the importance for practitioners to consider the complex nature of childhood obesity when planning and implementing obesity prevention programs.

Critique of the Ecological Theory

Strengths

Researchers and professionals have recognized the importance of a framework that assesses factors beyond the individual level. Bronfenbrenner's (1977) ecological theory provides a paradigm that is applicable or adaptable to diverse issues. This valuable theoretical framework is widely applied. It "provides social work with a framework by which to study, track, and forecast social movements and social change" (Rotabi, 2007, p. 125). It has been utilized to study and conceptualize diverse

phenomenon, such as (a) early developmental risk (Garbarino & Ganzel, 2000), (b) influences of ratification of the United Nations Convention on the Rights of U.S. children (Bruyere & Garbarino, 2010), (c) risk and protective factors for homophobic bullying in schools (Hong & Garbarino, 2012), and (d) a conceptual framework for studying childhood obesity (Davison & Birch, 2001).

The ecological perspective highlights the importance of the contexts in which a person resides. It provides a framework for considering issues on multiple levels simultaneously. It aids researchers in seeing the large picture of a phenomenon and points out the directions for future studies. For instance, Hong and Eamon (2011) examined the microsystem, mesosystem, and exosystem level factors associated with students' (10 to15 years old) perceptions of unsafe school environments. Factors at the microsystem and the exosystem were tested to investigate whether risk factor for problem behavior act in a cumulative manner and whether cumulative influences stem from the different ecological levels (Atzaba-Poria, Pike, & Deater-Deckard, 2004).

Brofenbrenner's (1977) ecological theory is very conceptually extended. It has been combined with several theories (e.g. Bandura's social cognitive theory (Lohrmann, 2010) to develop models, design and test interventions in various disciplines. For example, Reifsnider (1998) adapted Bronfenbrenner's model to study the growth stunting in low-income Hispanic children by combining epidemiology. Other models, such as (a) ecological model of growth, (b) ecological model of child high-level wellness (Reifsnider, Keller, & Gallagher, 2006), and (c) a complementary ecological model of the coordinated school health program (Lohrmann, 2010) are also derived from Bronfenbrenner's theory.

Weaknesses

Although Bronfenbrenner's (1977) ecological theory has been applied to many social problems and population, it has been criticized as being inadequate (Finn & Jacobson, 2003) and too abstract and broad. The famous concepts of microsystem, mesosystem, exosystem, and macrosystem have been well elucidated. However, Bronfenbrenner hardly provided assessments or measurements to direct studies. It has created obstacles for researchers to apply the theory by collecting data and conducting studies.

Another weakness is that factors at all four ecological levels were rarely examined in one single study. Although the ecological theory suggests the factors of each system may influence individuals' behaviors, evidence on the associations between some systems and the topics of interest is inconsistently provided. Previous research (Atzaba-Poria et al., 2004; Davison & Birch, 2001; Eamon, 2001a; Hong & Eamon, 2009; Hong & Garbarino, 2012; Reifsnider et al., 2006) were able to summarize factors at different levels from previous studies. However, there is a dearth of research on the relationships between some systems. It is not seldom seen that only one ecological system is tested (Eamon, 2001b; McIntosh, Lyon, Carlson, Everette, & Loera, 2008), but all systems are rarely addressed.

In general, previous research was established on "the nested structures, each inside the nest, like Russian dolls" (Bronfenbrenner, 1979, p. 22). Factors at different levels are identified within larger systems. However, levels are defined inconsistently. Some researchers (Hong & Eamon, 2011; Hong & Garbarino, 2012) described age, gender, ethnicity, marital status, and education as individual level characteristics, while

others (Birch & Ventura, 2009; Davison & Birch, 2001) take these as microsystem level factors.

The ecological approach takes the joint impact of multiple settings or their elements into consideration. Thus, the ecological theory has been used to guide research in diverse areas of child development, including obesity (Birch & Ventura, 2009; Davison & Birch, 2001). Davison and Birch (2001) adapted Bronfenbrenner's traditional theory to create a conceptual framework for studying childhood obesity. According to this model, childhood obesity is associated with risk factors at different levels (e.g. individual, familial, and societal). In current study, children's dietary intake (e.g. sugar-sweetened beverage and fruit and vegetable intake) and activity patterns (e.g. daily TV time) of children are categorized into microsystems. Parent's dietary habits (e.g. family meal and fast food frequency), parent's nutritional knowledge and physical activity support are classified as mesosystem factors. Exosystem level factor is food assistance programs. Acculturation is the macrosystem level factor.

Risk Factors

A range of personal, familial, community, and cultural factors have been identified as predictors in the development of obesity in children. Factors at different levels will be discussed in the following paragraphs.

Microsystem Level Factors

Sugar-sweetened Beverage Intake

Over the past 20 years, national survey data (the 1994-1996 CFSII) in the U. S. have suggested that increased rates of overweight and obesity are accompanied by the increased consumption of carbohydrates (Malik et al., 2006). Carbonated soft drinks

contribute most to the added sugars in children's diets but supply little or no nutritional value except for energy (Dubois, Farmer, Girard, & Peterson, 2007). Several studies have found that increased consumption of soft drinks is associated with excessive weight and childhood obesity (Berkey, Rockett, Field, Gillman, & Colditz, 2004; Gillis & Bar-Or, 2003; Ludwig, Peterson, & Gortmaker, 2001; Malik et al., 2006; Nicklas, Yang, Baranowski, Zakeri, & Berenson, 2003). However, controversial findings exist in the literature. Cross-sectional studies suggest a positive trend between the intake of sugar-sweetened beverages and children and adolescents overweight or obesity (Ariza, Chen, Binns, & Christoffel, 2004; Berkey et al., 2004; Ludwig et al., 2001; Striegel-Moore et al., 2006). Nevertheless, other studies have found negative, non-significant positive relations, or no associations (Andersen et al., 2005; Rajeshwari, Yang, Nicklas, & Berenson, 2005).

Berkey and colleagues (2004) examined the relationship between BMI changes and intakes of sugar-added beverages, milk, fruit juices, and diet soda among children aged 9 to 14 years old. These 16,771 children were the participants of the Growing Up Today Study in 50 states. Most of the children were white (94.7%). Beverage intakes were assessed by a self-administered semiquantitative food frequency questionnaire (FFQ), specifically for older children and adolescents. At the baseline, girls who drank more sugar-added beverages were heavier. For boys, increasing sugar-added beverage intake from one year to the next was significantly related to weight gain. For girls, increasing intake of sugar-added beverages was weakly linearly associated with weight gain. However, these relations were no long significant after adjusting for total energy intake.

A longitudinal study (Ludwig et al., 2001) of sugar-sweetened beverages on ethnically diverse 548 children (11-12 years old) in Boston-area public schools examined the relation between change in sugar-sweetened drinks consumption from baseline to 19 months later and children's BMI change. Students were asked to complete the youth food-frequency questionnaire (YFFQ) independently. At the baseline, sugar-sweetened beverages intakes were significantly associated with change in BMI. Both BMI and frequency of obesity increased for each additional serving of sugar-sweetened drink consumed after adjusting for anthropometric, demographic, dietary, and lifestyle variables.

Fruit and Vegetable Intake

Diets high in fruits and vegetables are associated with lower body weight due to the high level of water and fiber and low level of energy density (Lin & Morrison, 2002; Tohill, Seymour, Serdula, Kettle-Khan, & Rolls, 2004). Additionally, multiple health benefits are associated with diets rich in fruit and vegetables, including a decreased risk of cardiovascular disease, diabetes and some cancers (Cooke et al., 2004). Several national and world-wide health institutes, including the National Institute of Health, National Cancer Institute, and the World Health Organization have recommended that people consume more fruits and vegetables, at least five servings of fruit and vegetables a day (Cooke et al., 2004; Field et al., 2003). Nevertheless, the Continuing Survey of Food Intakes by Individuals conducted by the USDA between 1994 and 1996 showed that less than 25% of adolescents met the five a day goal (Field et al., 2003). The association of fruit and vegetable intake with body weight status has been studied by previous research. Fruit and vegetable consumption is expected to negatively relate to weight status

(Howard et al., 2006; Ledoux, Hingle, & Baranowski, 2011; Sartorelli, Franco, & Cardoso, 2008). However, findings are not consistent. One longitudinal study (Field et al., 2003) assessed the relations between fruit and vegetable intake and change in BMI among a large sample of children and adolescents (aged 9-14) in the U.S. Between 1996 and 1999, a cohort study of 8203 girls and 6715 boys completed at least two Growing Up Today Study questionnaires. After 3 years of follow-up, no relation between intake of fruits or vegetables and subsequent changes in BMI z-score was found among the girls. Intake of fruit didn't predict changes in BMI, but vegetables intake predicted the inverse association. Some studies didn't significantly predict changes in BMI, but predicted the inverse associations (Field et al., 2003; Whybrow, Harrison, Mayer, & James Stubbs, 2006).

Daily TV Viewing Time

Sedentary behaviors, such as watching television, may cause a positive energy balance and obesity (Rodríguez-Oliveros et al., 2011). In a study of children in grades 4-5 and 8-9, the overweight children participated in less physical activity and spent on average more time watching television than the nonobese children (Bernard, Lavallée, Gray-Donald, & Delisle, 1995). Several cross-sectional studies have reported significant positive associations between Television viewing time and weight status in children and adolescents (Kautiainen, Koivusilta, Lintonen, Virtanen, & Rimpelä, 2005; Lowry, Wechsler, Galuska, Fulton, & Kann, 2002; Stettler, Signer, & Suter, 2004). For instance, television watching for more than two hours a day is associated with an increased risk for overweight among 2-year-old children and among the adolescent population (Gortmaker et al., 1996; Lumeng, Rahnama, Appugliese, Kaciroti, & Bradley, 2006). A meta-

analysis on the effect of sedentary behavior on body composition, however, concluded that the effects of television and electronic games on BMI are small and unlikely to be of clinical relevance (Marshall, Biddle, Gorely, Cameron, & Murdey, 2004).

Previous studies have found that television watching is associated with adverse dietary behaviors (e.g. increased energy intake and poorer diet quality) among older children and adolescents, including consumption of fast foods, sugar-sweetened beverages, and consumption of fewer fruits and vegetable (Boynton-Jarrett et al., 2003; Dietz & Strasburger, 1991; Harrison & Marske, 2005; Miller, Taveras, Rifas-Shiman, & Gillman, 2008). Phillips and colleagues (2004) reported a significant relationship of television viewing to energy-dense snack food consumption (e.g. cookies, cakes, chocolate candy, ice cream, potato chips, and soda) in 196 nonobese premenarcheal girls 8 to 12 years old. Another study (Kremers, van der Horst, & Brug, 2007) examined the association between adolescent screen-viewing behaviors, including television viewing and computer use and the consumption of sugar-sweetened beverages in Dutch adolescents (aged 12–16 years) using self-administered questionnaires. The findings confirmed previous investigations regarding the positive relation between television viewing behavior and consumption of sugar-sweetened beverages.

Television viewing is one of the factors that contribute to the development of dietary habits. Television viewing may encourage children's consumption of highly advertised foods rather than fruits and vegetables. Additionally, children's preferences for vegetables are generally low (Domel et al., 1993). Therefore, vegetables may not be chosen for snacks during television viewing. Barr-Anderson and colleagues (2008) suggested that adolescents with a bedroom television tended to have more time spent

watching television and lower fruit and vegetable consumption and more sugar-sweetened beverages.

Boynton-Jarrett and colleagues (2003) evaluated the association between patterns of television viewing and fruit and vegetable consumption patterns in a cohort of 6th and 7th-grade of 548 students from 4 communities in Massachusetts during 1995–1997. Participants were asked typical hours of television viewed every day of the week in addition to use of video cassette recorders, movies, and video/computer games by using an 11-item television and video measure. The findings suggested that television viewing may contribute to a decrease in fruit and vegetable intake among adolescents. An adolescent had 0.16 (1 serving every 6 days) fewer servings of fruits and vegetables per day by increasing one hour television viewing at baseline. A reduction in fruit and vegetable intake was independently predicted by both baseline television viewing and change in television viewing time.

Another study (Miller et al., 2008) examined the association between television/video viewing and diet quality, indicated by selected food and nutrient intakes among 3-year-old children. The study included 1203 preschool children, who were participants in Project Viva. The number of hours of television and video viewing on average weekdays and weekend days was measured by asking the mothers. The intakes of selected foods and nutrients were assessed from a validated food frequency questionnaire. It asked questions regarding usual frequency of specific food intake (dietary fiber, dietary calcium, fruit and vegetables, red and processed meats, and snack food) and drink (sugar-sweetened beverages, fruit juice, skimmed or 1% milk, and whole milk) items during the past month. The authors reported that more time spent viewing

TV was associated with unhealthy dietary patterns among 3-year-old children: higher intakes of sugar-sweetened beverage, fast food, snack food, red and processed meat, total energy, and trans fat, as well as lower consumption of fruit and vegetables, dietary fiber, and calcium.

Other studies have linked family meals and television watching to dietary intake in children and adolescents, but research is mainly limited to adolescents (Boutelle, Birnbaum, Lytle, Murray, & Story, 2003; Feldman, Eisenberg, Neumark-Sztainer, & Story, 2007) and non-Hispanics (Befort et al., 2006; Cooke et al., 2004). To address these gaps, the current study has focused on Hispanic children from 5 to 9 years old.

Mesosystem Level Factors

Family Meal Frequency

An increasing amount of literature has studied the relations between family meal and obesity. Childhood obesity is negatively associated with the occurrence of family meal frequency in the United States (Rollins et al., 2010). Family meals have been related to prevention and correction of childhood overweight (Sen, 2006). Several cross-sectional studies have found that children who have family meals more frequently tend to have higher intakes of fruit, vegetables, and several nutrients, including fiber, several minerals, and vitamins (Berge, 2009; Larson, Neumark-Sztainer, Hannan, & Story, 2007) and lower intakes of soft drinks (Berge, 2009; Neumark-Sztainer, Hannan, Story, Croll, & Perry, 2003) and saturated fat (Larson et al., 2007; Videon & Manning, 2003). Family meal frequency is positively related to consumption of high diet quality and negatively related to unhealthy food choices (Gillman et al., 2000; Hammons & Fiese, 2011; Taveras et al., 2005). Additionally, higher family meal frequency is also negatively

related to dieting and extreme weight control behaviors (Berge, 2009; Eisenberg, Olson, Neumark-Sztainer, Story, & Bearinger, 2004; Fulkerson, Neumark-Sztainer, & Story, 2006). The researchers of some longitudinal studies (participants aged from 9 to 21) found that the odds of being overweight one year and three years later as well as soft drinks significantly reduced with higher family meal frequency (Berge, 2009). Parents can provide nutritious and healthy eating patterns by providing regular family meals so that their children will be able to develop healthy eating habits in the future even when they do not eat with the family (Sen, 2006). Veugelers and Fitzgerald (2005) evaluated the significance of these risk factors for overweight and obesity in 4298 grade 5 students in Nova Scotia, Canada. Family dinner frequency was negatively associated with the risk of overweight. Students who ate supper together with their family 3 or more times a week were at decreased risk of overweight.

Although study results have suggested that family meal can be a protective factor for unhealthy dietary habit (infrequent use of vegetables and fruit, and frequent use of sweets, soft drink, and fried food), findings have been inconsistent with some studies that discovered no relations to health outcomes, such as being overweight and obese (Fulkerson, Neumark-Sztainer, Hannan, & Story, 2008; Mamun, Lawlor, O'Callaghan, Williams, & Najman, 2005).

A 5-year longitudinal study (Fulkerson et al., 2008) aimed to find cross-sectional and longitudinal associations between the frequency of family meals and overweight status in a diverse population of 2516 adolescents. Frequency of family meals was assessed with the question, "During the past seven days, how many times did all, or most, of your family living in your house eat a meal together?" Response options were

"Never," "1–2 times," "3–4 times," "5–6 times," "7 times," and "More than 7 times." However, neither cross-sectional nor longitudinal associations were significant for males and older females (mid adolescence to young adulthood). The only significant result was the negative association between family meal frequency and overweight status for early adolescent females in cross-sectional models, but longitudinal associations were not significant. Thus, the authors concluded that eating family meals might not be a proactive factor against overweight during young adulthood.

An increasing amount of literature has studied the relations between family meal and obesity. Previous studies have concentrated on the study the effects of family meal on adolescents (Berge, 2009; Larson et al., 2007; Videon & Manning, 2003). This study will investigate the associations in young Hispanic children.

Fast Food Frequency

Although the findings are not consistent, previous studies (Cummins, 2007; Laska, Hearst, Forsyth, Pasch, & Lytle, 2010) have found that greater access to restaurants, such as fast food, has been associated with less favorable diet quality and increased obesity. The American Medical Association (AMA) Expert Committee on the Assessment, Prevention, and Treatment of Child and Adolescent Overweight and Obesity has identified a couple of dietary habits that contribute to obesity, including frequently consuming fast food and large volumes of sweet beverages (e.g., fruit juices, soft drinks) (Rao, 2008). Several studies have tested the associations between fast food and sugar-sweetened beverage consumption. Frequent consumption of fast food in adults was associated with a high level of sugar-sweetened beverage consumption and low fruit and vegetable intake (Sharkey, Johnson, & Dean, 2011). Collison and colleagues (2010) also

found that fast food meal intake was positively correlated with sugar-sweetened beverage intake among participants age from 10 to 19. Children and adolescents (4 to 19 years old) who ate fast food, compared with those who did not, consumed more sugar-sweetened beverages and fewer fruits and vegetables (Bowman, Gortmaker, Ebbeling, Pereira, & Ludwig, 2004). Therefore, fast food frequency may affect children's weight status indirectly.

Parent's Physical Activity Support

Children's activity patterns may also be associated with risk of being overweight and obese. Previous research has shown that an inactive lifestyle is likely to contribute to the increasing prevalence of obesity in youth (Fogelholm, Nuutinen, Pasanen, Myöhänen, & Säätelä, 1999; Hills, King, & Armstrong, 2007). Parents have a fundamental role in influencing their children's eating and physical activity practices. Parents' participation in physical activity has a positive influence on youth's activity preferences (Steinbeck, 2001; Vilhjalmsson & Thorlindsson, 1998; Wold & Anderssen, 1992). Previous studies have suggested that parental support is an important factor associated with physical activity in youth. Wilson and colleagues (2011) reported that higher levels of youth-reported parental support were associated with an increase in moderate-to-vigorous physical activity at mid-intervention. A significant positive relationship was also reported for parental support of physical activity and children's physical activity in other studies (Adkins, Sherwood, Story, & Davis, 2004; Hoefer, McKenzie, Sallis, Marshall, & Conway, 2001; Sallis et al., 1993; Wilson et al., 2011). A negative association between physical activity and TV viewing time has been reported in young children (Burdette, Whitaker, & Daniels, 2004; Montgomery et al., 2004). Parents who are supportive to

their children's physical activity may play a central role as they determine children's TV viewing time.

Previous research has shown that individuals practice combinations of health behaviors rather than only one health behavior at a time (Berrigan, Dodd, Troiano, Krebs-Smith, & Barbash, 2003; Krick & Sobal, 1990; Sobal, Revicki, & DeForge, 1992). A moderate relation was found between physical activity and eating behaviors (Johnson, Nichols, Sallis, Calfas, & Hovell, 1998). O'Halloran and colleagues (2001) tested how groupings of health lifestyle patterns impact dietary change using a nationally representative sample. Their results reported that dietary intervention had strongest influences on individuals who were in the most physically active group; these findings indicate that it might be easier to promote healthy behaviors to those who have already practiced one or more healthy behaviors, such as physical activity. Another study (Reedy, Haines, & Campbell, 2005) found that participants who were classified into the cluster "Physically Active" reported to be more likely to eat more vegetables and fruits than other clusters (e.g. "Average Americans" and "Most Challenged") due to intervention. Healthy behaviors occur simultaneously. Parents who are supportive for their children's physical activity may be more likely to realize the benefits of other healthy behaviors, such as eating healthfully and encouraging their children to practice healthy dietary patterns. Few studies have examined the associations among parent's physical activity support, child's daily fruits/vegetable, sugar-sweetened beverage intake, and TV viewing time. In order to fill these gaps in the literature, the current study will explore the potential associations these factors.

Parents' Subjective Nutrition Knowledge

Parents' eating habits can be influential to children's food preferences and intake. Obesity prevention should not only concentrate on the dietary and physical activity behaviors of children, but also pay attention to parents' involvement. A previous study in Latina mothers found that their nutrition knowledge, food selection, and meal structure impacted the development of their children's lifelong habits that lead to normal weight or overweight and obesity (Lindsay, Sussner, Greaney, & Peterson, 2011) .

The knowledge-attitude-behavior model suggests that increasing knowledge in health will lead to changes in attitude, and may result in changes in behavior (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003; Contento, 2008). Knowledge can enrich individuals' understanding of the critical issues and encourage them to evaluate their beliefs and behaviors.

Qualitative studies have suggested that mothers' beliefs and understanding of feeding practices and their children's weight status are related to obesity (Lindsay et al., 2011). Another study (Manios, Kafatos, & Mamalakis, 1998) only compared the effects of interventions on changes in children's and parents' health knowledge. Other studies associated nutrition knowledge with children's obesity. For instance, some have shown that nutrition knowledge can have positive effects on the prevention of obesity. Spiegel and Foulk (2006) found that fourth and fifth grade students' knowledge, attitudes and behaviors were changed during an intervention program that further resulted in desirable BMI shifts. Olstad and McCargar (2009) found that improved nutrition knowledge and dietary behaviors of parents could improve children's dietary fat quality and reduce overweight among young children. Other studies (Variyam, 2001) based on the analyses

of national data also found that greater parental nutrition knowledge generally, or on obesity prevention specifically, was associated with lower prevalence of overweight children. Therefore, parents' role in preventing obesity acquires more attention.

Exosystem Level Factor

Food Assistance Program Participation

Policymakers have been seeking effective strategies to fight against the increasing prevalence of obesity in the U.S. Several US domestic food assistance programs [e.g. Food Stamp Program (FSP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)] have been designed to reduce problems associated with undernutrition and poor nutrition among the low-income households. However, questions have been raised whether U.S. food assistance programs contribute to the problems of overweight and obesity (Besharov, 2002). Previous studies have evaluated the relations between FSP participation and the weight of children used cross-sectional and longitudinal data (Bhattacharya & Currie, 2002; D. Gibson, 2004; Jones, Jahns, Laraia, & Haughton, 2003; Leung & Villamor, 2011; Ver Ploeg, Mancino, Lin, & Guthrie, 2008).

VerPloeg and colleagues (2008) did not find significantly associations between participation in the FSP and adolescent obesity after controlling for family income and parent's education. Gibson (2004) reported mixed results for the long-term participants in FSP. There was a 42.8% increase for young girls (5–11 years old) and a 28.8% decrease for young boys (5–11 years old) in the predicted probability of overweight during the previous 5 years of the study, comparing with girls and boys whose families did not participate in the FSP during the same time. Long-term FSP participation was not

significantly related to overweight in older children (12–18 years old). Results in another study (Schmeiser, 2012) showed no systematic relationship over time between FSP and WIC participation and weight status.

Gibson (2004) evaluated the relation between long-term Food Stamp Program (FSP) participation and child overweight by using panel data and taking family and child fixed effects into account. The sample (3831 girls from 2656 families and 4012 boys from 2707 families, aged 5-18 years old) was from the National Longitudinal Survey of Youth 1979 (NLSY79). Follow-up interviews were conducted annually until 1994 and biennially thereafter. Thus, the sample used in the study included observations on children from the 1986 through the 2000 waves of the survey. A younger sample included children between the ages of 5 and 11 year, and an older sample included children between the ages of 12 and 18 year. Ordinary Least Squares and logistic regression models were estimated for each age range: model 1 did not include fixed effects, model 2 included family fixed effects, and model 3 included child fixed effects.

The findings in Gibson's (2004) study indicated that for girls, long-term FSP participation was positively and significantly related to overweight in girls in the full sample and the older sample in model 1; long-term FSP participation was positively and significantly related to overweight in the younger sample but was not significant for the other age ranges in the other two models. For boys, long-term FSP participation was not significantly related to overweight in boys in model 1, but was negatively and significantly associated with overweight in younger boys. Long-term FSP participation was not significant for older boys in mode 2 and 3. Given the estimates in model 3, children (other characteristics were equal to the sample averages) whose families did not

participate in the FSP in the previous 5 year had a predicted probability of overweight of 14.5%. FSP participation 100% of the time over the previous 5 years predicted a 42.8% increase for young girls and a 28.8% decrease for young boys in the predicted probability of overweight during the previous 5 years of the study, holding all else constant. The results did not indicate that long-term FSP participation caused an increase in child weight status, but provided an interpretation of the relation between FSP participation and child weight.

Although these food assistance programs have promoted the benefits of consuming fruit and vegetables during nutrition education classes, average fruit and vegetable intake among infants and toddlers is low (Gerstein et al., 2010; Ponza, Devaney, Ziegler, Reidy, & Squatrito, 2004). Thus, these food assistance programs have developed classes and programs (e.g. Finding the Teacher Within and 5-A-Day Promotion Program) to increase fruit and vegetable consumption in several states in the U.S. Previous studies have assessed the associations between participation in food assistance programs and dietary consumption (e.g. fruit and vegetable). For instance, Gerstein and colleagues (Gerstein et al., 2010) suggested that compared with participant from comparison groups, intervention groups identified more value, importance, and relevance of the fruit and vegetable information and adopting new fruit and vegetable practices after attending the class. Findings from another study (Havas et al., 1998) indicated a significant higher daily consumption of fruit and vegetable two months later in intervention participants than control participants.

Havas and colleagues (1998) implemented a multidimensional program among women served by Special Supplemental Nutrition Program for Women, Infants, and

Children (WIC) in 16 sites located in Baltimore City and 6 Maryland counties. Eight sites were randomized initially to intervention status and 8 to control status. The primary goal was to increase participants' consumption of fruit and vegetable by at least one half serving for intervention participants. Nutrition sessions conducted by peer educators, printed materials and visual reminders, and direct mail were included as intervention components. The control group participants were provided the normal WIC program, including less than 10 minutes of nutrition education at the bimonthly voucher pickup. All intervention and control site participants completed a self-administered survey upon enrollment and an identical post intervention survey (postsurvey) two months after the last nutrition session. Questions about factors related to fruit and vegetable intake were asked. Mean daily consumption of fruit and vegetable over the previous month were assessed by 7 summary questions survey used in all NCI-sponsored national surveys and 5-ADay research projects. A strong association between attendance at the nutrition sessions and changes in fruit and vegetable intake was reported. Mean daily consumption had significantly increased by 0.56 ± 0.11 servings in intervention participants and 0.13 ± 0.07 servings in control participants. Consumptions increased as the participants attended more sessions.

Food assistance programs (e.g. WIC, FS, and the Expanded Food and Nutrition Education Program [EFNEP]) have been developing and distributing nutrition education curriculum by providing nutrition messages to students, newsletters to parents via mails, and in-home education sessions. Nutrition programs are considered as an efficient approach to influence diets and improve children's health (Kennedy, 1996). Previous research has evaluated the impact of nutrition program provided by food assistance

program on participants' nutrition knowledge (Arnold & Sobal, 2000; DeVault et al., 2009; Dollahite, Rodibaugh, Holmes, Hosig, & White, 1998). However, findings are inconsistent. Dollahite and colleagues (1998) reported significant nutrition knowledge gain for students who were enrolled in food assistance programs, but not for parents. Arnold and Sobal (2000) found significant improvements of nutrition knowledge in participants who graduated from EFNEP. The only significant result found in Devault and colleagues' (2009) study was the improvement in knowledge of which food had more fat.

Dollahite and colleagues (1998) evaluated the effectiveness of nutrition education programs to school children (grades K-5) provided by several food assistance programs (e.g. WIC, FSP, and EFNEP). The outcomes they were interested in were the changes in nutrition knowledge and food choice behaviors of children and changes in nutrition knowledge, food choice behaviors, and diet-related beliefs in parents. The Health Behavior Questionnaire of the Child and Adolescent Trial for Cardiovascular Health (CATCH) (Edmundson et al., 1996) were used to assess the success of interventions in changing nutrition knowledge and food choices. Students in grades 2 to 5 were selected due to the immaturity of younger students. Parents were asked to answer an instrument including eight multiple choice items in the knowledge section. Analysis of variance (ANOVA) was used to test the effects of food assistance programs on knowledge gain in parents and children. For children, a significant knowledge gain was found in the intervention groups at every grade level, but not in control groups at any grade level. For parents, there no significant differences were reported at the intervention site regarding

knowledge gain. Implications for future research and practice were provided based on their findings.

Another study (DeVault et al., 2009) also investigated the influences of the It's All About Kids nutrition component on knowledge, attitudes, and behaviors related to nutrition among fourth graders in Tulsa, OK. The intervention, It's All About Kids was developed to improve food choices and increase physical activities of children in grades one to five in Tulsa. Both intervention and control group recruited 70 students. Outcomes were measured by a modified version of the Pathways Knowledge, Attitudes, and Behaviors (KAB) questionnaire (Stevens et al., 1999) and the Child and Adolescent Trial of Cardiovascular Health (CATCH) Food Checklist (Smith et al., 2001). No significant differences between intervention and control groups were reported in nutrition knowledge scores at posttest or follow-up. The only significant finding was increased knowledge of which food have more fat in intervention group.

Based on the theory and previous literature, the current study will examine the association between food assistance programs and parent's nutrition knowledge in Hispanic populations.

Macrosystem Level Factor

Acculturation

Culture has a marked influence on choice of foods consumed and meal patterns (De Castro, 1997). Acculturation refers to the process by which a racial group (e.g., Latin American) acquires and exchanges cultural elements and patterns (e.g., beliefs, religion, language) of another culture (e.g., Anglo American) (Morales, Lara, Kington, Valdez, & Escarce, 2002; Satia-Abouta et al., 2002; Sussner, Lindsay, & Peterson, 2009).

Meanwhile, immigrants can experience both positive and negative changes in personal lifestyle and environment, including diet and physical activity (Satia-Abouta et al., 2002). For instance, Arab mothers indicated that their children prefer American fast foods (Tami, Reed, Boylan, & Zvonkovic, In Press). It is important to understand the dietary and sedentary behaviors since these are two significant risk factors for overweight populations.

An increasing number of studies have examined the impacts of acculturation on the development of obesity. Acculturation has been related to shifts from traditional diets to Western food that are popular and easily available (Unger et al., 2004). These shifts can include both healthful and unhealthful dietary changes. Previous studies suggest that Hispanics consume a greater percentage of protein and fiber, and a lower percentage of saturated fat than non-Hispanics (Morales et al., 2002). Another study (Gordon-Larsen et al., 2003) found that foreign-born Hispanic-American adolescents consume more rice, fruits, vegetables and less cheese and fast foods than their US-born counterparts, which indicates a healthier dietary pattern. A review article also indicated that fast food consumption is increased with acculturation among Latinas (Ayala, Baquero, & Klinger, 2008). Adoption by Hispanics of a dietary pattern that is high in fat and calories and low in fruits and vegetables is of concern since this pattern can contribute to increased risk of obesity and increased risk factors for several major, chronic diseases (Satia-Abouta et al., 2002; Unger et al., 2004). On the other hand, less highly saturated fat consumption and more use of milk and salads are considered a healthful change (Morales et al., 2002; Satia-Abouta et al., 2002). Duerksen and colleagues (2007) reported that increased levels

of acculturation may lead to higher rates of overweight among Mexican American families by eating more fast food rather than their traditional, authentic Mexican food.

Acculturation is also closely associated with physical activity, and the relationship between acculturation and physical activity is complex. Overall, Hispanics live more sedentary lifestyles than whites (Morales et al., 2002). According to the study conducted by Jurkowski, Mosquera and Ramos (2010), the results showed that Latinas who are more acculturated to the American culture are more likely to engage in more physical activity than those less acculturated Latinas. For instance, Crespo and other scholars reported that acculturation is related to a lower prevalence of physical inactivity (2001). The findings in another study (Singh, Yu, Siahpush, & Kogan, 2008) also indicated that more acculturated immigrant children are less likely to participate in regular physical activity and sports and more likely to be physically inactive. Inactivity and low intensity and frequency of physical activity are increased with length of US residence among Hispanics (Gordon-Larsen et al., 2003; Unger et al., 2004). As stated above, parent's physical activity support may be associated with children's physical activity positively. This study evaluates the relation between acculturation and parent's physical activity support.

The association between acculturation and nutrition knowledge in Hispanic population has not been well examined. A positive relation was found between acculturation to Western culture and nutrition knowledge in a study that assessed the level of nutrition knowledge of young women (early 20s) with and without eating disorders in a Western (Australia) and non-Western country (Singapore) (Soh et al., 2009). A qualitative study (Franzen & Smith, 2009) investigated how acculturation

influences diet, cultural practices related to cooking and food preparation knowledge, and BMI of Hmong children. They reported that acculturation (years lived in the US and birth place) might play an important role in stature and BMI, food and physical activity habits, cooking and food preparation knowledge, and perceptions of health in Hmong children in the U.S. Thus, the current study focuses on the associations of acculturation with Hispanic family's eating patterns, parents' physical activity support, and nutrition knowledge.

Conclusion

With the rising prevalence rates of child and adolescent obesity over the last few decades, it is important to examine the multi-level influences that shape children's health behaviors and affect children in terms of BMI percentile, waist circumference, body fat percentage. This is especially important for Hispanic children who may be at high risk of overweight and obesity.

APPENDIX B

FAMILY SURVEY

Subject ID _____ Date_____

Family Survey

Directions: Please answer the following questions. If you have more than one child taking part in this research project, please complete a separate survey for each child. There are no right or wrong answers.

1.On a **typical weekday**, how many hours a day does your child watch TV, videos or DVD's, or play games on the TV? (Weekdays are Monday, Tuesday, Wednesday, Thursday, and Friday.) For example, if your child usually watches TV about 1 hour a day **on weekdays**, you would put "1" for hours watching TV. If your child usually plays games on the TV for 2 hours a day **on weekdays**, you would put "2" for hours playing games on TV.

____ hours a day watching TV

____ hours a day watching videos or DVD's

____ hours a day playing games on TV

2. On a **typical weekend day**, how many hours does your child watch TV, videos or DVD's, or play games on the TV? (Weekend days are Saturday and Sunday.) For example, if your child usually watches DVD's for about 4 hours on each day of the weekend, then put "4" for hours watching videos or DVD's.

____ hours a day watching TV

____ hours a day watching videos or DVD's

____ hours a day playing games on TV

3. Is there a TV in your child's bedroom?
____ Yes ____ No

4. Does your child watch TV in someone else's bedroom?
____ Yes ____ No

5. On a **typical weekday**, how many hours a day does your child use the computer (playing video games, using the Internet)? (Weekdays are Monday, Tuesday, Wednesday, Thursday, and Friday.)

_____ hours a day

_____ do not have computer

6. On a **typical weekend day**, how many hours a day does your child use the computer (playing video games, using the Internet)? (Weekend days are Saturday and Sunday.)

_____ hours a day

_____ do not have computer

7. How many total cups of **fruit** does your child **usually** eat a day? (include fresh, frozen, dried, canned, and 100% juices)
To help you estimate amounts:

- 1 piece of fresh fruit = 1 cup
- Any canned or frozen fruit eaten that would fit in a tennis ball = 1 cup
- ½ cup dried fruit = 1 cup fruit

____ cups a day

8. How many cups of **vegetables** does your child **usually** eat a day? (include fresh, frozen, canned, and juices)
To help you estimate amounts:

- 1 piece of fresh vegetable = ½ cup
- Any canned or frozen vegetable eaten that would fit in a tennis ball = 1 cup
- 2 cups lettuce or vegetables for salad = 1 cup

_____ cups a day

9. We are interested in the amount of ***sweetened beverages*** your child drinks. Sweetened beverages include soft drinks like Coke©, fruit drinks or punch like Koolaid©, sports drinks, sweet tea, lemonade, or any other drink that includes sugar or corn syrup.

How many ounces of sweetened beverages does your child drink in a **typicalweekday** (Monday, Tuesday, Wednesday, Thursday, Friday)? (To help you estimate: One can of soft drink equals 12 ounces or 1 ½ cups. One cup equals 8 ounces.) For example, in a typical weekday, if you child drinks 1 can of soda and ½ cup of Koolaid a day, you

would put 12 ounces of soda and 4 ounces of Koolaid in the blanks below. If you prefer to answer using "cups", you can mark through "ounces" and write in "cups."

_____ ounces of soda a day

_____ ounces of fruit drink (Koolaid, other) a day

_____ ounces of sports drink a day

_____ ounces of other sweet beverage like tea or lemonade a day

How many ounces of sweetened beverages does your child drink in a **typical weekend day** (Saturday or Sunday)? (To help you estimate: 1 can of soft drink equals 12 ounces or 1 ½ cups. One cup equals 8 ounces.) If you prefer to answer using "cups", you can mark through "ounces" and write in "cups."

_____ ounces of soda a day

_____ ounces of fruit drink (Koolaid, other) a day

_____ ounces of sports drink a day

_____ ounces of other sweet beverage like tea or lemonade a day

10. In a typical <u>week</u>, how many times does your family eat a meal together?
    Every day

    A few times a week

    Once a week

    Less than once a week

    Never

11. The following statements are about the **<u>amount of food</u>** your child eats.

I am aware of the recommended amounts of food for my child.	Yes	No	Sometimes
I use the serving size on food labels to guide the amount of food my child eats.	Yes	No	Sometimes
I think my child eats more food than he or she needs.	Yes	No	Sometimes

I need more information on the recommended amounts of food that my child should eat.	Yes	No	Sometimes
I need suggestions for ways to help my child not eat too much.	Yes	No	Sometimes
I feel confident that my child is eating the amount of food he or she needs.	Yes	No	Sometimes

12. In a typical week, how many times does your child eat food from a fast food restaurant like McDonald's, Sonic, Kentucky Fried Chicken, Taco Bell, etc.?

Every day

A few times a week

Once a week

Less than once a week

Never

13. The following statements are about **physical activity:**

	Never	Sometimes	Often	Always
a. I encourage my child to play outside when the weather is nice.	1	2	3	4
b. I encourage my child to be physically active instead of watching TV.	1	2	3	4
c. I do something physically active each week with my child.	1	2	3	4
d. I take my child to his/her sport practice, dance class or other physical activity program.	1	2	3	4
e. When the weather is nice, I go for a walk with my child.	1	2	3	4
f. I assign active chores for my child, such as vacuuming, doing lawn work, or babysitting young children.	1	2	3	4
g. For short trips, such as to the corner store or to a neighbor's house, we walk instead of drive.	1	2	3	4
h. Our family participates in community events that encourage physical activity as a family such as fun walking events.	1	2	3	4

Please look over the survey and make sure that you have not left any blanks. Thank you.

APPENDIX C

BRIEF ACCULTURAQTION RATING SCALE FOR MEXICAN-AMERICANS: ARSMA-II

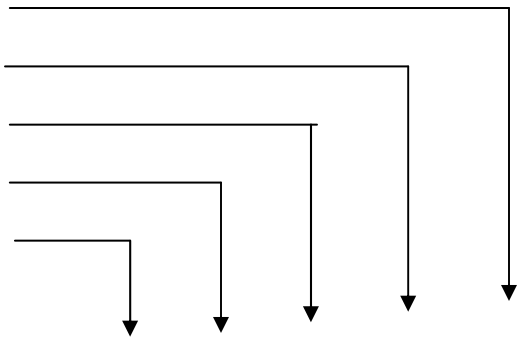
(5) Almost Always/Extremely Often

(4) Much/Very Often

(3) Moderately

(2) Very Little/Not Very Much

(1) Not at all



a. I Speak Spanish.		**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
b. I speak English.		**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
c. I enjoy speaking Spanish.		**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
d. I associate with Anglos.		**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
e. I enjoy listening to English language music.	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	
f. I enjoy Spanish language television.		**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
g. I enjoy Spanish language movies.	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	
h. I enjoy reading books in Spanish.		**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
i. I write letters in English.		**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
j. My thinking is done in the English language.		**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
k. My thinking is done in the Spanish language.		**(1)**	**(2)**	**(3)**	**(4)**	**(5)**

l. My friends are of Anglo origin.	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**

APPENDIX D

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