Spring 5-10-2019

Exploring Maternal Factors Linked to Weight Status in Salvadorian Infants

Carmen M. Kiraly
Duquesne University

Melanie Turk
Duquesne University

Melissa Kalarchian
Duquensne University

Cheryl Shaffer
Suffolk County Community College

EXPLORING MATERNAL FACTORS LINKED TO WEIGHT STATUS IN SALVADORAN INFANTS

A Dissertation

Submitted to the School of Nursing

Duquesne University

In partial fulfillment of the requirements for

the degree of Doctor of Philosophy

By

Carmen Kiraly

May 2019

EXPLORING MATERNAL FACTORS LINKED TO WEIGHT STATUS

IN SALVADORAN INFANTS

By

Carmen Kiraly

Approved on March 27, 2019

Dr. Melanie Turk
Associate Professor of Nursing
Duquesne University
(Committee Chair)

Dr. Melissa Kalarchian
Professor of Nursing
Duquesne University
(Committee Member)

Dr. Cheryl Shaffer
Professor of Nursing
Suffolk County Community College
(External Committee Member)

Dr. Mary Ellen Smith Glasgow
Dean, Duquesne School of Nursing
Professor of Nursing

Dr. Richard Zoucha
Chair; Duquesne School of Nursing
Professor of Nursing

ABSTRACT

EXPLORING MATERNAL FACTORS LINKED TO WEIGHT STATUS IN SALVADORAN INFANTS

By

Carmen Kiraly

May 2019

Dissertation supervised by Dr. Melanie Turk

Background: Obesity rates in the US have risen dramatically, especially among Hispanic adults and children. Because of the high prevalence of overweight and obesity in Latino children by preschool age, it is prudent to examine maternal factors potentially linked to weight status during an infant's first year of life. The literature on risk factors of child obesity has focused primarily on children of Mexican descent, and little research exists for other Latino populations, such as Salvadorans. **Objective:** To investigate maternal physiologic and infant feeding factors associated with infant overweight and/or obesity in a sample of Salvadoran mother-infant dyads. **Methods:** A cross-sectional, correlational study, utilizing an ecological framework, was conducted at the 9-12-month well-baby visit in two private pediatric offices on Long Island, New York. Maternal physiologic risk factors and feeding beliefs as well as infant feeding practices during the first 5 months were self-reported by the mothers. Infants birth weight, current weight and recumbent length were retrieved from the electronic charts. Bivariate logistic regression models examined the relationship of the variables with infant weight status, > *85th weight-for-length percentile (WFL) for sex.* **Results:** In this sample of mothers (*N*=88), 94.3% were born in El Salvador, 92.1% were married, and the mean age was 28.5 years (*SD* = 5.9 years); 43% of the total sample of infants had a WFL > 85th percentile. After controlling for maternal age, insurance type, income, education, and marital status, no significant associations with infant WFL > 85th percentile at the 9-12-month well-visit were found. Infant feeding practices in the first five months and maternal physiologic risk factors were not associated with infant weight status. Infant birth weight (kg) was the only variable significantly associated with WFL > 85th percentile, $p < .05$. **Conclusion**: This is the first study to examine infant weight status in the Salvadoran population. Future studies should objectively investigate infant feeding practices and other potential contributing factors among Salvadoran mother-infant dyads, since nearly half of the infant sample had a WFL > 85th percentile.

DEDICATION

I would like to dedicate this dissertation to my family for their unending love, support, and inspiration which facilitated the completion of my PhD coursework in a timely manner. I would like to sincerely thank Dr. Melanie Turk, my committee chair, who diligently guided me through this arduous process, and the rest of my committee, Dr. Melissa Kalarchian and Dr. Cheryl Shaffer, for their invaluable feedback and support. I would like to thank my friends and colleagues for their words of inspiration throughout the years. Finally, I would like to thank the pediatricians, office staff, and participants for making this study possible.

ACKNOWLEDGEMENT

We would like to thank Dr. William Gallo for his expertise with the statistical measures. We thank Dr. Juan Espinoza and Dr. David Sanchez, the pediatricians that made this study possible by allowing the recruitment of potential participants in their offices. We thank Natasha Sanchez and the office staff at the two pediatric offices for their timely assistance with patient recruitment. Finally, we thank the participants of this study for their willingness to share their experiences on infant feeding practices and beliefs.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

Insufficient power (i.e. prevalence too low) to generate estimated logistic regression coefficient.

*p<.05.

Ref = Reference Group

OR=Odds Ratio

CI=Confidence Interval

IFSQ=Infant Feeding Styles Questionnaire

WFL=Weight for Length

GDM=Gestational Diabetes Mellitus

HS=High School

IFSQ Behaviors and Beliefs: Lower scores represent healthier feeding beliefs/behaviors

BMI = Body Mass Index

kg = kilograms

U.S.=United States

Exploring Maternal Factors Linked to Weight Status in Salvadoran Infants

Specific Aims

High rates of obesity exist among Hispanic adults and children in the US. Results from the National Health and Nutrition Examination Survey (2011-2014) show a disparity among children ages 6 to 11 years with 24.1% of Hispanic girls and 25.8% of Hispanic boys being obese (BMI ≥ sex-specific 95^{th} percentile) compared to 14.4% of non-Hispanic white girls and 13% of non-Hispanic white boys (Ogden et al., 2016). Similarly, Hispanic Latino infants from 3 to 23 months were found to have higher weights-for-length when compared to non-Hispanic black or white children of the same age; 13.8%, 11.9%, and 11% respectively, based on World Health Organization growth standards (Freedman et al., 2017).

Because of the prevalence of obesity in Latino children by preschool age, it is prudent to examine maternal feeding practices and beliefs during the infant's first year of life for a potential link to infant weight status (Kupers et al., 2015; Liu, Hannon, Rong, Downs, & Marrero, 2015). Exclusive breastfeeding for 6 months and delaying solids (complimentary feeding) until 5 to 6 months are believed to protect against childhood overweight/obesity (American Academy of Pediatrics, 2012). Latina mothers often introduce solids at 2 to 3 months, combine breastfeeding with formula, or formula feed only (Ahluwalia, D'Angelo, Morrow, & McDonald, 2012; Gross, Mendelsohn, Fierman, Hauser, & Messito, 2014), underestimating infant satiety and prompting overfeeding (Gross et al., 2014; Kupers et al., 2015). Studies link complementary feeding before 5 months to accelerated infant growth (Pearce, Taylor, & Langley-Evans, 2013; Schwartz, Vigo, Dias de Oliveira, & Justo Giugliani, 2015). Also, maternal risk factors such as pre-pregnancy BMI > 25 kg/m^2, gestational diabetes mellitus (GDM), and pregnancy weight gain > 35 lbs.

(Institute of Medicine and National Research Council, 2009) expose the fetus to undue intrauterine growth and increase the likelihood of rapid infant weight gain (Bowers et al., 2013). To date, the literature on childhood obesity in Latino youth has focused primarily on children of Mexican descent, and is scant for other Latino populations (Ahluwalia et al., 2012; Gross et al., 2014; Schwartz et al., 2015), particularly Salvadorans. Salvadorans are the fourth largest Latino subgroup in the US (U.S. Census Bureau, 2014). Knowing whether maternal feeding practices and physiological factors confer similar risk in Salvadoran children will expand our knowledge of this phenomenon in another major Latino subgroup.

The study proposed here will assess environmental factors hypothesized to be associated with an increased risk for the development of overweight/obesity in ~100 Salvadoran mother-infant dyads in a cross-sectional, correlational study, utilizing an ecological model as a framework. These factors include maternal feeding practices during the infant's first 5 months of life; maternal feeding beliefs; and maternal risk factors, which will be documented in this study at the 9-12-month well-baby visit. The specific aims of the study are to:

Aim 1: Determine the association between *maternal feeding practices* (complementary feeding, breast/formula feeding) during the first 5 months of the infant's life and *infant weight status* (>85th weight-for-length percentile for sex) at the 9-12-month visit. **Aim 2:** Determine the association between *maternal feeding beliefs* and *infant weight status* (>85th weight-for-length percentile for sex) at the 9-12-month visit. **Aim 3**: Determine the association between *maternal risk factors* (pre-pregnancy BMI > 25 kg/m^2, GDM, pregnancy weight gain > 35 lbs.) and *infant weight status* (>85th weight-for-length percentile for sex) at the 9-12-month visit. **Aim 4:** Determine the association of each domain of factors (*maternal feeding practices, beliefs, history* *of maternal risk factors*) during the first 5 months with *infant weight status* (>85th weight-for-length percentile for sex) at the 9-12-month visit, while controlling for the other factors.

The proposed study seeks to support the mission of the National Institute for Nursing Research to promote and improve the health of individuals and families, and enhance wellness in diverse groups by understanding physical, behavioral, and environmental correlates of weight status among Salvadoran infants. Ultimately, study findings will guide the development of inter-professional collaborative interventions to address risk factors from a cultural perspective, help infants start on a healthy weight trajectory, and attempt to reduce disparities in this population.

Significance

The Problem of Obesity among Latino and Hispanic Youth

Obesity rates in the US have risen dramatically in the last 30 years, especially among Hispanic adults and children. Results from the National Health and Nutrition Examination Survey (NHANES, 2011-2014) showed a disparity among children between 6 to 11 years of age with 24.1% of Hispanic girls and 25.8% of Hispanic boys being obese (BMI for age ≥ 95th percentile, Centers for Disease Control (CDC) Growth Charts) compared to 14.4% of non-Hispanic white girls and 13% of non-Hispanic white boys (Ogden et al., 2016). In the 2 to 5-year-old age group, although rates of obesity have declined since 2003-2004 from 13.9% ($p <$ .001) to 9.4% in 2013-2014 (p=.03), the downward trend appears to be more significant in non-Hispanic white children (5.2% obesity rate) than in children from ethnic minority groups; e.g., 15.6% in Hispanic children and 10.4% in non-Hispanic black children in this age group (Ogden et al., 2016). Similarly, Hispanic Latino infants from 3 to 23 months have higher weights-for-length when compared to non-Hispanic black or white children of the same age; 13.8%, 11.9%, and 11% respectively, based on World Health Organization growth standards (Freedman et al., 2017).

In addition to an increased risk for developing obesity in adolescence and young adulthood, childhood obesity sets the stage for other physiologic, psychological, and social consequences, such as type 2 diabetes, hypertension, dyslipidemia, low self-esteem, depression, bullying, and poor school performance, with greater rates of comorbidities in children from minority groups (Barlow, 2007). For example, a study by Wen and colleagues (2012), found only a small decline from 2004-2008 in obesity prevalence in children who were Medicaid recipients, suggesting persistent health disparities in lower income groups. Because obesity reduction strategies in children appear to have a greater effect among higher socio-economic status (SES) groups than in lower SES groups (Wen et al., 2012), it will be beneficial to examine aspects of the mother-infant dyad's socioeconomic status and type of health insurance in this study. The possible sequelae of obesity in minority children underscores the urgent need to address potentially modifiable risk factors, especially among Hispanic and Latino youth where the rates of obesity are among the highest. As will be discussed in the following sections, several potentially modifiable obesity risk factors identified within the child's environmental milieu include less exclusive breastfeeding, prolonged formula feeding, complimentary feeding < 4 months of age, high intake of sugary drinks, sedentary behaviors among family members, and complex parent-child feeding patterns (Taveras, Gillman, Kleinman, Rich-Edwards, & Rifas-Shiman, 2010). Therefore, a better understanding of these factors within the child's environment among subgroups of the Hispanic population may help inform obesity prevention efforts.

Breastfeeding Guidelines

To protect against childhood overweight and obesity, the American Academy of Pediatrics (AAP) (2012) recommends exclusive breastfeeding for 6 months or more instead of formula feeding and delaying complimentary feeding (introduction of solids other than breastmilk/formula) until 5 to 6 months. Research findings support an association between longer duration of breastfeeding and a reduced risk of obesity (Wang, C., Ratliff, Xie, & Wang, 2017), compared with formula feeding (odds ratio: 0.87; 95% confidence interval [CI]: 0.85–0.89) (Owen, Martin, Whincup, Smith, & Cook, 2005; Perez-Escamilla & Kac, 2013). From 2000 to 2008, the rate of breastfeeding initiation in the early postpartum period in Latina mothers increased from 77.6% to 80.0%, however this increase was not significant (p=0.2). Although, during 2000-2008, breastfeeding at 6 months in Latina mothers increased from 34.6% to 45.2% (p<0.01), and from 18.2% to 26.3% (p<0.01) at 12 months, these rates did not meet current CDC recommendations of 61% of any breastfeeding at 6 months or 34% at 12 months (Morbidity and Mortality Weekly Report MMWR, 2013; National Center for Chronic Disease Prevention and Health Promotion, 2014). Since little is known about the feeding practices of Salvadoran mother-infant dyads during early infancy, this study will examine rates of breastfeeding and other forms of feeding in Salvadoran infants from 0-to-5 months.

Maternal Feeding Practices

Research shows that immigrant Latinas who have acculturated to US customs are less likely to practice exclusive breastfeeding and more likely to combine breastfeeding with formula, formula feed only, or introduce complimentary feeding as early as 2-3 months, practices which underestimate infant satiety, and lead to overfeeding (Gross et al., 2014; Kupers et al., 2015). Complimentary feeding, also known as “double feeding,” is perceived by many Latina mothers to provide better nourishment than breast milk or formula alone (Pearce et al., 2013; Schwartz et al., 2010) and may be based on a lack of knowledge and understanding of the benefits of exclusive breastfeeding, as well as a fear of under nourishing the child (Houston, Waldrop, & McCarthy, 2011). These practices are thought to accelerate the infant growth trajectory (Ahluwalia et al., 2012; Gross et al., 2014), and have been attributed to the assimilation process and the belief that breastfeeding is associated with the poverty experienced in their native countries (Ahluwalia et al., 2012; Hernandez, 2006).

Up to now, studies have measured acculturation mainly in terms of years of residency and degree of fluency in the English language. Research on acculturation and feeding choices should consider the level of maternal education because a higher level of education has been linked to more compliance with exclusive breastfeeding (Ahluwalia et al., 2012; Gill, Reifsnider, & Tinkle, 2004; Vaughn, Geraghty, Nino, & Valenzuela, 2010). The association between acculturation factors (primary language spoken and years living in the U.S.), feeding practices, and infant weight status, specifically in Salvadoran infants, will be examined in this study.

Maternal Feeding Beliefs

Because of the high prevalence of overweight and obesity in Latino children by preschool age, it is prudent to examine maternal feeding style, including feeding beliefs, during an infant's first year of life to determine a potential association with infant weight (Kupers et al., 2015; Liu et al., 2015). Family influence is a strong contributing factor to infant feeding behaviors such as "pressure feeding," a desire for the infant to finish the entire bottle, which often underestimates infant satiety. This practice is also found among Latina mothers (Anderson & Whitaker, 2009; Cartagena et al., 2014). The AAP (2012) recommends that a 6-month old infant consume 6 to 8 ounces (180–240 ml) 5 to 6 times in a 24-hour period. Research shows this amount is often exceeded by Latina mothers (Cartagena et al., 2014). Finally, there appears to be an underestimation of overweight, as several studies report Latina mothers' preference for a plump child and perceptions of thinness as an unhealthy state (Gill et al., 2004; Houston et al., 2011). Further investigation on double feeding and the cultural perspective in which it takes place is warranted because this practice does not provide optimal benefit to the baby (Ahluwalia et al., 2012). The proposed study will examine the maternal feeding beliefs of Salvadoran mothers who have the potential to promote obesity and impede a healthy weight in Salvadoran infants.

Maternal Risk Factors

Certain maternal risk factors also influence infant weight status. Conditions such as pre-pregnancy overweight or obesity (BMI > 25 kg/m^2), GDM, and excessive pregnancy weight gain > 35 pounds (Institute of Medicine and National Research Council, 2009) expose the fetus to excessive intrauterine growth and lead to rapid weight gain in infancy, increasing the risk of childhood obesity (Bowers et al., 2013). Studies show that Latina women have a higher rate of being overweight or obese than Non-Hispanic white women, and consequently, their children face even greater rates of obesity and diabetes than their immigrant parents (National Center for Health Statistics, 2012). Pre-pregnancy maternal obesity and obesity during pregnancy have been linked to the development of GDM, childhood obesity, and lowered rates of breastfeeding in all populations of childbearing women (Tenfelde, Finnegan, & Hill, 2011). In addition to childhood obesity, maternal GDM predisposes the child to developing type 2 diabetes later in life. Research examining the effects of pre-pregnancy obesity and pregnancy weight gain on infant weight status together with an increased tendency to formula feed is scarce (Mayer-Davis et al., 2008; Smith, Hulsey, & Goodnight, 2008). These maternal physiologic conditions are believed to be strong indicators of obesity in infants by the first year of age (Bowers et al., 2013). The multidimensional factors of maternal feeding practices and beliefs, as well as maternal physiologic risk factors are all believed to potentially confer obesity risk in Latino infants; an examination of these and other variables in Salvadoran infants will be the focus of the proposed study.

Theoretical Framework Guiding Research

Current research suggests that the causes of obesity in Latino children are multifaceted and that this problem is best addressed by adopting a broad, multi-dimensional perspective that considers the complex, but changing, cultural and social milieu in which Latinos live (Ndiaye et al., 2013; Williams, Kabukuru, Mayo, & Griffin, 2011). Characteristics of the child and parents, family structure and functioning, cultural influences, community and societal norms, and public policies are some reasons, hypothesized within an ecological framework, for the obesogenic tendencies in Latino children (National Academies of Sciences Engineering and Medicine, 2016; Williams et al., 2011).

Bronfenbrenner's (1977) Ecological Systems Theory (EST) will be used as an overarching framework for this study to examine infant weight status within the environmental context of maternal risk factors, infant feeding beliefs and feeding behaviors. The EST defines the environment as having layers, each with the capacity to affect child development positively or negatively. The environment is comprised of the *microsystem* (immediate setting surrounding the child such as the parents, family, home, and health services), the *mesosystem* (all interactions within child's microsystem), the *exosystem* (extended family, friends, social welfare policies, community, and mass media) and the *macrosystem* (outermost layer that involves cultural values, language, attitudes, and the economy). The ecological framework provides a vantage point from which to explore the development of the mother's roles and practices related to child health. This development is ongoing and is subject to change as the person(s) involved perceives, interacts, and adapts to the surrounding environment (Bronfenbrenner, 1977).

The ecological model was instrumental in guiding the design of this study. First, aspects from the infant's *microsystem* were selected as factors to be studied for their association with infant weight status: maternal feeding practices and beliefs; maternal physiologic risk factors; and family influence on infant feeding. Second, effects of the interactions of these factors on infant weight status will be measured as part of the infant's *mesosystem*. Finally, certain characteristics of the infant's *exosystem* and *macrosystem*, for example, mother's level of education, type of health insurance, employment status, and birthplace will be explored in relationship to infant weight status.

Gaps in Knowledge

To date, the literature on risk factors of child obesity has focused primarily on children of Mexican descent (Adair, 2008; Dennison, Edmunds, Stratton, & Pruzek, 2006; Kumanyika, 2008), and the literature is scant for other Latino populations (Ahluwalia et al., 2012; Cartagena et al., 2014; Gross et al., 2014). Salvadorans are the fourth largest Latino subgroup in the US (U.S. Census Bureau, 2014); yet, there is no data on the feeding practices of Salvadoran mothers and the effects on infant weight status. Knowing whether maternal feeding practices confer similar risk in Salvadoran children will add to the state of the science by investigating this phenomenon in another major Latino subgroup (Barroso et al., 2012; National Center for Health Statistics, 2012). Accordingly, the proposed cross-sectional, correlational study will explore the association of maternal feeding practices during the first 5 months; feeding beliefs; and maternal risk factors with infant weight status in ~100 Salvadoran mother-infant dyads presenting for the 9-to-12-month well-baby check-up.

Importance of the Research to Health and Nursing

As members of the inter-disciplinary team, nurses play a vital role in battling the childhood obesity epidemic in Hispanic and Latino populations by recognizing cultural beliefs and practices that encourage obesogenic tendencies in young children. Primary care settings, such as pediatrician offices, provide unique opportunities to counsel children and families on how to implement realistic behavioral changes to improve physical activity and nutritional choices during critical periods of growth and development in their child's life. Obesity prevention and treatment efforts in young Latino children and families must be directed at multiple levels in order to create change that is positive and sustainable (Barlow, 2007; National Academies of Sciences Engineering and Medicine, 2016).

The contributions of the proposed research study to the resolution of the problem will be significant from numerous standpoints. First, from an ecological perspective, the assessment of multiple complex influences related to feeding practices and beliefs can yield valuable data that will add to the scant body of knowledge on this topic among Salvadoran mothers and infants. Second, results from this study can aid in the creation of culturally sensitive interventions for Salvadoran mothers that increase adherence to current AAP (2012) recommendations regarding breastfeeding and improve health outcomes for their children. A greater understanding of parental views and behaviors on infant feeding and weight is critical in order for healthcare providers to cultivate effective strategies that address excessive weight gain in infancy and childhood in the Salvadoran subgroup of the Latino population (Houston et al., 2011).

Innovation

The proposed study is innovative for the following reasons: First, this study will examine risk factors of infant weight status in the Salvadoran subgroup of the Latino population. To date, the literature in this area has focused primarily on parent-child dyads of Mexican descent and mothers' feeding practices of Mexican infants (Ahluwalia et al., 2012; Cartagena et al., 2014; Gross et al., 2014). The large variation within and among Latino subgroups in the United States is misinterpreted by researchers who often refer to Latinos as a homogenous group (Cauce & Domenech-Rodríguez, 2002). Because data on the feeding practices of Salvadoran mothers and the effects on infant weight status is sparse, knowing whether maternal feeding practices and beliefs confer similar risk in Salvadoran children will add to the state of the science by broadening our knowledge of this phenomenon in another major Latino subgroup (Adair, 2008; Dennison et al., 2006; Kumanyika, 2008; Owen, Martin, Whincup, Davey-Smith, et al., 2005).

Second, this study will examine multiple complex factors (maternal physiological risk factors, maternal feeding practices, and maternal feeding beliefs) that are believed to affect Latino infant weight status. These factors are hypothesized to be associated with the development of overweight and obesity in Latino infants by the 9-to-12-month well-baby visit (Taveras et al., 2010). Research examining multiple factors related to Latino infant weight status is scant. To date, only a few studies have examined the effects of maternal risk factors such as pre-pregnancy weight, pregnancy weight gain, and a history of GDM together with maternal feeding practices and feeding beliefs on weight status in Latino infants (Cartagena et al., 2014; Taveras et al., 2010). The effect of these multiple factors in Salvadoran infants will be examined in this study.

Third, this study will use the EST to examine *host, agent*, *microsystem, mesosystem, exosystem*, and *macrosystem* domains of the mother-infant dyad. The EST posits that to study a child's development, the child, the immediate environment, and the interaction of the larger environment must be examined to understand human development. Studies using the ecological model as a framework to examine early life risk factors in the development of infant obesity in Latino children are limited (Cartagena et al., 2014; Reifsnider, Keller, & Gallagher, 2006).

Approach

Research Design

The proposed cross-sectional, correlational study will explore the association of maternal feeding practices during the infant's first 5 months of life; feeding beliefs; and maternal risk factors as they relate to infant weight status in ~100 Salvadoran mother-infant dyads presenting for the 9-to-12-month well-baby check-up. Mothers will be asked to self-report this information retrospectively on the day of data collection at the 9-to-12-month well-baby visit. Infant birth weight and recumbent length and current infant weight and recumbent length at the 9-to-12-month visit will be obtained from the infant's electronic health record (EHR) by either the PI, who will complete HIPPA training, or by the office staff. Consents will be sought from the mothers to agree to participate in the study and obtain only this EHR data on the infant. Utilizing an ecological model as a framework, the study will assess the infant's immediate environment for its effect on weight status. Please see Figure 1 for a diagram of the association between the variables using an ecological model.

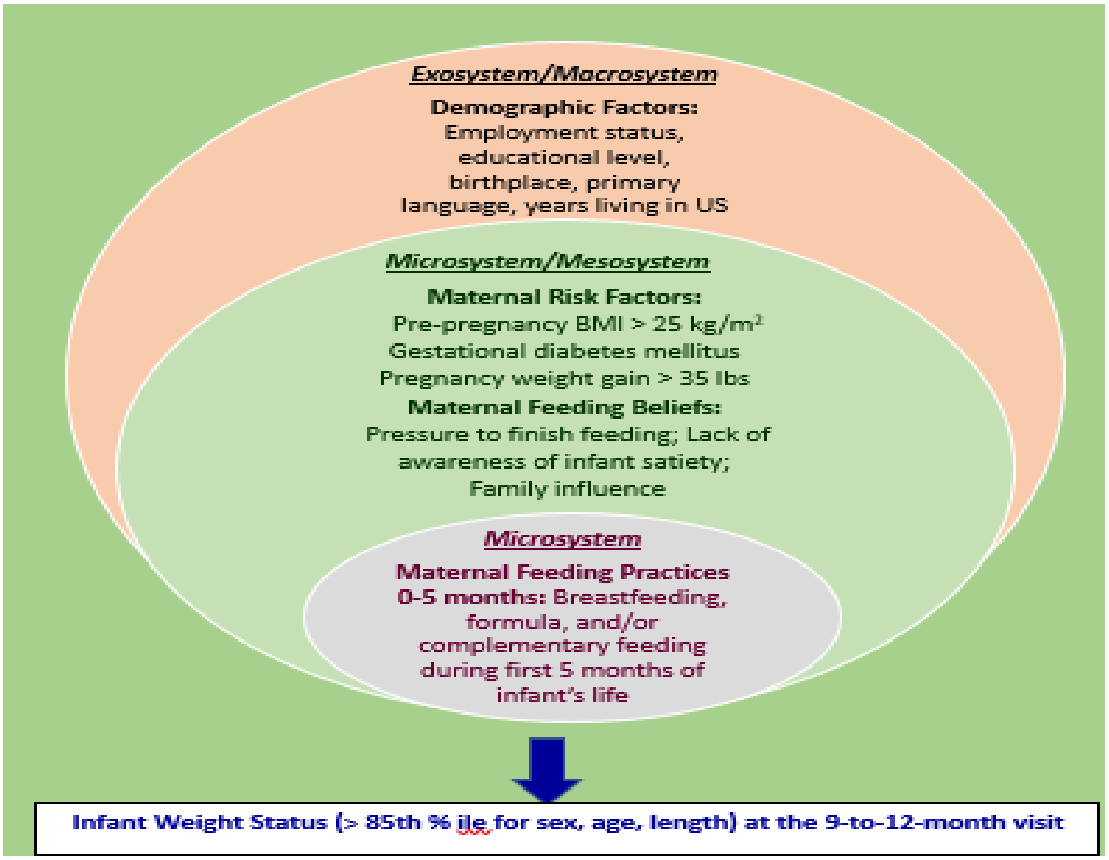

Figure 1. Adapted Ecological Model of the Relationship of Environmental Factors to Infant Weight Status

Setting

The study will be conducted in the private offices of three pediatricians in Suffolk County, Long Island, New York, where over 50,000 Salvadorans reside (U.S. Census Bureau, 2014). The private offices are located in Bayshore and Central Islip, which are areas with a higher concentration of Latino residents, including immigrant and native-born Salvadorans (U.S. Census Bureau, 2014). Based on recent conversations with the three pediatricians, the number of Latino mother-infant dyads visiting all three practices at the 9-to-12-month well-baby visit is estimated to be between 10 and 15 per week. Each practice has a waiting room and several exam rooms to accommodate patients and families.

Sample

The study population will include Salvadoran mothers and infants visiting a private pediatrician for the 9-to-12-month well-baby visit. Inclusion criteria will include: 1) immigrant and first-generation Salvadoran women who are 18 years of age or older, and 2) mothers of infants attending a 9-to-12-month well-baby visit who were born as single, full-term infants, 3) mothers who are able to speak and read in either English or Spanish. The inclusion criterion of belonging to the Salvadoran subgroup is needed for the recruitment of the target population. The inclusion criterion of a full-term infant is to collect data on infants who did not have interrupted feedings due to illness. Exclusion criteria will include: 1) infants with a history of having been admitted to the neonatal intensive care unit, 2) infants who required a special diet, for example, Alimentum formula, and 3) infants brought to the office for the well-baby visit by someone other than the infant’s mother.

Recruitment and Consent

Participants will be recruited from several private pediatric offices in suburban settings in Suffolk County, on Long Island, NY. With the permission of the physicians, the office staff will be informed of the purpose of the study by the Principal Investigator (PI) prior to the initiation of the study. The recruitment of potential participants will be done by the office staff who will inform Latina mothers bringing their infants to the pediatrician office for the 9-to-12-month well-baby visit about the study. Flyers developed by the PI will describe the study and be distributed by the office staff to potential participants on days when the PI is available to collect data on site. Flyers will be available in English and Spanish. The mothers will be asked by the office staff if they are interested in participating in a brief study on infant feeding practices and infant weight before the child's well-baby visit. Potential participants expressing an interest in the study will be directed to meet with the PI before or after the well-baby visit in an exam room in the office; this is the preferred method of data collection by the pediatricians who agreed to participate in the study. After meeting the potential participants, the PI will screen the participants to determine if they meet the inclusion criteria for participation in the study. Once eligibility is determined, participants will be informed of the details of the study by the PI. They will be reminded that participation is voluntary and confidential and will have no effect on the healthcare they receive at this location. written informed consent developed in English and Spanish will be read to the participants by the PI in their preferred language prior to data collection.

Pediatricians at the offices have agreed to grant permission to the PI to access the infants' EHR and written informed consent will also be obtained from the mothers to access the infant's birth weight and recumbent length and current weight and recumbent length at the 9-to-12-month well-baby visit. Participants will sign the consent form prior to the start of the study. Participants will receive a copy of the signed written informed consent to keep for their records, and the PI will keep a second copy of the signed written informed consent in a secure, locked location. The PI will obtain data from the infant's medical record after the completion of HIPPA training provided by the pediatricians or from the office staff and after completion and submission of HIPPA forms to Duquesne University's IRB and receiving IRB approval. Participants will be asked if they understand all instructions prior to the study, and if they have any questions related to the study before, during, and after the completion of the measures. Participants will be fully informed of study procedures, risks, benefits, and time needed for completion of questionnaires.

Data Collection

If eligibility criteria are met, participants will meet with the PI before or after the well-baby visit in a private exam room to complete the study materials. Instructions on completing the study materials will be given verbally to participants in English or Spanish by the PI to facilitate comprehension and ensure accuracy. Translation to Spanish will be provided as needed by the PI who is fluent in Spanish. English and Spanish versions of all materials will be prepared and brought to the facility by the PI on specific days designated for well-baby appointments. Participants will complete a data collection form developed by the PI with questions pertaining to the mother's socio-demographic background and maternal factors believed to incur risk for childhood obesity. A history of GDM, pre-pregnancy weight and pregnancy weight-gain in pounds/ounces or kilograms, and height in feet/inches or centimeters will be self-reported and documented on the form. Participants will then complete two surveys: one on infant feeding practices and one on feeding beliefs/behaviors. The PI will retrieve the infant's gender, birth weight/length, and current weight/length (dependent variable) from the infant's EHR and document this information on the data collection form that corresponds to the mother-infant dyad at that time. The PI will keep the signed consent form and completed study materials together in a folder with a corresponding and unique dyad ID assigned to each participant and place them in a secure location, such as a briefcase, after data collection is complete. The signed consent forms will be separated and placed in a locked cabinet at the end of the day on each date of data collection. The maximum anticipated time for completing the written informed consent, data collection form, and the two surveys on infant feeding practices and feeding beliefs and behaviors, is 30-45 minutes, at which time a $20 gift card will be distributed. Participants will initial that they have received the financial incentive at the completion of the interview on a line at the bottom of this form.

References

Adair, L. S. (2008). Child and adolescent obesity: Epidemiology and developmental perspectives. *Purdue University Ingestive Behavior Research Center Symposium. Influences on Eating and Body Weight over the Lifespan: Childhood and Adolescence, 94*(1), 8-16. doi:http://dx.doi.org.authenticate.library.duq.edu/10.1016/j.physbeh.2007.11.016

Ahluwalia, I., D'Angelo, D., Morrow, B., & McDonald, J. (2012). Association between acculturation and breastfeeding among Hispanic women: Data from the pregnancy risk assessment and monitoring system. *Journal of Human Lactation, 28*(2), 167-173.

American Academy of Pediatrics. (2012). Section on breastfeeding: Breastfeeding and the use of human milk. *Pediatrics, 115*, 496-506.

American College of Obstetricians and Gynecologists. (2013). Weight gain during pregnancy. Committee opinion no. 548. *Obstetric Gynecology, 121*, 210-212.

Anderson, S. E., & Whitaker, R. C. (2009). Prevalence of obesity among us preschool children in different racial and ethnic groups. *Arch Pediatr Adolesc Med, 163*. doi:10.1001/archpediatrics.2009.18

Barlow, S. E. (2007). Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: Summary report. *Pediatrics, 120*(Supplement 4), S164.

Barroso, C. S., Roncancio, A., Hinojosa, M. B., & Reifsnider, E. (2012). The Association between early childhood overweight and maternal factors. *Childhood Obesity, 8*(5), 449-454. doi:10.1089/chi.2011.0094

Bowers, K., Laughon, S., Kiely, M., Brite, J., Chen, Z., & Zhang, C. (2013). Gestational diabetes, pre-pregnancy obesity and pregnancy weight gain in relation to excess fetal growth: Variations by race/ethnicity. . *Diabetologia, 56*, 1263-1271.

Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist, 32*, 513-531.

Cartagena, D., Ameringer, S., McGrath, J., Jallo, N., Masho, S., & Myers, B. (2014). Factors contributing to infant overfeeding with Hispanic mothers. *Journal of Obstetric, Gynecologic, and Neonatal Nursing, 43*(2), 139-159. doi:10.1111/1552-6909.12279

Cartagena, D., McGrath, J., & Masho, S. (2016). Differences in modifiable feeding factors by overweight status in Latino infants. *Applied Nursing Research, 30*, 210-215. doi:http://dx.doi.org/10.1016/j.apnr.2015.09.005

Cauce, A. M., & Domenech-Rodríguez, M. (2002). Latino families: Myths and realities. *In j. M. Contreras, k. A. Kerns, & a. M. Neal-barnett. Praeger series in applied psychology. Latino children and families in the United States: Current research and future directions.* (pp. 3-25). Westport, CT. : Praeger/Greenwood.

Cronk, B. (2012). *How to use SPSS: A step by step analysis and interpretation* (7th ed.). Glendale, CA: Pyrczak Publishing.

Dennison, B. A., Edmunds, L. S., Stratton, H. H., & Pruzek, R. M. (2006). Rapid Infant weight gain predicts childhood overweight. *Obesity, 14*(3), 491-499. doi:10.1038/oby.2006.64

Faul, F., Erdfelder, E., Buchner, A., & , & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*, 1149-1160.

Ferguson, C. (2009). An effect size primer: A guide for clinicians and researchers. *Professional Psychology: Research and Practice., 40*(5), 532-538.

Freedman, D., Sharma, A., Hamner, H., Pan, L., Panzera, A., Smith, R., ... (2017). Trends in weight-for-length among infants in WIC from 2000 to 2014. *Pediatrics, 139*(1), 1-11. doi:DOI: 10.1542/peds.2016-2034

Gill, S., Reifsnider, E., & Tinkle, M. (2004). Assessing Infant breastfeeding beliefs among low-income Mexican Americans. *The Journal of Perinatal Education, 13*(3), 39-50.

Gill, S. R. E., & Tinkle, M. (2004). . *Journal of Perinatal Education, 13*(3), 39-50.

Gross, R., Mendelsohn, A., Fierman, A., Hauser, N., & Messito, M. (2014). Maternal and infant feeding behaviors and disparities in early childhood obesity. *Childhood Obesity, 10*(2), 145-152.

Hernandez, I. (2006). Promoting exclusive breastfeeding for Hispanic women. *MCN, American Journal of Maternal Child Nursing, 31*(5), 318-324.

Horodynski, M., Olson, B., Baker, S., Brophy-Herb, H., Auld, G., Van Egeren, L., . . . Singleterry, L. (2011). Healthy babies through infant-centered feeding protocol: An intervention targeting early childhood obesity in vulnerable populations. *BMC Public Health, 11*(1), 868.

Houston, K., Waldrop, J., & McCarthy, R. (2011). Evidence to guide feeding practices for Latino children. *The Journal for Nurse Practitioners, 7*(4), 271-275.

Hulley, S., Cummings, S. B., W., Grady, D., & Newman, T. (2013). *Designing clinical research* (4th ed. ed.). New York: Lippincott Williams & Wilkins.

IBM Corp. (2016). IBM SPSS Statistics for Windows, Version 24.0. . Armonk, NY IBM Corp.

Institute of Medicine and National Research Council. (2009). *Weight gain during pregnancy: Reexamining the guidelines*. Washington, DC.: Rasmussen KM, Yaktine AL (eds).

Kuczmarski, R., Ogden, C., & Grummer-Strawn, L. (2000). *CDC growth charts: United States. Advance data from vital and health statistics; no 314.* Hyattsville, Maryland Retrieved from URL:www.cdc.gov/growthcharts.

Kumanyika, S. K. (2008). Environmental influences on childhood obesity: Ethnic and cultural influences in context. *Purdue University Ingestive Behavior Research Center Symposium. Influences on Eating and Body Weight over the Lifespan: Childhood and Adolescence, 94*(1), 61-70. doi:http://dx.doi.org/10.1016/j.physbeh.2007.11.019

Kupers, L., L'Abee, C., Bocca, G., Stolk, R., Sauer, P., & Corpeleijn, E. (2015). Determinants of weight gain during the first two years of life – the gecko drenthe birth cohort. . *PLoS One, 10*(7), 1-15.

Lindsay, A., Sussner, K., Greaney, M., Wang, M., Davis, R., & Peterson, K. (2012). Using qualitative methods to design a culturally appropriate child Feeding Questionnaire for low-income, Latina mothers: Development of a child Feeding Questionnaire for Latinos. *Maternal and Child Health Journal, 16*(4), 860-866. doi:doi:10.1007/s10995-011-0804-y

Liu, G., Hannon, T., Rong, Q., Downs, S., & Marrero, D. (2015). The obesity epidemic in children: Latino children are disproportionately affected at younger ages. *International Journal of Pediatrics and Adolescent Medicine, 2*, 12-18. doi:http://doi.org/10.1016/j.ijpam.2015.03.004

Mayer-Davis, E., Dabelea, D., Lamichhane, A., D'Agostino, R., Liese, A., Thomas, J., . . . Hamman, R. (2008). Breast-Feeding and type 2 diabetes in the youth of three ethnic groups: The search for diabetes in youth case-control study. *Diabetes Care, 31*(3), 470-475.

Morbidity and Mortality Weekly Report MMWR. (2013). *Progress in increasing breastfeeding and reducing racial/ethnic differences — United States, 2000–2008 births*.

National Academies of Sciences Engineering and Medicine. (2016). *Obesity in the early childhood years: State of the science and implementation of promising solutions: Workshop summary.* Washington, DC: The National Academies Press.

National Center for Chronic Disease Prevention and Health Promotion. (2014). *Chronic diseases: The leading causes of death and disability in the United States*. Atlanta, GA.

National Center for Health Statistics. (2012). *National diabetes fact sheet: National estimates and general information on diabetes and pre-diabetes in the United States, 2011. Atlanta, ga.* . Hyattsville, MD.

National League for Nursing. (2016). *Nln research priorities in nursing education 2016-2019*. Chamberlain College of Nursing: Center for the Advancement of the Science of Nursing Education Retrieved from http://www.nln.org/docs/default-source/professional-development-programs/nln-research-priorities-in-nursing-education-single-pages.pdf?sfvrsn=2.

Ndiaye, K., Silk, K. J., Anderson, J., Horstman, H. K., Carpenter, A., Hurley, A., & Proulx, J. (2013). Using an ecological framework to understand parent–child communication about nutritional decision-making and behavior. *Journal of Applied Communication Research, 41*(3), 253-274. doi:10.1080/00909882.2013.792434

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

Owen, C. G., Martin, R. M., Whincup, P. H., Davey-Smith, G., Gillman, M. W., & Cook, D. G. (2005). The effect of breastfeeding on mean body mass index throughout life: A quantitative review of published and uppublished observational evidence. *Am J Clin Nutr, 82*.

Owen, C. G., Martin, R. M., Whincup, P. H., Smith, G. D., & Cook, D. G. (2005). Effect of Infant Feeding on the risk of obesity across the life course: A quantitative review of published evidence. *Pediatrics, 115*(5), 1367-1377. doi:10.1542/peds.2004-1176

Pearce, J., Taylor, M., & Langley-Evans, S. (2013). Timing of the introduction of complementary feeding and risk of childhood obesity: A systematic review. *International Journal of Obesity, 37*, 1295-1306.

Perez-Escamilla, R., & Kac, G. (2013). Childhood obesity prevention: A life-course framework. *International Journal of Obesity Supplements, 3*(S1), S3-S5. doi:10.1038/ijosup.2013.2

Polit, D. (2010). *Statistics and data analysis for nursing research* (2nd ed.). New York: Pearson.

Raymond, J. (n.d.). Baby Infant growth chart calculator. Who 0-2 years: Weight for length percentile. Retrieved from http://www.infantchart.com/infantweightlength.php

Reifsnider, E., Keller, C., & Gallagher, M. (2006). Factors related to overweight and risk for overweight status among low-income Hispanic children. *Journal of pediatric nursing, 21*(3), 186-196.

Roy, S. M., Spivack, J. G., Faith, M. S., Chesi, A., Mitchell, J. A., Kelly, A., . . . Zemel, B. S. (2016). Infant bmi or weight-for-length and obesity risk in early childhood. *Pediatrics*.

Schwartz, F., Hutchings, T., Friedman, A. J., Quartey, N. K., Urowitz, S., Wiljer, D., & Smith, R. E. (2010). Moving toward an organized approach to patient education in Canadian hospitals. *Healthcare Quarterly, 13*(4), 84-88.

Schwartz, R., Vigo, A., Dias de Oliveira, L., & Justo Giugliani, E. (2015). The effect of a pro-breast feeding and healthy complementary feeding intervention targeting adolescent mothers and grandmothers on growth and prevalence of overweight of preschool children. . *PLoS One, 10*(7), 1-13.

Smego, A., Woo, J., Klein, J., Bansal, D., Bolling, C., Daniels, S., & Crimmins, N. (2016). High body mass index in infancy may predict severe obesity in early childhood. *The Journal of Pediatrics, 183*, 87-93. doi:http://dx.doi.org10.1016/j.jpeds.2016.11.020

Smith, Hulsey, T., & Goodnight, W. (2008). Effects of obesity in pregnancy. *The Association of Women's Health, Obstetrics, and Neonatal Nurses, 37*(2), 176-184.

Status, C. D. C. N. C. f. H. S. W. S. F. o. S., & Health. (2012). National diabetes fact sheet: National estimates and general information on diabetes and prediabetes in the United States. .

Suitor, C., & Gardner, J. (1992). Development of an interactive, self-administered computerized food frequency questionnaire for use with low-income women. *Journal of Nutrition Education, 24*, 82-86.

Taveras, E. M., Gillman, M. W., Kleinman, K., Rich-Edwards, J. W., & Rifas-Shiman, S. L. (2010). Racial/ethnic differences in early-life risk factors for childhood obesity. *Pediatrics, 125*(4), 686.

Tenfelde, S., Finnegan, L., & Hill, P. (2011). Predictors of breastfeeding exclusivity in a WIC sample. *Journal of Obstetrics, Gynecologic, and Neonatal Nursing, 40*, 179-189.

The Pell Institute. (2015). Evaluation toolkit. Retrieved from http://toolkit.pellinstitute.org/contact-us/

Thompson, A., Mendez, M., Borja, J., Adair, L., Zimmer, C., & Bentley, M. (2009). Development and validation of the Infant Feeding Style Questionnaire. *Appetite, 53*(2), 210-221. doi:10.1016/j.appet.2009.06.010

U.S. Census Bureau. (2014). *American fact finder*. Retrieved from www.census.gov/acs/www.

Vaughn, L., Geraghty, S., Nino, V., & Valenzuela, J. (2010). Sociocultural inflences on the determinants of breast-feeding by Latina mothers in the Cincinnati area. *Family Community Health, 33*(4), 318-328.

Wang, L., C., C., Ratliff, M., Xie, B., & Wang, Y. (2017). Breastfeeding reduces childhood obesity risks. *Childhood Obesity, 13*(3), 197-204. doi:https://doi.org/10.1089/chi.2016.0210

Wen, L., Baur, L., Rissel, C., Wardle, K., Alperstein, G., & Simpson, J. (2007). Early intervention of multiple home visits to prevent childhood obesity in a disadvantaged population: A home-based randomised controlled trial (healthy beginnings trial). *BMC Public Health, 7*, 76.

Wen, X., Gillman, M., Rifas-Shiman, S., Sherry, B., Kleinman, K., & Taveras, E. (2012). Decreasing prevalence of obesity among young children in Massachusetts from 2004 to 2008. *Pediatrics, 129*(5), 823-831. doi:10.1542/peds.2011-1833

WHO Multicentre Growth Reference Study Group. (2006). *Who child growth standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development.* . Geneva, Switzerland: World Health Organization Retrieved from http://www.who.int/childgrowth/standards/Technical_report.pdf?ua=1.

Williams, J., Kabukuru, A., Mayo, R., & Griffin, S. (2011). Commentary: A socio-ecological perspective on obesity among Latinos. *Ethnicity & Disease, 21*, 467-472.

Wood, C. T., Perreira, K. M., Perrin, E. M., Yin, H. S., Rothman, R. L., Sanders, L. M., . . . Thompson, A. L. (2016). Confirmatory factor analysis of the Infant Feeding Styles Questionnaire in Latino families. *Appetite, 100*, 118-125. doi:http://dx.doi.org/10.1016/j.appet.2016.02.018

World Health Organization. (2008). *Training course on child growth assessment*. Geneva, Switzerland: WHO Retrieved from http://www.who.int/childgrowth/training/module_c_interpreting_indicators.pdf?ua=1.

World Health Organization (2010). [Who growth standards are recommended for use in the U.S. For infants and children 0 to 2 years of age].

World Health Organization, n. d. Baby Infant growth chart calculator. Who 0-2 years: Weight for length percentile. Retrieved from http://www.infantchart.com/infantweightlength.php

Applying Ecological Frameworks in Obesity Intervention Studies in Hispanic/Latino Youth: A Systematic Review

Carmen Kiraly, MSN, RN, WHNP-BC1,

Melanie T. Turk, PhD, MSN, RN2, Melissa A. Kalarchian, PhD2, and Cheryl Shaffer, PhD, MS, APRN1,3

Hispanic Health Care International 2017, Vol. 15(3) 130-142

1 Suffolk County Community College, Brentwood, NY, USA

2 Duquesne University, Pittsburgh, PA, USA

3 Suffolk County Community College, Sayville, NY, USA

Corresponding Author:

Carmen Kiraly, Suffolk County Community College School of Nursing, Crooked Hill Road, Brentwood, NY 11717, USA.

Email: kiralyc@duq.edu

Kiraly et al. 131

Reprints and permission: sagepub.com/journalsPermissions.nav DOI: 10.1177/1540415317731069 journals.sagepub.com/home/hci

Reprinted with permission from Hispanic Health Care International.

Kiraly, C., Turk, M., Kalarchian, M., & Shaffer, C. (2017). *Hispanic Health Care International*. 15(3) 130-142.

Abstract

Introduction: In the United States, Hispanic children have higher rates of obesity compared with non-Hispanic White children. An ecological framework provides a holistic view of the environment to which Hispanic/Latino children are exposed that can potentially inform prevention and treatment initiatives for this vulnerable population. Method: This systematic review examines the existing evidence on the use of an ecological framework in intervention studies targeting overweight and obesity in Hispanic youth from birth to 8 years. Key terms guided the search of PubMed, Google Scholar, CINAHL, and EBSCOhost databases from 1997 to 2016. Results were organized using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) method. Results: Seven studies met the inclusion and exclusion criteria. Significant improvements in body mass index z scores in treatment children were evident in five of the seven studies. Increases in fruit, water, and vegetable consumption and physical activity levels were reported in four of the seven studies. Conclusion: Multilevel interventions targeting a child's home and community suggest efficacy in reducing or preventing obesity; increasing fruit, water, and vegetable consumption; and increasing physical activity in overweight/obese young Hispanic children. Future research is needed to explore the sustainability of multilevel obesity prevention interventions in this vulnerable population.

Keywords

ecological framework, Hispanic/Latino children, obesity prevention/treatment

Introduction

High rates of obesity exist among Hispanic adults and children in the United States. Results from the National Health and Nutrition Examination Survey (2011-2014) show a disparity in children between 6 and 11 years of age, with 24.1% of Hispanic girls and 25.8% of Hispanic boys being obese (body mass index [BMI] 95th percentile) compared with 14.4% of non-Hispanic White girls and 13.0% of non-Hispanic White boys (Ogden et al., 2016). In 2- to 5-year-olds, although rates of obesity have declined since 2003-2004 from 13.9% ($p < .001$) to 9.4% in 2013-2014 (p .03), the downward trend is more significant in non-Hispanic White children (5.2%) than in Hispanic (15.6%) or non-Hispanic Black (10.4%) children (National Center for Health Statistics, 2016). In a study on infants enrolled in the Women, Infants, and Children program, Hispanic children from 3-to-23-months of age had higher weight-for-length (2 standard deviations) when compared with non-Hispanic Black or White children of the same age; 13.8%, 11.9%, and 11.0%, respectively, based on World Health Organization growth standards (Freedman et al., 2017). Frequently, early-onset obesity in Hispanic children continues into adolescence and adulthood (Winkleby, Robinson, Sundquist, & Kraemer, 1999).

These findings are concerning because the Hispanic/Latino population is the second fastest growing ethnic group in the United States and is expected to more than double by the year 2060 (Colby & Ortman, 2014). Some Hispanics experience higher rates of poverty and have lower rates of health insurance than other racial or ethnic groups (Centers for Disease Control and Prevention, 2004). Improved health insurance coverage in Hispanics is uncertain due to the inaccessibility of the Affordable Care Act in every state (Ortega, Rodriguez, & Bustamante, 2015). Consequently, Hispanics are vulnerable to poor health outcomes associated with obesity (Hubert, Snider, & Winkleby, 2005). A family's lack of knowledge of nutrition can lead to poor food choices and excessive feeding, thereby affecting a child's weight (Reifsnider, 1995; Wilson & Sato, 2013). It is not uncommon for Hispanic families to choose meals high in sodium, sugar, and saturated fats, resulting in an energy-dense diet over recommended values (National Academies of Sciences Engineering and Medicine, 2016). Inadequate knowledge on grocery shopping for healthy foods and the potential health risks of increased sedentary time and television viewing with limited active play have been linked to obesity in Hispanic children (Tovar et al., 2012; Williams, Kabukuru, Mayo, & Griffin, 2011).

Environmental stressors such as low socioeconomic status, unsafe neighborhoods, low educational attainment and unemployment also have been linked to higher child obesity rates because they affect the family unit and, subsequently, the child (Grow et al., 2010; Isasi et al., 2017; Wilson & Sato, 2013). Lower income children, many of whom are of Hispanic descent, have a greater risk of obesity com- pared with children of higher income families (Pan et al., 2016; Powell, Wada, Krauss, & Wang, 2012; Wilson & Sato, 2013). Because conditions of lower income and minority status often exist simultaneously in Hispanic children, they are at a higher risk for obesity and other comorbidities (Grow et al., 2010; Wilson & Sato, 2013).

Adherence to family views on infant feeding (equating quantity with effective parenting) has been identified as a determinant of rapid infant weight gain and early childhood obesity in Hispanic children. Infant satiety is underestimated, leading to "double feeding" (offering formula after breastfeeding), "pressure-feeding" (desire for the infant to finish the bottle), and "complimentary feeding" (feeding foods other than breastmilk or formula); Ahluwalia, D'Angelo, Morrow, & McDonald, 2012; Peneau et al., 2011). Contrary to the American Academy of Pediatrics (AAP; 2012) guidelines to offer only breastmilk during the first 6 months, introducing formula and complimentary feeding at 2 to 3 months are perceived by some

Hispanic mothers to provide better nutrition than breast milk alone (Pearce, Taylor, & Langley-Evans, 2013; Schwartz et al., 2010).

Causes of obesity in Hispanic children are best addressed by a multidimensional perspective that considers the com- plex cultural and social milieu in which Hispanics live (National Academies of Sciences Engineering and Medi- cine, 2016). Characteristics of the parent–child dyad, family function, cultural influences, societal norms, and public policies are some reasons, hypothesized within an ecological framework, for the obesogenic tendencies in Hispanic children (National Academies of Sciences Engineering and Medicine, 2016).

Purpose

The purpose of this review is to present a review of intervention studies that target obesity prevention/treatment in Hispanic/ Latino infants and young children through the theoretical lens of an ecological framework and determine if the strategies used were efficacious in preventing and/or treating obesity and creating healthy lifestyle changes in the target population.

Method

Bronfenbrenner's (1977) ecological systems theory (EST) examines a child's development within the context of the relations- hips that form the environment. The environment, defined as having layers each with the capacity to positively or negatively affect child development, is composed of four systems: microsystem, the layer closest to the child that includes the child's immediate setting (parents, family, home); (2) mesosystem, all the interactions within the microsystem; (3) exosystem, extended family, friends, social welfare policies, community, and mass media; and (4) macrosystem, the outermost layer (cultural values, language, attitudes, economy). The ecological framework provides a vantage point from which to explore the child's surroundings as mothering roles and practices related to child health evolve in response to interacting with the surrounding environment (Bronfenbrenner, 1977). Supporters of the theory discourage promoting change at one or two levels as these have not provided long-term solutions (Glanz, Rimer, & Viswanath, 2008). Interventions should address as many influencers as possible, using a community or participatory approach over single-level approaches (Tovar, Renzaho, Guerrero, Mena, & Ayala, 2014).

The EST has been applied in several studies on infant and child feeding. A home mentorship program to deter complimentary feeding before 5 months among low-income African American adolescent mothers living in multigenerational homes targeted cultural barriers hindering adherence to AAP guidelines on infant feeding. An increase in breastfeeding duration, better awareness of hunger and satiety cues, and responses to infant behaviors without the use of food suggested program effectiveness (Black, Siegel, Abel, & Bentley, 2001). In another study using the EST with low-income parent–child dyads, communication patterns and family culture had the greatest influence on the nutritional decision-making process and children's health behaviors (Ndiaye et al., 2013). Dev, McBride, Fiese, Jones, and Cho (2013) studied obesity risk factors using the Six Cs ecological model (culture, country, community, clan, child, cell [biological factors]) and found three risk factors to be significant for childhood overweight and obesity: sleeping 8 hours or less, high parental BMI, and restrictive feeding practices. In these studies, the ecological model helped evaluate factors influencing obesity within the child and family environment.

The EST was modified by Reifsnider (1995) who developed the Ecological Model of Growth and used the Ecological Model of Growth to study child overweight in low-income Hispanic mothers and children enrolled in the Women, Infants, and Children program. Maternal BMI and attitude on child feeding were significantly related to child BMI and attributed to the home environment where food is shared in the microsystem (Reifsnider, Keller, & Gallagher, 2006). Another study in low-income Latino mother–infant dyads found that host factors (infant birth weight, temperament) and dietary intake (breast, formula, complimentary feeding) interacted with the agent (food types/availability) and maternal factors (demographics, perceived/desired infant weight, acculturation) in the mesosystem. In both overweight and healthy weight infants, almost one third of the mothers expressed a desire for a heavier infant (Cartagena et al., 2014). Because obesity in Hispanic children is evident by preschool age, often persisting into adolescence and adulthood, interventions initiated in infancy or early childhood are advised before unhealthy dietary practices become established (Institute of Medicine, 2015; Ndiaye et al., 2013; Paul et al., 2011). To date, there are a limited number of intervention studies utilizing an ecological model that address overweight and obesity in Hispanic children.

A review of the literature was conducted following the guidelines for the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) method. Included in the review were intervention studies published between 1997 and 2016 with healthy Hispanic and Latino children from birth to 8 years on prevention and/or treatment strategies that utilized an ecological framework, either explicitly or by incorporating multiple components of the model in the interventions. Search terms used were the following: (Ecological framework OR ecological model) AND obesity AND (Infant* OR Child*) AND (Latino* OR Latina* OR Hispanic* OR Chican*) AND (Prevention OR Treatment). PubMed, Google Scholar, CINAHL, and all other EBSCOhost databases were searched using an advanced search. Articles were hand retrieved by searching issues of Childhood Obesity and other journal articles meeting the inclusion criteria, as well as citations of two existing systematic literature reviews on obesity interventions for young children, and citations of the primary articles them- selves. After using the limiters, English language, and publication years between 1997 and 2016, a total of 585 articles were retrieved and 7 duplicates were removed, resulting in 578 articles. An initial screen of abstracts included those that questionably met the inclusion criteria: Hispanic/Latino infant or child, childhood overweight or obesity, ecological framework, or interventions to prevent/treat child obesity.

Four hundred and twenty-three articles were excluded because they did not meet all the inclusion criteria based on further review of the abstract. The remaining full-text articles (n 155) were examined for eligibility, applying the following exclusion criteria: instrument development, commentary, literature review, theoretical and/or position paper; <20% Hispanic/Latino sample; and studies in progress. Thus, an additional 148 articles were excluded, leaving 7 studies to be included in this review. See Figure 1 for a PRISMA flow diagram of the search strategy, inclusion/exclusion criteria, and the elimination process. A data extraction grid categorized the articles by author, year, purpose/ design, interventions, sample, and findings (Table 1).

Data from seven obesity prevention and treatment studies meeting inclusion criteria were evaluated and synthesized for this review. Effects of multilevel educational and/or physical activity (PA) interventions on primary outcomes, changes in BMI z scores or weight status, were measured in all the studies. Effects on secondary outcomes, increases in healthy food intake and PA, were reported in four of the seven studies. Findings were organized according to the setting used in the delivery of the interventions: community based (Bender, Nader, Kennedy, & Gahagan, 2013; Crespo et al., 2012; Economos et al., 2013; Gesell, Bess, & Barkin, 2012; Yin et al., 2012) or primary care (Cloutier et al., 2015; Machuca et al., 2016).

Results

Participants were primarily mother–child dyads (*97%) from low-income urban communities throughout the United States. Hispanic/Latino enrollment was between 20% and 100% and was *90% in six of the seven studies. Children's mean ages ranged from 2 months to 8 years. Sample sizes ranged from 33 mother–child dyads to 1,028 children with a baseline rate of child overweight/obesity ranging from 11.8% to 46.5%. In this review, it was noted that the ethnonyms "Hispanic" and "Latino" were used interchangeably; therefore, the term used by the original authors will be followed. See Table 1 for details about the included studies and characteristics of the samples of participants.

Primary and Secondary Outcomes in Community-Based Settings

Improvements in primary outcomes in intervention children were evident in three of five community-based studies (Economos et al., 2013; Gesell et al., 2012; Yin et al., 2012). *Miranos!* by Yin et al. (2012) was based on the principle that to alter obesogenic tendencies in young children (3-5 years), strategies must be geared toward early care centers such as Head Start, and the home environment. Bilingual center- based and center- and home-based interventions representing the micro- and mesosystem of the ecological model integrated healthy eating and PA into the home and classroom (hands-on games, story-telling, and parent education). Weight gain based on z scores in the center-and-home group was lower ($p < .04$) than in the center-only and control group at posttest.

In *Shape Up Somerville*, excessive weight gain prevention was tested in a diverse group of elementary school–aged children (Economos et al., 2013). Intervention children had steady access to nutritious foods and PA levels beyond normal growth requirements at home, and before, during, and after school. The collaboration between community leaders and researchers extended beyond the children's micro- and mesosystem and mapped to the exosystem of the ecological model. A decline in BMI z scores of 0.1005 (p .001) in Year 1 and 0.06 (p.005) in Year 2 in intervention children was noted with an almost 30% drop in child overweight and obesity (p .004). A high level of participation from parents, primary care providers, community leaders, school officials, and local restaurants was instrumental in reinforcing community policies that sustained healthy changes over the 2-year period.

Promotoras or trained Spanish-speaking facilitators provided the intervention in three of the five community-based studies (Bender et al., 2013; Crespo et al., 2012; Gesell et al., 2012), where Gesell et al. (2012) had significant findings. Parent–child dyads in *Salud Con La Familia* received culturally and family-oriented strategies, representing various layers of the ecological model, to improve PA and nutrition. A decrease in BMI of 0.59 kg/m2 ($p < .001$) was noted in treatment children with a mean BMI change of 0.51 + 0.87 compared with 0.06 + 0.61 kg/m2 in controls. Treatment children that were obese at baseline had a mean BMI change of 0.81 + 1.48, compared with 0.08 + 0.46 kg/m2 in control children. In *Vida Saludable*, culturally appropriate biweekly parent group lessons (healthy food/beverage selection, modeling of healthy behaviors) and monthly community activities (pedometers, grocery store/restaurant visits, and cooking classes) addressed the micro- and mesosystems of the parent–child dyad. At post-intervention, although 82% of mothers and 21% of children remained overweight/obese, a lower mean maternal BMI (29.2 + 5.1 kg/m2; $p < .05$) compared with baseline (30.7 +6.4 kg/m2) was noted. Albeit a significant decrease in mothers' BMI, the number of children classified as obese at post-intervention (12) increased compared with baseline (9) Bender et al., 2013). Similar findings were noted in *Aventuras Para Ninos* (*Aventuras*), where changes in BMI z scores were non-significant in children from 13 elementary schools randomized into one of four groups: family-only, community-only, family community, and measurement-only. Although the physical and home environments were positively affected by the community-only and family-only interventions, children's mean BMI z scores increased in all groups. Community interventions (refurbishment of local parks and playgrounds) represented the exosystem of the ecological model, while family education and school activities mapped to the micro-/mesosystem (Crespo et al., 2012).

Significant secondary outcomes were found in three of the five community-based studies (Bender et al., 2013; Crespo et al., 2012; Yin et al., 2012). A greater consumption of fruits, vegetables, and low-fat milk and increased PA and gross motor skills in center-only ($p < .01$) and center-and-home children ($p < .001$) was found in *Miranos*! Promotora-based interventions in *Aventuras* supported behavior changes that resulted in a reduction of fat intake in parents ($p < .0001$). In treatment children, the intervention resulted in increased PA (p.008), water (p .026), and fruit/vegetable intake (p.011) along with a decrease in TV viewing (p .033), consumption of snacks (p .056), sugary drinks (p .027), and fat (p .003). Success in modifying the home environment, placing vegetables within reach, and keeping televisions out of children's rooms underscored the importance of affecting change within the microsystem since behaviors affecting children's weights are frequently influenced by parents (Wilson & Sato, 2013). Community health promotion in the exosystem was sustained through *Aventuras* menus at local restaurants, *Start with Salad* school menus, modification of school recess, and the garnering of support from community stakeholders. In *Vida Saludable*, children's soda (2.8 ounces/day, $p < .0167$), sugary drink (4.7 ounces/day, $p < .0167$), and bottled water intake (9.2 ounces/day, $p < .0167$) were significant at post-intervention. At 6 months post-intervention, treatment effects were sustained in children's water (16.2 ounces/day, $p < .0167$), sugary drink (3.0 ounces/day, $p < .0167$), and milk (3.8 ounces/day, $p < .0167$) intake, but not in soda or juice intake. Interventions geared toward parents within the micro- and mesosystem were successful at modifying behaviors in treatment children.

Primary and Secondary Outcomes in Primary Care Settings

Significant primary outcomes were noted in the primary care studies (Cloutier et al., 2015; Machuca et al., 2016). *Well-Baby Group* (Machuca et al., 2016) measured the post-intervention effects of group sessions aimed at overweight/obesity prevention during the first 2 years of life in low-income mother–infant dyads. *Well-Baby Group* resulted in lower rates of BMIs 85th percentile in intervention versus control children (2.1% vs. 15.0%; p.02); none of the intervention children were obese compared with 6.4% of children in the control group. In *Steps to Growing Up Healthy* (*Steps*), brief motivational counseling with positive reinforcement and therapeutic listening was offered. At post-intervention, treatment children had a decrease in BMI percentile of 0.33 while control participants had an increase of 8.75 ($p < .001$). In both studies, primary care providers targeted the micro- and mesosystem by offering evidence-based education and professional support for health behavior changes in mother–child dyads. Mother–child dyads in *Steps* reported less juice/whole milk consumption ($p < .001$) at 12 months (Cloutier et al., 2015). Strategies suggesting efficacy for obesity prevention and treatment in children and/or parents are summarized in Table 2.

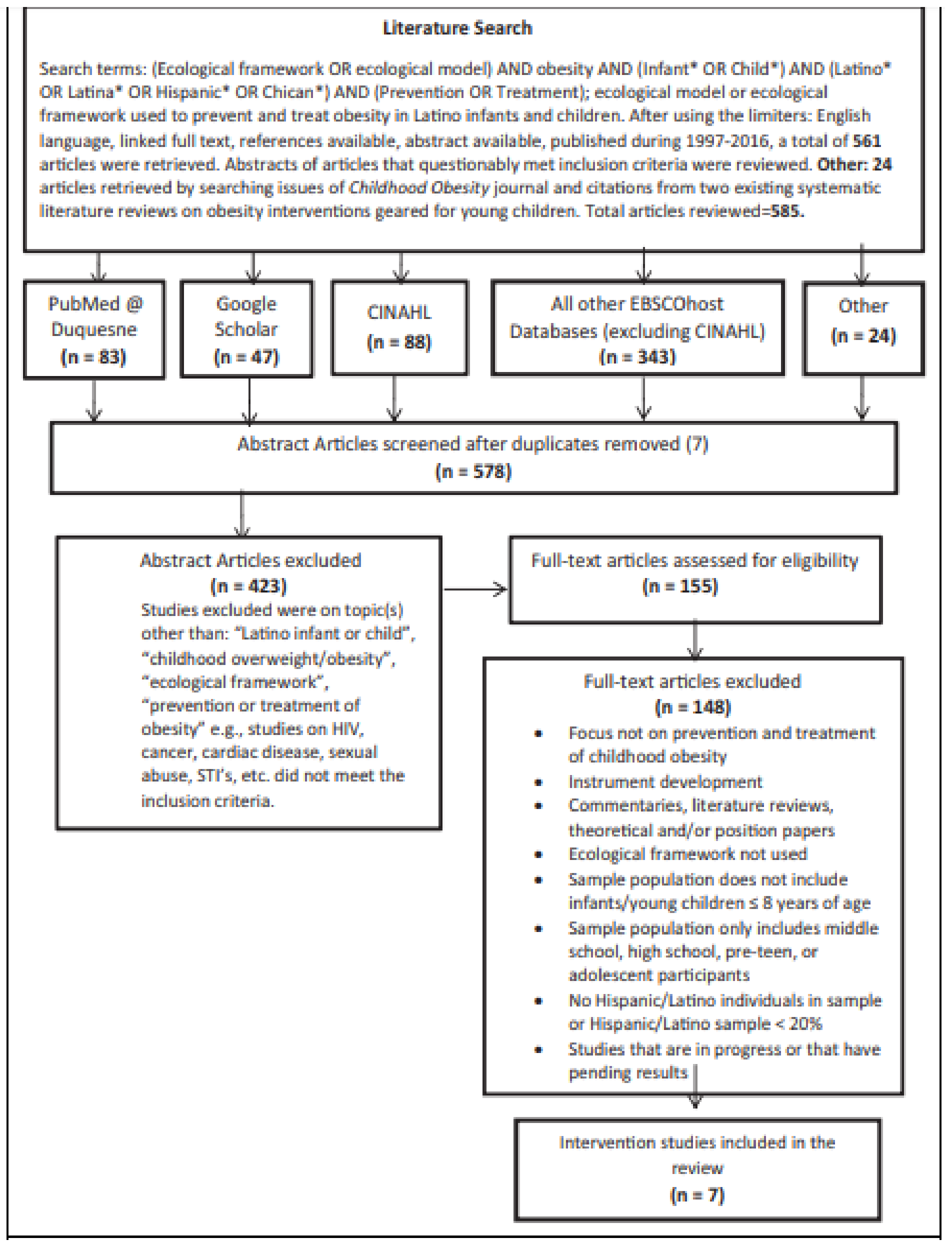

Figure 1. Flow diagram for literature search.

Table 1. Intervention Studies Using an Ecological Model for the Prevention or Treatment of Obesity Among Hispanic or Latino Infants and Children (0-8 Years).

Study	Design	Sample	Purpose	Interventions	Findings
Community-based settings					
Bender, Nader, Kennedy, and Gahagan (2013)	Pilot study, *Vida Saludable*, pre–posttest; no control group	*N*=33 Mexican mother–child dyads from large California urban health center	To assess changes in children's intake of sugar-sweetened beverages (SSB), mothers' pedometer steps, and BMI from baseline to post-intervention (9 months) and 6 months postintervention (15 months)	9-Month pilot community engagement approach	*Primary outcomes:* Postintervention: 82% mothers and 21% children overweight/obese. Maternal BMI ↓ by 1.5 points. Mean baseline to 9-month postintervention BMI: 30.7 (6.4) to 29.2 (5.1) ($p < .05$). Change in children's BMI was stable and nonsignificant
		Mothers ages: 18-35 years; 88% overweight/obese at baseline		*Phase 1:* Group lessons by *Promotoras* in lowering sweetened beverage intake, water and 1% milk intake; PA	*Secondary outcomes:* 6-Month postintervention: soda -2.8oz/ day ($p < .0167$); sugary drinks - 4.7 ($p < .0167$); water 9.2 ($p < .0167$); nonsignificant reduction for 100% juice; Milk ($p < .0001$)
		Mean child age: 3.6 ±0.7 years; 21% overweight/obese at baseline		*Phase 2:* group activities to ↑community engagement (pedometers, visits to grocery stores, parks, restaurants, a trail walk, cooking classes) *Hypothesis:* A community-engaged, culturally relevant intervention will improve target health behaviors in low-income Mexican mothers with children 3-5 years of age.	Maternal step counts significantly ↑ on weekdays by 69% and weekend days by 49% ($p < .0167$)
Crespo et al. (2012)	3-year (4-arm) 2x2 factorial RCT	*N= 808 Latino p*arent/child dyads	*Aventuras para Ninos (Aventuras)*	Promotoras received 22 hours of curriculum training	*Primary outcomes:* No significant intervention effects on parent or children's BMI *z* scores. All children had ↑BMI in all conditions
		Family-only (*n*= 198); Family + Community (*n*=165); Community-only (*n*=218); Control (n=227)	Evaluate impact of multilevel *Promotora*-based intervention to promote healthy eating/PA and prevent excess weight gain. Compare effects of changes in home/family environments and school/community environments in prevention/control of obesity in Latino children.	*Four intervention groups*	*Secondary outcomes:* Family main effect significant for: ↓ TV viewing (p=.033), ↓fat intake ($p < .0001$), ↓ snacks (p=.056), ↑FV (p=.011), ↑ child PA (p= .008)

Table 1. (continued)

Study	Design	Sample	Purpose	Interventions	Findings
		K-2nd recruited from 13 elementary schools in South Bay area, CA, near U.S.–Mexico border. Sample at year 3=441 97% mothers: 33±6 years; 75.1% overweight/obese Mean child age: 5.9 ± 0.9 years; 46.5% overweight/obese at baseline		Family-only =home visits and phone calls r/t health habits (↓sweetened drinks and TV; ↑PA, water, F/V); boundary setting with reinforcement Community-only= improved outdoor play periods/parks, equipment; healthy school menu; health posters in grocery stores; children's menus at local restaurants Family/community = both family-only and Community-only Control group: measurement only=maintain regular lifestyles and submit yearly measurements *Hypothesis:* A combined family/community intervention will improve children's BMI *z*-scores more than a family-only or community-only intervention.	Family+ Community had significant results: ↓ sugary drinks (p= .027), ↓ fat (p= .003), ↑water (p= .026)
Economos et al. (2013)	2-Year-non RCT using CBPR approach	N=1,028 children; Intervention (n= 335); Control 1 (n= 486); Control 2 (n= 207) Mean child age: 7.6±1.0 years; 58.6% overweight/23.7% obese at baseline Diverse group of elementary school–aged children from three diverse cities in Massachusetts; 20% Hispanic/Latino; recruited from 30 public elementary schools (1 intervention community/2 control communities)	Test effects of a community-based participatory, environmental change intervention, *Shape Up Somerville* (*SUS*), aimed to prevent weight gain in sample of low-income minority children	*Intervention group:* Year 1: ↑children's PA beyond normal growth requirements, offer consistent access to healthy foods and PA opportunities in home/school (before, during, after school). Classroom integration of healthy eating/PA through participation in walking contests, cooking classes, farm trips, vegetarian recipes, family fitness fairs, walk-to-school-day. Year 2: ↑involvement from community "champions," local family fitness fair, support from local restaurants.	*Primary outcomes:* Modest effect size Year 1: BMI z scores ↓ by −0.1005 (p = .001). Year 2: BMI z score changes = −0.08 (p < .001). Change in intervention BMI z score compared to Control 1 = -0.05 (p=.07) and -0.06 (p=.03) compared to Control 2

Table 1. (continued)

Study	Design	Sample	Purpose	Interventions	Findings
				Parent support/education; training teachers/primary care providers No control	~30% ↓ overweight/obesity (p= .004) and overweight/obesity remission (p= .02) Overweight/obesity ↓ males (p = .01) and ↓ females (p = .013) with remission ↑ in intervention males (p=.033) and females (p=.027) over control
				Hypothesis: Community-based environmental change intervention prevents undesirable weight gain in children.	In summer ↑ in all children's BMI *z* scores d/t less PA/monitoring of unhealthy foods *Secondary outcomes:* Not measured
Gesell, Bess, and Barkin (2012)	3-Month RCT	*N*=106 parent–child dyads	Examine short-term effect of culturally and family-centered behavioral intervention delivered in community setting on weight status in Latino preschool children	*Intervention group:* 3-Month obesity prevention intervention, *Salud con la Familia*. Twelve 90-minute group sessions aimed at skill building (↑ PA and healthy eating, ↓sedentary behavior) given by Spanish-speaking staff to measure change in PA/nutrition. Component to enhance social ties added: random assignment to small groups (6-8 parent–child dyads) weekly sessions to practice healthy lifestyle skills (right portions; ↑ active play).	*Primary outcomes:* ↓ BMI in all children (obese, overweight, normal BMI) in intervention children (-0.59, p < .001) vs. control groups
		Intervention (n= 54 dyads); Control (n= 52 dyads) Predominantly Mexican immigrant mothers of ↓ literacy, ↓ SES, ↓ education 81% mothers' overweight/obese at baseline Mean child age: 4.2 ± 0.9 years; 42% overweight/obese at baseline	Examine if new social networks form between families participating in group-level pediatric obesity prevention trial	*Control group:* School readiness program where parent–child dyads met 3 x for 60 minutes in 12 weeks. *Hypothesis:* A family-centered, community-based intervention will have a positive effect on early growth patterns in Latino American preschool children.	Mean change in BMI for treatment group (-0.51 ±0.87); obese: -0.80±1.48; overweight: -0.63 ± 0.67. In control children, average BMI change was 0.06 ± 0.61. In control children that were obese/overweight at baseline, average BMI change of 0.08 ± 0.467 and 0.11 ± 0.76. *Secondary outcomes:* Not available

47

Table 1. (continued)

Study	Design	Sample	Purpose	Interventions	Findings
Yin et al. (2012)	Quasi-experimental with pre/posttest Two treatment groups and one control group at four Head Start centers	*N*=423 children. Center-based intervention (*n*=179), center- and-home-based intervention (*n*= 80), control (*n*= 97) 90% Mexican American sample of preschool children 3-5 years attending Head Start in southern Texas Mean child age: 4.1± 0.56 years; 62% normal weight at baseline	Test efficacy of 18-week, culturally/ family oriented, multilevel obesity prevention intervention	*Two center-based intervention groups:* center-based and center-and- home-based. Staff: Wellness training. Outdoor: Structured play, new equipment, gross motor skills (30-45 min/day), music *Center-based intervention group:* 9 *Sesame Street Workshop Healthy Habits for Life* bilingual health education to ↑PA/healthy eating; classroom (hands-on games, storytelling, food-tasting contests, music). Dietary intake measuring served/uneaten portions on lunch plates *Combined center-and-home based intervention group:* Parent group sessions by parent-peer presenters promoted education on obesity/health promotion (↓sweetened drinks/TV viewing; ↑water, fruits/vegetables; ↑PA). Health promotion at home through parent education *Control group:* Educational materials/ training at end of study *Hypothesis:* Combined center-and- home based intervention will have more favorable changes in BMI *z* scores and weight loss behaviors than center-based and home-based interventions alone.	*Primary outcomes:* Significantly lower rates of weight gain (*z* scores for weight, age and gender) in center- and home-based intervention (one-tailed $p < .04$) than center-only and comparison groups *Secondary outcomes:* Greater consumption of fruits, vegetables, and low-fat milk, and increase in PA and gross motor skills found in center-only ($p < .01$) and center-and-home groups ($p < .001$) compared to control group
Primary care settings					
Cloutier et al. (2015)	12-Month non-RCT Control (*n*=	*N*= 418 mother–child dyads: Intervention (*n* = 200 dyads); 218 dyads)	*Steps to Growing Up Healthy* (*STEPS*) tested efficacy of obesity prevention intervention brief motivational counseling (BMC) delivered by primary care clinicians to prevent/reverse obesity in urban, lower income Latino and Black children, 2-4 years of age	3-5-Minute evidence-based intervention by 32 pediatric physicians/nurses at clinic visits for 12 months	*Primary outcomes:* 12 months: children in intervention group, especially those of normal weight, had small, statistically significant ↓BMI (0.33). Control participants: ↑ BMI (8.75) ($p < .001$)

Table 1. (continued)

Study	Design	Sample	Purpose	Interventions	Findings
		82% Hispanic, 18% African American Mean child age: 35.8 ± 8.6 months; 21% overweight and 21% obese at baseline		*Aims:* ↓ milk intake, ↓sweetened juice intake, ↑ PA, and ↓TV *Randomization to two groups:* *Intervention group:* Mothers received brief motivational counseling (BMC); tool-kit; goal setting/behavioral strategies; identification of barriers Data collected at baseline and 12 months *Control group:* Standard care *Hypothesis:* BMC by medical team will prevent childhood obesity and ↓obesogenic behaviors more than standard care alone.	*Secondary outcomes:* 12-month consumption of milk and juice ↓in intervention group (p < .001). Sweetened beverage intake, television viewing, PA levels are pending
Machuca et al. (2016)	Pilot study	N= 187 parent–child dyads. Intervention (n= 47 dyads); Control (n= 140 dyads) Group sessions in 6-8 mother–infant dyads with children born between 2007 and 2011 (66% Latino) from urban impoverished low-income South Bronx, NY; 48.9% first-time mothers. Mean child age: 6.6 ±6.8 days at firstwell-care visit and 2.2 ±0.2 years at 2-year well-care visit; 11.8% toddlers overweight/obese at 2 years	*Well-Baby Group* (*WBG*), using well- baby group care approach to test impact on childhood overweight/ obesity prevention during first 2 years of life	*Intervention group:* Eleven 2-hour well-child care sessions (3 more than control) taught by pediatrician/dietician to offer education skills r/t child feeding, nutrition, parenting skills, family relationships during group child visit in primary care setting *Control group:* One-to-one well-child visits *Hypothesis:* Well-baby group care program focused on healthy nutrition and responsive parenting will be associated with reduced obesity at 2 years in a low-income community.	*Primary outcomes:* Children in *WBG* care significantly less likely to be overweight/obese at 2 years than control children (2.1% vs. 15.0%; OR 0.12; 95% CI 0.02-0.94; P= .02) At the end of trial, none of the children in WBG were obese compared to 6.4% in control *Secondary outcomes:* Not measured

/
Note. BMI body mass index; PA physical activity; RCT randomized controlled trial; FV fruit and vegetable; CBPR community-based participatory research; SES socio-economic-status; OR odds ratio; CI confidence interval.

Table 2. Strategies for Reduction of Parent–Child BMI and Promotion of Healthy Lifestyles According to Bronfenbrenner's Ecological Systems Theory

Exosystem
Social welfare policies/local industry
Community stakeholder commitment (e.g., school board/local businesses) to enhance physical environment by improving parks, playground equipment, grocery stores, and menu options
Micro-/Mesosystem
Health services/home/school/neighborhood
Modification of school environment (e.g., storytelling, hands-on games, food tasting contests, extended school recess, school lunch menus)
Community health-related events (e.g., trail walking, restaurant visits, parenting/cooking classes)
Primary care providers to deliver clinic-based interventions Trained Promotoras to deliver home and community-based interventions, follow-up home visits, and phone calls
Family/parents/child
Parent/family group sessions to improve health literacy and encourage routine healthy eating and physical activity Toolkit with pedometer, calibrated drinking cup, and food portion placemat
Problem-solving skills, positive reinforcement, and reflective listening

Note. BMI: body mass index.

Discussion

This review article is the first to focus on the application of an ecological framework to intervention studies for the prevention and treatment of childhood obesity among the high-risk population of Hispanic/Latino children. Principal methods targeting the child's microsystem and mesosystem to elicit positive primary and secondary outcomes in the community-based studies included family education during home visits and/or center-based group sessions; use of Promotoras; classroom reinforcement of health literacy; extension of school recess; upgrading of school lunch menus; staff/ teacher professional development; pedometer use; and opportunities for participation in community events (Bender et al., 2013; Crespo et al., 2012; Economos et al., 2013; Gesell et al., 2012; Yin et al., 2012). Since the microsystem and mesosystem of the ecological model are the most influential factors in the child's immediate environment (Bronfenbrenner, 1977), mapping obesity prevention strategies to these levels is essential. Additionally, elements of the exosystem are needed to sustain ongoing positive behavior changes

(Bronfenbrenner, 1977). In these studies, the exosystem was represented by improved outdoor play areas and the commitment of local businesses and community stakeholders to engage in obesity prevention and treatment initiatives.

Significant weight reduction effects were noted in four studies that encouraged parent networking and skill building through group sessions (Bender et al., 2013; Gesell et al., 2012; Machuca et al., 2016; Yin et al., 2012). Two studies measuring secondary outcomes demonstrated improved nutritional intake and PA post-treatment (Bender et al., 2013; Yin et al., 2012). Contrary to these results, increased BMI levels in treatment children were found in two of the five community-based studies where Promotoras delivered the interventions, and 100% of the mother–child dyads self-identified as Hispanic or Latino (Bender et al., 2013; Crespo et al., 2012). Evidence- based interventions delivered by health care providers (pediatricians, dieticians, and/or nurses) in the primary care settings may have had a greater impact on health behaviors compared with those provided by Promotoras alone (Cloutier et al., 2015; Machuca et al., 2016). This outcome may be attributed to extended exposure to professional advice and counseling from members of the interdisciplinary team during well-child visits. Receiving consistent professional support and anticipatory guidance assists parents with goal setting during well-child visits and achieving positive health behavior changes in children (Norlin, Crawford, Bell, Sheng, & Stein, 2011; Sege, 2011). The new AAP guidelines and the Bright Futures initiative support these methods to enhance problem-solving skills and health promotion in families (Daniels & Hassink, 2015; Hagan, Shaw, & Duncan, 2017).

Of the reviewed studies, only Bender et al. (2013) measured 6-month post-treatment effects to assess program sustainability; significant secondary outcomes were evident in children's water, sugary drink, and milk intake, but not in soda or juice. In *Aventuras* and *Steps*, program sustainability was noted: The *Aventuras* menu was still in use by more than half of the local restaurants (Crespo et al., 2012), and the *Steps* intervention site retained teaching tools previously implemented during the study (Cloutier et al., 2015). In *Shape Up Somerville*, because sustained treatment effects during the second intervention year were not evident during the summer months, the authors recommended more potent interventions to ensure year-round maintenance of effects over time (Economos et al., 2013). Community ownership and the ability to influence social norms are qualities believed to be highly effective at sustaining obesity treatment effects over time (World Health Organization, 2012).

Conclusion

A limitation in some of the individual studies was a small sample size (Bender et al., 2013; Gesell et al., 2012; Machuca et al., 2016). In studies where parents self-reported survey information, the potential for bias and socially desirable responses was present (Crespo et al., 2012). Five of the studies were nonrandomized, which could have potentially weakened the strength of these findings (Bender et al., 2013; Cloutier et al., 2015; Economos et al., 2013; Machuca et al., 2016; Yin et al., 2012). Last, the degree of contribution that each component of the multilevel interventions was responsible for in affecting change was not possible to assess.

This review suggests obesity prevention and treatment interventions for Hispanic/ Latino families with young children that nurses can apply in primary care or community settings. As part of the child's microsystem and mesosystem, the primary care setting provides nurses with unique opportunities to educate families on the health benefits of increasing PA and fruit/vegetable consumption and decreasing sweetened beverage intake. In community-based and early education centers, nurses can recognize cultural perceptions and practices that encourage obesogenic tendencies and deliver culturally appropriate anticipatory guidance via group sessions. Nurses can make a difference on a larger scale by tapping into the child's exosystem and advocating for government funding to improve school lunches, lengthen recess periods, create safe recreational spaces, and encourage local businesses to sponsor health initiatives. Last, by fostering trusting relationships, nurses can support parents to voice concerns, address barriers, and find solutions in preventing and treating obesity in their children.

Healthy lifestyle practices in Hispanic/Latino children must be established in infancy or early childhood before unhealthy eating and sedentary habits take root (Institute of Medicine, 2015). Interventions developed within an ecological frame- work must target the family, not solely the child, because the family significantly influences the health habits of children (Berkowitz & Borchard, 2009). The reviewed studies demonstrate promising multilevel strategies in weight reduction and improvement of healthy eating and PA in children, and in some cases parents, immediately post-intervention. Although the number of studies utilizing the ecological model is limited, the model's usefulness in its application to child obesity prevention and treatment is evident. Obesity prevention and treatment programs targeting Hispanic/Latino youth would benefit from purposefully implementing an ecological model when designing interventions to address multiple stressors in these families. Future research using an ecological model will ideally offer new knowledge on effective obesity prevention and treatment in Hispanic/Latino families for the management and sustainability of a healthy weight in the long term.

Acknowledgments

The authors offer special thanks to David Nolfi, Health Sciences Librarian and Library Assessment Coordinator at the Gumberg Library at Duquesne University, for his assistance with the advanced search of the online databases.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, author- ship, and/or publication of this article.

References

Ahluwalia, I., D'Angelo, D., Morrow, B., & McDonald, J. (2012). Association between acculturation and breastfeeding among His- panic women: Data from the pregnancy risk assessment and mon- itoring system. *Journal of Human Lactation*, *28*, 167–173.

American Academy of Pediatrics. (2012). Section on breastfeeding: Breastfeeding and the use of human milk. *Pediatrics*, *115*, 496–506.

Bender, M., Nader, P., Kennedy, C., & Gahagan, S. (2013). A cultu- rally appropriate intervention to improve health behaviors in His- panic mother-child dyads. *Childhood Obesity*, *9*, 157–163.

Berkowitz, B., & Borchard, M. (2009). Advocating for the prevention of childhood obesity: A call to action for nursing. *Online Journal of Issues in Nursing*, *14*(1). Retrieved from http://nursingworld.org/MainMenuCategories/ANAMarketplace/ANAPeriodicals/OJIN/TableofContents/Vol142009/No1Jan09/Prevention-of- Childhood-Obesity.html

Black, M., Siegel, E., Abel, Y., & Bentley, M. (2001). Home and videotape intervention delays early complementary Feeding among adolescent mothers. *Pediatrics*, *107*(5), E67.

Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist*, *32*, 513–531.

Cartagena, D., Ameringer, S., McGrath, J., Jallo, N., Masho, S., & Myers, B. (2014). Factors contributing to infant overfeeding with Hispanic mothers. *Journal of Obstetric, Gynecologic, and Neona- tal Nursing*, *43*, 139–159. doi:10.1111/1552-6909.12279

Centers for Disease Control and Prevention. (2004). *Access to health-care and preventive services among Hispanics and non-Hispanics: United States, 2001-2002*. Retrieved from https://www.cdc.gov/ mmwr/preview/mmwrhtml/mm5340a2.htm

Cloutier, M., Wiley, J., Huedo-Medina, T., Ohannessian, C., Grant, A., Hernandez, D., & Gorin, A. (2015). Outcomes from a pediatric primary care weight management program: Steps to growing up healthy. *Journal of Pediatrics*, *167*, 372–377.e371. doi:10.1016/j. jpeds.2015.05.028

Colby, S., & Ortman, J. (2014). *Projections of the size and composition of the U.S. population: 2014 to 2060, current population reports*. Retrieved from: https://www.census.gov/content/dam/Cen sus/library/publications/2015/demo/p25-143.pdf

Crespo, N., Elder, J., Ayala, G., Slymen, D., Campbell, N., Sallis, J., Arredondo, E. (2012). Results of a multi-level intervention to prevent and control childhood obesity among Latino children: The Aventuras para Niños study. *Annals of Behavioral Medicine*, *43*, 84–100.

Daniels, S., & Hassink, S. (2015). The role of the pediatrician in primary prevention of obesity. *Pediatrics*, *136*, e275–e292. doi: 10.1542/peds.2015-1558

Dev, D., McBride, B., Fiese, B., Jones, B., & Cho, H. (2013). Risk factors for overweight/obesity in preschool children: An ecological approach. *Childhood Obesity*, *9*, 399–408.

Economos, C., Hyatt, R., Must, A., Goldberg, J., Kuder, J., Naumova, E., … Nelson, M. (2013). Shape up Somerville two-year results: A community-based environmental change intervention sustains weight reduction in children. *Preventive Medicine*, *57*, 322–

327. doi:10.1016/j.ypmed.2013.06.001

Freedman, D., Sharma, A., Hamner, H., Pan, L., Panzera, A., Smith, R., & Blanck, H. M. (2017). Trends in weight-for-length among infants in WIC from 2000 to 2014. *Pediatrics*, *139*(1). doi:10.1542/peds. 2016-2034

Gesell, S., Bess, K., & Barkin, S. (2012). Understanding the social networks that form within the context of an obesity prevention intervention. *Journal of Obesity*, *2012*, 749832. doi:10.1155/ 2012/749832

Glanz, K., Rimer, B., & Viswanath, K. (2008). *Health behavior and health education: Theory, research, and practice* (4th ed.). San Francisco, CA: Jossey-Bass.

Grow, M., Cook, A., Arterburn, D., Saelens, B., Drewnowski, A., & Lozano, P. (2010). Child obesity associated with social disadvan- tage of children's neighborhoods. *Social Science & Medicine*, *71* 584–591. doi:10.1016/j.socscimed.2010.04.018

Hagan, J. F., Shaw, J. S., & Duncan, P. M. (Eds.). (2017). *Bright futures: Guidelines for health supervision of infants, children, and adolescents* (3rd ed.). Elk Grove Village, IL: American Academy of Pediatrics.

Hubert, H. B., Snider, J., & Winkleby, M. A. (2005). Health status, health behaviors, and acculturation factors associated with over- weight and obesity in Latinos from a community and agricul- tural labor camp survey. *Preventive Medicine*, *40*, 642–651. doi:10.1016/j.ypmed.2004.09.001

Institute of Medicine. (2015). *Examining a developmental approach to childhood obesity: The fetal and early childhood years: Workshop summary*. Washington, DC: National Academies Press.

Isasi, C., Hua, S., Jung, M., Carnethon, M., Perreira, K., Vidot, D., Gallo, L. (2017). The association of parental/caregiver chronic stress with youth obesity: Findings from the study of Latino youth and the Hispanic community health study/study of Latinos sociocultural ancillary study. *Childhood Obesity*, *13*, 251–258. doi:10.1089/chi.2016.0205

Machuca, H., Arevalo, S., Hackley, B., Applebaum, J., Mishkin, A., Heo, M., & Shapiro, A. (2016). Well baby group care: Evaluation of a promising intervention for primary obesity prevention in tod- dlers. *Childhood Obesity*, *12*, 171–178. doi:10.1089/chi.2015.0212

National Academies of Sciences Engineering and Medicine. (2016). *Obesity in the early childhood years: State of the science and implementation of promising solutions: Workshop summary*. Washington, DC: National Academies Press.

National Center for Health Statistics. (2016). *Health e-stats: Prevalence of overweight and obesity among children and adolescents aged 2-19 years: United States. 1963-1965 through 2013-2014*. Retrieved from https://www.cdc.gov/nchs/data/hestat/obesity_ child_13_14/obesity_child_13_14.htm#table1

Ndiaye, K., Silk, K. J., Anderson, J., Horstman, H. K., Carpenter, A., Hurley, A., & Proulx, J. (2013). Using an ecological framework to understand parent–child communication about nutritional decision-making and behavior. *Journal of Applied Communication Research*, *41*, 253–274. doi:10.1080/00909882.2013.792434

Norlin, C., Crawford, M. A., Bell, C. T., Sheng, X., & Stein, M. T. (2011). Delivery of well-child care: A look inside the door. *Aca- demic Pediatrics*, *11*(1), 18–26.

doi:10.1016/j.acap.2010.12.008
Ogden, C. L., Carroll, M. D., Lawman, H. G., Fryar, C. D., Kruszon- Moran, D., Kit, B. K., & Flegal, K. M. (2016). Trends in obesity prevalence among children and adolescents in the United States, 1988-1994 through 2013-2014. *Journal of the American Medical Association*, *315*, 2292–2299. doi:10.1001/jama.2016.6361
Ortega, A., Rodriguez, H., & Bustamante, A. (2015). Policy dilemmas in Latino health care and implementation of the affordable care act. *Annual Review of Public Health*, *36*, 525–544. doi:10.1146/ annurev-publhealth-031914-122421
Pan, L., Freedman, D., Sharma, A., Castellanos-Brown, K., Park, S., Smith, R., & Blanck, H. (2016). Trends in obesity among partici- pants aged 2-4 years in the special supplemental nutrition program for women, infants, and children: United States, 2000-2014. *Morbidity and Mortality Weekly Report*, *65*, 1256–1260. doi:10.15585/ mmwr.mm6545a2
Paul, I., Savage, J., Anzman, S., Beiler, J., Marini, M., Stokes, J., & Birch, L. (2011). Preventing obesity during infancy: A pilot study. *Obesity*, *19*, 353–361. doi:10.1038/oby.2010.182
Pearce, J., Taylor, M., & Langley-Evans, S. (2013). Timing of the introduction of complementary feeding and risk of childhood obe- sity: A systematic review. *International Journal of Obesity*, *37*, 1295–1306.
Peneau, S., Rouchard, A., Rolland-Cachera, M., Arnault, N., Herc- berg, S., & Castetbon, K. (2011). Body size and growth from birth to 2 years and risk of overweight at 7-9 years. *International Jour- nal of Pediatric Obesity*, *6*, 162–169.
Powell, L. M., Wada, R., Krauss, R. C., & Wang, Y. (2012). Ethnic disparities in adolescent body mass index in the United States: The role of parental socioeconomic status and economic contextual factors. *Social Science & Medicine*, *75*, 469–476. doi:10.1016/ j.socscimed.2012.03.019
Reifsnider, E. (1995). The use of human ecology and epidemiology in nonorganic failure to thrive. *Public Health Nursing*, *12*, 262–268. Reifsnider, E., Keller, C., & Gallagher, M. (2006). Factors related to overweight and risk for overweight status among low-income Hispanic children. *Journal of Pediatric Nursing*, *21*, 186–196.
Schwartz, F., Hutchings, T., Friedman, A. J., Quartey, N. K., Urowitz, S., Wiljer, D., & Smith, R. E. (2010). Moving toward an organized approach to patient education in Canadian hospitals. *Healthcare Quarterly*, *13*(4), 84–88.
Sege, R. (2011). It's not what you say, its how you say it: Improving the effectiveness of anticipatory guidance. *Academic Pediatrics*, *11*(1), 3–4. doi:10.1016/j.acap.2010.12.011
Tovar, A., Hennessy, E., Pirie, A., Must, A., Gute, D., Hyatt, R., Economos, C. (2012). Feeding styles and child weight status among recent immigrant mother-child dyads. *International Journal of Behavioral Nutrition and Physical Activity*, *9*, 62.
Tovar, A., Renzaho, A., Guerrero, A., Mena, N., & Ayala, G. (2014). A systematic review of obesity prevention intervention studies among immigrant populations in the US. *Current Obesity Reports*, *3*, 206–222.
Williams, J., Kabukuru, A., Mayo, R., & Griffin, S. (2011). Commen- tary: A socio-ecological perspective on obesity among Latinos. *Ethnicity & Disease*, *21*, 467–472.
Wilson, S., & Sato, A. (2013). Stress and paediatric obesity: What we know and where to go. *Stress Health*, *30*, 91–102. doi:10.1002/smi. 2501

Winkleby, M., Robinson, T., Sundquist, J., & Kraemer, H. (1999). Ethnic variations in cardiovascular disease risk factors among chil- dren and young adults: Findings from the Third National Health and Nutrition Examination Survey, 1988-1994. *Journal of the American Medical Association*, *281*, 1006–1013.

World Health Organization. (2012). *Population-based approaches to childhood obesity prevention*. Retrieved from http://www.who.int/dietphysicalactivity/childhood/WHO_new_childhoodobesity_PREVENTION_27nov_HR_PRINT_OK.pdf

Yin, Z., Parra-Medina, D., Cordova, A., He, M., Trummer, V., Sosa, E., … Ramirez, A. (2012). Miranos! Look at us, we are healthy! An environmental approach to early childhood obesity prevention. *Childhood Obesity*, *8*, 429–439. doi:10.1089/chi.2011.0125

RESULTS MANUSCRIPT

Exploring Maternal Factors Linked to Weight Status in Salvadoran Infants

ABSTRACT

Background: Obesity rates in the US have risen dramatically, especially among Hispanic adults and children. Because of the high prevalence of overweight and obesity in Latino children by preschool age, it is prudent to examine maternal factors potentially linked to weight status during an infant's first year of life. The literature on risk factors of child obesity has focused primarily on children of Mexican descent, and little research exists for other Latino populations, such as Salvadorans. **Objective:** To investigate maternal physiologic and infant feeding factors associated with infant overweight and/or obesity in a sample of Salvadoran mother-infant dyads. **Methods:** A cross-sectional, correlational study, utilizing an ecological framework, was conducted at the 9-12-month well-baby visit in two private pediatric offices on Long Island, New York. Maternal physiologic risk factors and feeding beliefs as well as infant feeding practices during the first 5 months were self-reported by the mothers. Infants' birth weight, current weight and recumbent length were retrieved from the electronic charts. Bivariate logistic regression models examined the relationship of the variables with infant weight status, > *85^{th} weight-for-length percentile (WFL) for sex.* **Results:** In this sample of mothers (N=88), 94.3% were born in El Salvador, 92.1% were married, and the mean age was 28.5 years (SD = 5.9 years); 43% of the total sample of infants had a WFL > 85^{th} percentile. After controlling for maternal age, insurance type, income, education, and marital status, no significant associations with infant WFL > 85^{th} percentile at the 9-12-month well-visit were found. Infant feeding practices in the first five months and maternal physiologic risk factors were not associated with infant weight status. Infant birth weight (kg) was the only variable significantly associated with WFL > 85^{th}

percentile, $p < .05$. **Conclusion**: This is the first study to examine infant weight status in the Salvadoran population. Future studies should objectively investigate infant feeding practices and other potential contributing factors among Salvadoran mother-infant dyads, since nearly half of the infant sample had a WFL > 85th percentile.

4.2 INTRODUCTION

Obesity rates in the US have risen dramatically in the last 30 years, especially among Hispanic adults and children. Results from the National Health and Nutrition Examination Survey (NHANES, 2011-2014) showed a disparity among children between 6 to 11 years of age with 24.1% of Hispanic girls and 25.8% of Hispanic boys being obese (BMI for age ≥ 95th percentile, Centers for Disease Control (CDC) Growth Charts) compared to 14.4% of non-Hispanic white girls and 13% of non-Hispanic white boys (Ogden et al., 2016). In the 2 to 5-year-old age group, although rates of obesity have declined significantly since 2003-2004 from 13.9% to 9.4% in 2013-2014, the downward trend appears to be more significant in non-Hispanic white children (5.2% obesity rate) than in children from ethnic minority groups; e.g., 15.6% in Hispanic children and 10.4% in non-Hispanic black children in this age group (Ogden et al., 2016). Similarly, Hispanic Latino infants from 3 to 23 months have higher weights-for-length when compared to non-Hispanic black or white children of the same age; 13.8%, 11.9%, and 11% respectively, based on World Health Organization growth standards (Freedman et al., 2017).

In addition to an increased risk for developing obesity in adolescence and young adulthood, childhood obesity sets the stage for other physiologic, psychological, and social consequences, such as type 2 diabetes, hypertension, dyslipidemia, low self-esteem, depression, bullying, and poor school performance, with greater rates of comorbidities in children from minority groups (Barlow, 2007). A study by Wen and colleagues (2012) found only a small decline from 2004-2008 in obesity prevalence in children who were Medicaid recipients, suggesting persistent health disparities in lower income groups. Because obesity reduction strategies in children appear to have greater effects among higher socio-economic status (SES) groups than in lower SES groups (Wen et al., 2012), further research that examines aspects of the mother-infant dyad's socioeconomic status and type of health insurance is needed. The possible sequelae of obesity in minority children underscores the urgent need to address potentially modifiable risk factors, especially among Hispanic and Latino youth where the rates of obesity are among the highest. Several potentially modifiable obesity risk factors identified within the child's environmental milieu include less exclusive breastfeeding, prolonged formula feeding, and complimentary feeding < 4 months of age, (Taveras, Gillman, Kleinman, Rich-Edwards, & Rifas-Shiman, 2010). To date, the literature on risk factors of child obesity has focused primarily on children of Mexican descent (Adair, 2008; Dennison, Edmunds, Stratton, & Pruzek, 2006; Kumanyika, 2008), and the literature is scant for other Latino populations (Ahluwalia, D'Angelo, Morrow, & McDonald, 2012; Cartagena et al., 2014; Gross, Mendelsohn, Fierman, Hauser, & Messito, 2014; Schwartz, Vigo, Dias de Oliveira, & Justo Giugliani, 2015). Although Salvadorans are the fourth largest Latino subgroup in the US (U.S. Census Bureau, 2014), there are no data on the feeding practices of Salvadoran mothers and the effects on infant weight status. Knowing whether maternal feeding practices confer similar risk in Salvadoran children will add to the state of the science by investigating these factors within the child's environment in another subgroup of the Hispanic population and may help inform obesity prevention efforts.

To protect against childhood overweight and obesity, the American Academy of Pediatrics (AAP) (2012) recommends exclusive breastfeeding for 6 months or more instead of formula feeding and delaying complimentary feeding (introduction of solids other than breastmilk or formula) until 5 to 6 months. Research findings support an association between longer duration of breastfeeding and a reduced risk of obesity (Wang, C., Ratliff, Xie, & Wang, 2017), compared with formula feeding (odds ratio: 0.87; 95% confidence interval [CI]: 0.85–0.89) (Owen, Martin, Whincup, Smith, & Cook, 2005; Perez-Escamilla & Kac, 2013). During 2000-2008, although breastfeeding at 6 months in Latina mothers significantly increased from 34.6% to 45.2%, and from 18.2% to 26.3% at 12 months, these rates did not meet CDC recommendations of 61% of any breastfeeding at 6 months or 34% at 12 months (Morbidity and Mortality Weekly Report MMWR, 2013; National Center for Chronic Disease Prevention and Health Promotion, 2014). The association of infant weight status to the feeding practices of Latino mother-infant dyads during early infancy has been largely unexplored, particularly in Salvadoran infants.

Research shows that immigrant Latinas who have acculturated to US customs are less likely to practice exclusive breastfeeding and more likely to combine breastfeeding with formula, formula feed only, or introduce complimentary feeding as early as 2-3 months, practices which underestimate infant satiety, and lead to overfeeding (Gross et al., 2014; Kupers et al., 2015). Complimentary feeding, also known as "double feeding," is perceived by many Latina mothers to provide better nourishment than breast milk or formula alone (Pearce, Taylor, & Langley-Evans, 2013; Schwartz et al., 2010) and may be based on a lack of knowledge and understanding of the benefits of exclusive breastfeeding, as well as a fear of under nourishing the child (Houston, Waldrop, & McCarthy, 2011). These practices are thought to accelerate the infant growth trajectory (Ahluwalia et al., 2012; Gross et al., 2014).. Until now, studies have measured acculturation mainly in terms of years of residency and degree of fluency in the English language. Research that examines acculturation and feeding choices together with the level of maternal education is needed because a higher level of education has been linked to more compliance with exclusive breastfeeding (Ahluwalia et al., 2012; Gill et al., 2004; Vaughn, Geraghty, Nino, & Valenzuela, 2010).

Because of the high prevalence of overweight and obesity in Latino children by preschool age, it is prudent to examine maternal feeding style, including feeding beliefs, during an infant's first year of life to determine a potential association with infant weight (Kupers et al., 2015; Liu, Hannon, Rong, Downs, & Marrero, 2015). Family influence is a strong contributing factor to infant feeding behaviors such as "pressure feeding," a desire for the infant to finish the entire bottle, which often underestimates infant satiety. This practice is also found among Latina mothers (Anderson & Whitaker, 2009; Cartagena et al., 2014). The AAP (2012) recommends that a 6-month old infant consume 6 to 8 ounces (180–240 ml) 5 to 6 times in a 24-hour period. Research shows this amount is often exceeded by Latina mothers (Cartagena et al., 2014). Finally, there appears to be an underestimation of overweight, as several studies report Latina mothers' preference for a plump child and perceptions of thinness as an unhealthy state (Cartagena, McGrath, & Masho, 2016; Houston et al., 2011). Further investigation on double feeding and the cultural perspective in which it takes place is needed as this practice does not provide optimal benefit to the baby (Ahluwalia et al., 2012).

Certain maternal risk factors also influence infant weight status. Conditions such as pre-pregnancy overweight or obesity (BMI > 25 kg/m^2), GDM, and excessive pregnancy weight gain > 35 pounds (Institute of Medicine and National Research Council, 2009) expose the fetus to excessive intrauterine growth and lead to rapid weight gain in infancy, increasing the risk of childhood obesity (Bowers et al., 2013). Studies show that Latina women have a higher rate of being overweight or obese than Non-Hispanic white women, and consequently, their children face even greater rates of obesity and diabetes than their immigrant parents (National Center for Health Statistics, 2012). Pre-pregnancy maternal obesity and obesity during pregnancy have been linked to the development of GDM, childhood obesity, and lower rates of breastfeeding in all populations of childbearing women (Tenfelde, Finnegan, & Hill, 2011). In addition to childhood obesity, maternal GDM predisposes the child to developing type 2 diabetes later in life. Research examining the effects of pre-pregnancy obesity and pregnancy weight gain on infant weight status together with an increased tendency to formula feed is scarce (Mayer-Davis et al., 2008; Smith, Hulsey, & Goodnight, 2008). These maternal physiologic conditions are believed to be strong indicators of obesity in infants by the first year of age (Bowers et al., 2013).

To date, the literature on risk factors of child obesity has focused primarily on children of Mexican descent (Adair, 2008; Dennison et al., 2006; Kumanyika, 2008), and the literature is scant for other Latino populations (Ahluwalia et al., 2012; Cartagena et al., 2014; Gross et al., 2014; Schwartz et al., 2015). Salvadorans are the fourth largest Latino subgroup in the US (U.S. Census Bureau, 2014); yet, there is no data on the feeding practices of Salvadoran mothers and the effects on infant weight status. Knowing whether maternal feeding practices confer similar risk in Salvadoran children will add to the state of the science by investigating this phenomenon in another major Latino subgroup (Barroso, Roncancio, Hinojosa, & Reifsnider, 2012; National Center for Health Statistics, 2012).

The proposed cross-sectional, correlational study will explore the association of maternal feeding practices during the first 5 months; feeding beliefs; and maternal risk factors with infant weight status in ~100 Salvadoran mother-infant dyads presenting for the 9-to-12-month well-baby check-up. Further research is needed to examine the multidimensional factors of maternal feeding practices and beliefs, as well as maternal physiologic risk factors that are believed to potentially confer obesity risk in Latino infants.

The aims of this study were to 1) determine the association between *maternal feeding practices* (complementary feeding, breast/formula feeding) during the first 5 months of the infant's life and *infant weight status* (>85th weight-for-length percentile for sex) at the 9-12-month visit, 2) determine the association between *maternal feeding beliefs* and *infant weight status* (>85th weight-for-length percentile for sex) at the 9-12-month visit, 3) determine the association between *maternal risk factors* (pre-pregnancy BMI > 25 kg/m^2, GDM, pregnancy weight gain > 35 lbs.) and *infant weight status* (>85th weight-for-length percentile for sex) at the 9-12-month visit, and 4) determine the association of each domain of factors (*maternal feeding practices, beliefs, history of maternal risk factors*) during the first 5 months with *infant weight status* (>85th weight-for-length percentile for sex) at the 9-12-month visit.

4.3 METHODS

4.3.1 Design Overview and Study Sample

This cross-sectional, correlational study was conducted between January 2018 and May 2018 in the private offices of two local pediatricians in communities within Suffolk County, New York with high concentrations of Latino residents, including immigrant and native-born Salvadorans (U.S. Census Bureau, 2014). Inclusion criteria included immigrant and/or first-generation Salvadoran women who were 18 years of age or older; mothers of infants attending a 9-to-12-month well-visit who were born as single, full-term infants; and mothers who were able to speak and read in either English or Spanish. Mothers were excluded if they had an infant with a history of having been admitted to the neonatal intensive care unit, if the infant required a special diet such as Alimentum, or if the infant was brought to the visit by someone other than the infant's mother.

Recruitment of potential participants was done by the staff who informed Latina mothers bringing their infants to the pediatrician office for the 9-to-12-month well-visit about the study. Flyers describing the study were available in English and Spanish and were distributed by the staff to potential participants on days when the Principal Investigator (PI) was on site to collect data. Mothers were asked if they were interested in participating in the study while their child's measurements were being taken by the staff or while they waited for the pediatrician in the exam room. Mothers expressing an interest in the study met with the PI before or after the well-visit in a private exam room. Eligible mothers were informed of the study's details, procedures, risks, benefits, and time needed for completion of questionnaires. The PI read the consent to the participants in their preferred language prior to data collection, and written informed consent was obtained from the mothers to allow the staff and PI to access the infant's birth weight and current weight and recumbent length at the visit; these variables were retrieved from the electronic health record (EHR) by the staff and given to the PI.

Upon completion of the questionnaires, a $20 gift card was given. Institutional Review Board (IRB) approval of the study's process and materials was obtained prior to data collection as per Duquesne University's IRB protocol and appropriate HIPPA forms were completed and submitted. Physician approval of the study at the participating pediatric offices was obtained in advance.

4.3.2 Measures

Mothers' socio-demographic variables such as educational level; years living in the US; age; birthplace (US/El Salvador); marital status; primary language (English/Spanish); presence of the baby's father (yes/no), grandmother (yes/no), or others (yes/no) in the household; employment status (full-time, part-time, none); and insurance status (private, public, none), were documented on a demographic form created by the PI. Family income range was not asked because some of the mothers may have been undocumented immigrants.

Maternal feeding practices from 0-to-5 months of the infant's life were self-reported by the mothers who were asked to recall and report this information retrospectively on the day of the study at the 9-to-12-month well-baby visit utilizing two questionnaires. The entire *Infant Feeding Scale (IFS),* an adaptation of the *Harvard Food Frequency Scale* for children (Suitor & Gardner, 1992), consists of the food frequency scale and the feeding environment scale (Horodynski et al., 2011). The *IFS* food frequency subscale has been used by other researchers measuring feeding practices related to overweight status (>85th weight-for-length percentile) in Latino infants (Cartagena et al., 2016). In this study, only the first page of the *IFS* food frequency subscale was used. Twelve questions measured maternal feeding practices based on recall of the feeding environment and types of foods fed to the infants from birth to 5 months. Seven questions related to the infant's dietary intake (breastfeeding, formula feeding, and complimentary feeding) during the first five months and required a "yes/no" response. Examples were: "Has your baby ever had anything to drink other than breastmilk or formula?" and "Have you started feeding your baby any solid foods?" Two questions pertained to the age at which the infant received substances other than breast milk or formula. One question asked participants to list food (s) that the baby had taken in "solid" form (e.g. juice, rice, yogurt, baby cereal, or other)

(Horodynski et al., 2011). Two 3-part questions developed by the PI were added to assess family influence on feeding practices and required a "yes/no" response. For example, "Was the baby's father involved in the infant feeding from 0-to-5-months?" and "Did the baby's father pressure the baby to finish his/her food?" These questions were also directed at the grandmother and any other members of the household, if they were involved in the feeding of the infant. This tool did not have a total score, rather, each item was used to assess actual maternal infant feeding practices and analyzed individually for its effect on infant weight status.

The *Infant Feeding Styles Questionnaire (IFSQ*) included two subscales that measured maternal feeding beliefs and behaviors associated with level of control over infants' feeding from birth to 5 months (Thompson et al., 2009; Wood et al., 2016). The Spanish version of the *IFSQ,* developed as part of the Latino Infant Nutrition Study, was validated in the Greenlight study (Wood et al., 2016) with a large sample of Latino mothers at the infant's 12-month clinic visit using the *laissez-faire, pressuring, restrictive*, and *responsive* constructs to collect data. The 51 items from the beliefs and behaviors subscales reflected laissez-faire, pressuring, restrictive, and responsive constructs. Two subscale scores for 23 beliefs items and 28 behaviors items were calculated using a Likert scale. Scores on the beliefs items could vary from 23 to 115, with lower scores indicating healthier feeding beliefs (Thompson et al., 2009). Internal consistency of the belief subscale is 0.83 (Cartagena et al., 2014). On the behaviors scale, scores could vary from 28-140, with lower scores also indicating healthier feeding behaviors (Thompson et al., 2009). Internal consistency of the behavior subscale is 0.94 (Cartagena et al., 2014).

On the *IFSQ,* seven total scales were generated, with internal consistency assessed by Cronbach's alpha. These comprised a total score, which summed responses to the 51 items (after reverse coding, as appropriate) in the IFSQ instrument; two subscales for the 23 beliefs items (alpha = 0.55) and 28 behaviors items (alpha = .80); and four subscales for the items pertaining to laissez faire feeding behavior (11 items; alpha = .46), pressuring behavior (17 items; alpha = .83), restrictive behavior (11 items; alpha =.20), and responsive behavior (12 items; alpha = .62).

Mothers self-reported their height in feet and inches and/or centimeters, as well as their pre-pregnancy weight, weight gained during the pregnancy, and whether they experienced gestational diabetes mellitus (GDM) during the pregnancy. Based on the mothers' self-reported height and recall of their pre-pregnancy weight, pre-pregnancy-BMI was calculated by the PI with the formula: weight (lb)/height^2 (in^2) x 703 (Garrow, 1988). BMI categories included: 18.5 to <25 kg/m^2 = normal; 25 kg/m^2 to < 30 kg/m^2 = overweight; and ≥ 30 kg/m^2 = obese (Institute of Medicine and National Research Council, 2009). Pregnancy weight gain was defined as the total weight gained by the mother from the time she learned she was pregnant to the end of the pregnancy in pounds (lbs.); the recommended weight gain in pregnancy varies by weight category prior to becoming pregnant: underweight women (BMI < 18.5 lbs.) should gain 28-40 lbs.; normal weight women (BMI 18.5-24.9) should gain 25-35 lbs.; overweight women (BMI 25-29.9) should gain 15-25 lbs.; and obese women (BMI ≥ 30) should gain 11-20 lbs. (Institute of Medicine and National Research Council, 2009). GDM is defined as diabetes that develops in a pregnant woman after the 24th week of pregnancy, and is considered a risk factor for child overweight or obesity (National Academies of Sciences Engineering and Medicine, 2016). GDM was described to the participants for clarity and was documented on the data collection form.

A Health-o-meter Professional Digital Pediatric scale (Pelstar, LLC., McCook, IL) and length board was used by the staff to measure the infants' weight in kilograms while the infant was wearing only a diaper, and recumbent length was measured in centimeters. Birth weight represented a baseline point of reference when assessing infant weight status at 9-to-12-months and, in addition to infant sex, was retrieved from the electronic health record by the office staff. Staff entered this information into the infant's EHR at the time the measurements were taken and gave this information to the PI.

Infant weight status at the 9-to-12-month visit was operationalized as weight-for-length (WFL) percentile based on World Health Organization (WHO) guidelines for weight-for-length for children from 0-to-2 years of age (World Health Organization, 2010). Weight-for-length percentiles were calculated with an infant growth online calculator based on WHO guidelines for weight-for-length for children from 0-to-2 years of age (Raymond, n.d.). The outcome of weight percentile based on the child's length is produced by inputting gender, weight in kilograms, and recumbent length in centimeters into the data entry table of the online calculator. A cross check of the weight-for-length percentiles calculated with the online calculator in 30% of the infants was done with an online WHO weight-for-length growth chart to verify the accuracy of the online calculations. Two studies have used the cutoff at the 85^{th} percentile for identifying infants at risk for subsequent obesity, and this cutoff was used as a marker of at-risk weight status (Cartagena et al., 2016; Roy et al., 2016). Although a percentile to distinguish overweight status does not exist with WHO weight-for-length percentile curves in children from 0-to-2-years, a study by Smego et al. (2016) showed that the 85^{th} percentile cut point in WHO WFL percentile models in infants was predictive of severe obesity by the age of 6 years. This data supports the use of the 85^{th} percentile cut point to identify infants at risk for developing obesity later in childhood.

4.3.3 Statistical Analysis

G*Power 3.1.9.2 software (Faul, Erdfelder, Buchner, & Lang, 2009) was used to determine that a sample size of 100 would provide a statistical power of 0.80 to detect a moderate effect size of 0.30, using a significance level of 0.05 (two tailed). Because the

G*Power estimate assumes a normally distributed outcome, a second sample size calculator, applying a binomial distribution, consistent with the dichotomous at-risk for overweight outcome variable, was also used (Hulley, Cummings, Grady, & Newman, 2013). Assuming a 95% confidence level, 30% expected probability of being overweight, and .20 Confidence Interval width, the desired sample was 88 participants.

Using univariate descriptive analysis, data were examined for outliers and missing values, and scanned for erroneous responses resulting from possible transposition errors or investigator miscoding. Missing or erroneous data were not found however, two outliers were discovered and excluded from the bivariate models because they were diagnosed as failure-to-thrive infants and their weight, on the day of data collection, was slightly more than one standard deviation below the mean compared to the rest of the sample. After the removal of the two outliers, analyses were done with and without the two outliers and no change was noted in the outcome variable, infant weight status. Univariate descriptive statistics (means and standard deviations for continuous variables; number and percent for categorical variables) were generated.

The primary outcome, infant weight status, was operationalized as a weight-for-length percentile > 85^{th} percentile and coded as a binary variable. The continuous measure of WFL percentiles was also tested as the outcome measure because the study's modest sample size limited the power to infer statistical differences in at-risk weight status by some explanatory variable categories.

Maternal feeding practices were coded as three mutually exclusive, exhaustive, binary dummy variables: breastfeeding only (1 = yes; 0 = no), formula only (1 = yes; 0 = no), and both breastfeeding and formula (1 = yes; 0 = no). Supplementary measures of maternal feeding, operationalized equivalently to the primary measure, included the following: other food (1 = yes; 0 = no), other liquid (1 = yes; 0 = no), juice (no juice = 0/referent; apple juice = 1, other juice = 2), solid food (1 = yes; 0 = no), cereal in bottle (1 = yes; 0 = no), father pressures during feeding (1 = yes; 0 = no), grandmother pressures during feeding (1 = yes; 0 = no), other relative pressures during feeding (1 = yes; 0 = no).

Mother's age, years in the US, pre-pregnancy weight, pregnancy weight gain, and BMI were treated as continuous variables, as were baby's birthweight and age at the 9-to-12-month well visit. Mother's birthplace (1 = El Salvador; 0 = US), primary language (1 = Spanish; 0 = English), education (1 = High School graduate or higher; 0 = less than High School graduate), marital/partner status (1 = married or partnered; 0 = not married or partnered), history of GDM (GDM = 1; no GDM = 0), presence in household of father, grandmother, and/or other family member were treated as binary dummy variables (1 = yes; 0 = no). Employment status and insurance status, which were multinomial categorical variables, were decomposed to binary dummy variables, with private insurance (vs. no insurance/public insurance) and full-time employment (vs. not employed/part-time employed) serving as the referent variables in the statistical analyses.

Bivariate logistic regression was used to estimate the association between infant weight status as a binary variable (weight > 85th WFL percentile as a cut point) and each explanatory variable. Assumptions of logistic regression are that observations are independent of each other and there is a linear relationship between continuous predictors and the log odds of the dependent variable. The dependent variable does not have to be normally distributed (NB: the dependent variable is binary in this study), and it is assumed that there is homogeneity of variance (Polit, 2010). Logistic regression yields an odds ratio, which is the exponentiated value of the estimated regression coefficient (i.e., 2.71828… raised to the coefficient), and a confidence interval around the odds ratio. The odds ratio is interpreted as the odds that the infant weight status is above the 85^{th} percentile (vs. below the 85^{th} percentile) for a given value of the independent variable. A *p* value of .05 was used for two-tailed significance testing.

Bivariate linear (ordinary least squares) regression was applied to the WFL percentiles outcome measures, which is continuous. This analysis was performed as a sensitivity check to test whether the results derived from the bivariate logistic regression might be biased by "information loss" which can occur when one imposes a threshold on an outcome variable's distribution, as was done in applying the cut-point of the 85^{th} percentile of the infant weight status to achieve the binary measure. In this case, a measure that contained a broad range of values (i.e., percentiles) was collapsed to two: above the threshold versus at or below the threshold. This loss of information may translate to error when the threshold is somewhat arbitrary—that is, does not have robust clinical underpinnings. In this study, the binary measure (above the 85^{th} percentile vs. at or below) increases interpretability of the results. The linear regression models test how "sensitive" those results are to the removal of the threshold—in other words, using the full distribution of infant weight status percentiles. The direction and statistical significance of the results of the linear regression models were not noticeably different to those derived from the logistic regression models. This suggests that the imposition of the 85^{th} percentile threshold did not materially affect the results.

A second sensitivity analysis evaluated the effect of eliminating two outlier observations in which the baby's weight-for-length percentile appeared inconceivably low. All analyses were re-estimated with the two observations omitted ($N = 86$). The results were consistent with those generated by the full, 88-observation sample. Therefore, models were reported with the entire sample.

First, bivariate logistic regression models were applied, in which the dependent variable was regressed on individual independent variables, and statistical significance was noted. A proposed second step involved estimating a multivariable model, in which significant variables from the first-step bivariate regressions would be entered into a multivariable model. Such an approach was proposed because the small sample size (and limited degrees of freedom) would not permit inclusion of numerous independent variables. Since the results of the bivariate models indicated few significant variables, with only one variable robustly related to the outcome, only bivariate models are presented.

4.4 RESULTS

Table 1 provides descriptive data on the mother-child dyads. The full sample (N=88) is described, as well as sub-samples by feeding practice: breast-only (n=7), formula only (n=21), and both breast and formula (n=60). IFSQ total scores and sub-scores are presented for reference only, as they are not normed to any standard.

Just over 2 of every 5 children (43.2%) in the total sample were >85th weight-for-length percentile for sex. Regarding feeding practices, most of the sample fed both formula and breastmilk (68.2%), while only 8% were fed by breast-only, and 23.8% by formula only. Although less than half of the mothers stated they did not supplement with other food, and more than half stated they did not give other liquid, juice, or cereal in the bottle, 59% stated they did supplement with solids. Only a small percentage of mothers reported feeding pressure from the father, grandmother, or other relative.

The average age of the mothers in the total sample was 28.5 years. The majority were born in El Salvador, lived, on average, 10.1 years in the US and stated that Spanish was their primary language. More than one-third of mothers graduated from high school or pursued some higher education. Most of the mothers were married, and the mean BMI of 27.4 among mothers was in the overweight category. Approximately one-fifth of the sample had GDM. Just under half of the mothers had no health insurance and were not employed. Regarding relatives living in the home, most of the fathers were present, approximately one third had a grandmother present, and under one third had another relative present. Of the full sample of babies, 54.5% were male. Average infant birthweight in kilos was 3.36 (7.5 pounds), and average age at the well-visit was 10.5 months. Demographic and physiologic variables for the subsamples of breast only, formula only, and breast and formula mother-infant dyads are also reported in Table 1.

Bivariate analyses

Table 2 contains the results of logistic regression analyses that investigate the association between infant weight status as a binary outcome measure by applying the cut-point of the 85^{th} percentile and the explanatory variables. Linear regression models did not reveal any significant findings (data not shown).

Maternal Feeding Practices. Aim 1 tested the association between infant weight status ($>85^{th}$ weight-for-length percentile for sex) and maternal feeding practices during the first 5 months of life. The hypothesis was that infant weight status at the 9-12-month visit would be associated with maternal feeding practices during the infant's first 5 months of life. The results did not indicate that any of the maternal feeding practice variables were statistically significant correlates of infant weight status $> 85^{th}$ percentile. One family feeding-practice variable, father pressures during feeding, approached statistical significance ($p = .076$). Babies whose fathers pressured had roughly four and a half times the odds of being above the 85th weight-for-length percentile than babies whose fathers did not pressure feed did [Odds Ratio (OR) = 4.5; 95% Confidence Interval (CI) = 0.85, 23.71)]. The wide confidence interval suggests a large margin for error and is the result of the low proportion of babies whose fathers pressured during feeding (n=8), as well as the rarity of its intersection with the presence of the outcome state (i.e., WFL percentile > 85). Whereas an odds ratio can be calculated when only a few observations fall into the intersection of those two cells, the corresponding confidence of the estimate is low. See Table 2.

Maternal Feeding Beliefs/Behaviors and Constructs. Aim 2 evaluated the association between infant weight status (>85th weight-for-length percentile for sex) and maternal feeding behaviors/beliefs during the first 5 months of the infant's life measured by scores on the *IFSQ Beliefs* and *Behaviors* subscales, as well as domain-specific subscales. The hypothesis was that infant weight status at the 9-12-month visit would be associated with maternal feeding behaviors and beliefs in the infant's first 5 months of life. The results do not suggest an association between the outcome and maternal beliefs/behaviors. The four feeding constructs: laissez faire, pressuring, restrictive, and responsive feeding behaviors were not significantly associated with weight status. Neither the total *IFSQ* score nor the Beliefs subscale score or the Behaviors subscale score were statistically significant correlates of infant weight status. See Table 3.

Maternal Physiologic Risk Factors and Infant Factors. Aim 3 assessed the association between infant weight status (>85th weight-for-length percentile for sex) and maternal and baby physiologic risk factors. The hypothesis was that infant weight status at the 9-12-month visit would be associated with a history of maternal and baby physiologic risk factors. The results indicate that infant birthweight, in kilograms, is significantly positively associated with WFL percentile > 85th percentile at the well-visit. For each additional unit (kilo), the odds of being above the 85th percentile increase by nearly 3 times (OR = 2.88; 95% CI = 1.25, 6.59). No other maternal or baby physiologic risk factors were significantly associated with infant weight status. See Table 4.

4.5 DISCUSSION

The primary aims of this cross-sectional, correlational study were to explore the potential associations of infant weight status > 85th percentile at 9-12-months to early infant feeding practices and behaviors during the first five months of life, maternal feeding beliefs, and maternal physiologic factors in a modest sample of Salvadoran mother-infant dyads. The association of each domain of factors with infant weight status at the 9-12-month visit was determined, and multiple logistic regression was used to test these associations. Infant feeding practices and behaviors in the first five months, maternal beliefs, and maternal physiologic risk factors were not found to be significantly associated with infant weight status. Within sociodemographic factors, after controlling for each of the other variables, no significant association was found between maternal age, insurance type, income, education, and marital status with infant WFL > 85th percentile at the 9-12-month well-visit. Despite these findings, 43% of the total infant sample (males = 48; females = 40) was > 85th weight-for-length percentile for sex at the 9-12-month well-visit. Infant birth weight (kg) was the only statistically significant variable associated with WFL > 85th percentile at this time.

Infant feeding practices during the first five months of age did not correlate to infant weight of > 85th percentile at the 9-12-month visit in our sample. Feeding practices included breast only, formula only, both breast and formula, other liquids (e.g. apple juice), complimentary feedings, and the addition of cereal in the bottle. Feeding pressure by family members, specifically the father, grandmother, or another person in the household was also measured. The variable, *father pressures during feeding*, approached statistical significance (p = .076). However, the wide confidence interval suggests a large margin for error, and the sample of fathers was quite small. Research studies examining the influence of fathers on early childhood feeding practices are very limited. For example, Wong and colleauges (2017) assessed father's involvement in meal preparation against their child's BMI z-scores at 2 years of life, however feeding pressure was not measured. In another study that tested the effectiveness of an educational intervention on responsive maternal infant feeding practices that discouraged pressure feeding, fathers were not included (Savage et al., 2018).

Research examining associations between early infant feeding practices and infant-child weight status have produced inconsistent findings. Comparing breastfeeding rates to child weight status in 12-to-24-month old Mexican American children, Barroso and colleagues (2012) found no difference in WFL z-scores (p=.496) between children that were breastfed and those that were not. In studies using WFL > 85^{th} percentile, no association of infant overweight to breastfeeding after delivery or breastfeeding until 6 months (p=.672, p=.424, respectively) was found in 12-month infants in a predominantly Hispanic sample (98%) (Terling Watt, Appel, Roberts, Flores, & Morris, 2013), and in Latino infants between 4-12-months, when comparing non-exclusive breastfeeding to formula feeding (p=.76, p=.98, respectively) (Cartagena et al., 2016). The null findings in these studies comparing infant weight in breastfed versus formula fed infants in Latino populations support the findings in our sample of Salvadoran infants and suggest that early breastfeeding instead of formula may not be protective against later infant overweight or obesity in this population.

Nevertheless, in larger studies, significant associations between early infant feeding and child weight status were evident. By the age of 24 months, infants up to 6 months of age receiving mainly formula had more than twice the rate of obesity (≥ 95th percentile), and infants receiving breast and formula had 1.8 times the rate of obesity compared to infants receiving mostly breast milk in a study with a 20% Latino sub-sample (*n*=1630) (Gibbs & Forste, 2013). The following studies did not define "other" in their description of ethnicity in the sample; therefore, the percentage of Hispanic or Latino participants, if any, is unknown. Using BMI z-scores > 2 to define overweight at 12 months, Azad and colleagues (2018) observed that infants not breastfeeding at 6 months had 3 times the risk of being overweight at 12 months compared to infants who were exclusively breastfed for ≥ 3 months. Similarly, in a large Dutch sample (*N*=2475) at 6 months, infants fed formula during the first 6 months had higher WFL z-scores than breastfed infants during the same time period. From 6-to-12-months, higher WFL z-scores were noted with combined breast and formula feeding (Kupers et al., 2015). Others noted higher BMI percentiles at 24 months in children not breastfed compared to children who had been breastfed for ≥ 6 months (Wang et al., 2017), and in children who were never breastfed versus those who were ever breastfed (Moss & Yeaton, 2014).

Research findings regarding the introduction of solids under 4 months and subsequent infant-child obesity are also inconclusive. Non-significant results were found in 6-month old infants in a small Hispanic sample (*n*=65, 6%) (Taveras et al., 2009), and at 6 years, after adjusting for covariates which included maternal BMI (Barrera, Perrine, Li, & Scanlon, 2016). Similarly, a prospective study without a Hispanic sample did not find that exclusive breastfeeding versus never breastfeeding in the first 4 months, introduction of solids < 4 months, and introduction of liquids < 6 months, were predictive of a BMI ≥ 85th percentile at 5 years after adjusting for multiple covariates (p=0.68) (Burdette, Whitaker, Hall, & Daniels, 2006). Yet, others found that introducing solids prior to 4 months was linked to a higher obesity rate by 24 months (Gibbs & Forste, 2013; Moss & Yeaton, 2014) compared to children who received solids from 4-5-months or ≥ 6 months; and introducing solids < 5 months resulted in higher BMI z-scores at 12-months compared to starting solids between 5 and 6 months (Azad et al., 2018). In a sample of African American mothers, the feeding of complimentary foods deemed "inappropriate" was measured at 5 different time points: 3, 6, 9,12, and 18 months through feeding recall by the mother, and was found to be predictive of WFL > 90th percentile at 12-18 months (Thompson & Bentley, 2013). These foods were age dependent and included infant cereal in the bottle < 3 months, juice before 6 months, and sugar sweetened beverages such as soda and iced tea by 12-18 months. Results of studies testing the association between the timing of solids and infant-child weight status are inconclusive and neither support nor refute our study's findings that the introduction of solids < 5 months is not predictive of infant overweight or obesity.

Maternal Beliefs and Behaviors. As previously stated, our results do not suggest an association between the outcome variable, infant weight status > 85th percentile, and maternal beliefs and behaviors. Neither the total *IFSQ* score, the Beliefs subscale score or the Behaviors subscale score, nor any of the four feeding constructs were statistically significant correlates of infant weight status. The *IFSQ* has been used in several studies to measure the prevalence of maternal feeding beliefs and behaviors believed to increase obesity risk in infants up to12 months of age (Cartagena et al., 2016; Dinkevich et al., 2015; Doub, Moding, & Stifter, 2015; Perrin et al., 2014; Savage et al., 2018). In one small study with Latino participants, findings revealed that maternal feeding beliefs and behaviors did not influence infant weight trajectories

(Cartagena et al., 2016). Others used the *IFSQ* to assess parental feeding styles, without measuring for infant overweight or obesity. Perrin and colleagues (2014) tested parents' feeding behaviors in children up to 24 months in their Greenlight study (50% Hispanic sub-sample, n=430) with previously validated *IFSQ* questions. Common feeding behaviors believed to be associated with infant-child weight gain were more prevalent in the Hispanic sub-sample such as, encouraging the child to finish the bottle during almost every feeding (69%) and immediately feeding infants when crying (47%), than in white or black parents. Watching television while feeding (37%) was the least common in the Hispanic sub-group compared to white or black parents. In a mostly white sample of mothers, the *IFSQ* examined maternal feeding styles as predictors of the timing of the introduction of solids in infants between 4-to-6 months of age (Doub et al., 2015), where the only significant feeding style associated with the introduction of solids < 6 months was the *Pressuring: Cereal feeding* style ($p < .01$). Finally, specific constructs of the *IFSQ* were used to measure parents' feeding practices after the implementation of an infant obesity prevention intervention that stressed responsive parenting (RP) during the first year of life (Savage et al., 2018). At 7 months, mothers in the RP group were less likely to use *pressure to finish, pressure to soothe with feeding,* and *pressure with cereal* (<.0001, <.0001, <.0003, respectively), than mothers in the control group, thus supporting the responsive parenting intervention. Dinkevich and colleagues (2015) used a similar instrument, the *Infant Feeding Questionaire (IFS*), in a mostly African American sample of low-income mothers with infants aged 6-to-12 months, to measure maternal feeding behaviors and concerns and subsequent weight gain. At the time of the infants' enrollment in the study, between 6-to-12 months of age, higher scores on *Restrictive Feeding* and *Concern About Overeating/Weight* were predictive of higher WFL z-scores (p=.001, p=.002, respectively).

Although the *IFSQ* has been implemented and validated in several studies within different racial groups, it has been used sparingly with Spanish-speaking clients (Cartagena et al., 2016; Perrin et al., 2014). Thus, further validation on the usefulness of this tool in Spanish speaking clients is justified.

Among **maternal physiological risk factors**, pre-pregnancy BMI, pregnancy weight gain, and a history of GDM mellitus were not significantly associated with infant weight status of > 85^{th} percentile in our study. One possible reason for the null findings in this category of variables could be due to an underreporting of pre-pregnancy weight and pregnancy weight gain by the mothers because this information was self-reported and not verified by an actual measurement at the time of data collection. Contrary to our findings, several larger studies had significant results. Maternal obesity and formula feeding were predictive of higher weight z-scores, and a greater trajectory of weight gain in 6-month old infants from lower-income areas in the UK (Patel et al., 2018). In low-income Mexican-American children between the ages of 12-24-months, (*N*=372), where maternal weight and height were obtained by objective measurements instead of through mother's recall, child weight status was found to be ≥ 85^{th} WFL percentile in children of overweight mothers compared to children of normal weight mothers (Barroso et al., 2012). Similarly, a study in low income WIC participants with a small Hispanic sub-sample (*n*=207, 2.4%) that retrieved maternal weight and height from the prenatal electronic health record found obesity to be significant at 2, 3, and 4 years of age in children of mothers who were obese in the first trimester of pregnancy (Whitaker, 2004). At each age group, the Hispanic sample of children had the highest percentage of obesity compared to non-Hispanic black, non-Hispanic white, and other children (Whitaker, 2004). In other studies with self-reported weight and measured height, maternal BMI was predictive of childhood obesity ≥ 95^{th}

percentile at 24 months (Fuemmeler et al., 2016; Gibbs & Forste, 2013). Mothers with a pre-pregnancy BMI ≥ 40 kg/m^2 had babies 8% larger (p = 0.02) at 24 months than babies born to mothers of normal weight; between these two groups of mothers, accelerated infant growth was noted at 8-to-9 months, but not before (Fuemmeler et al., 2016). No correlation between maternal pre-pregnancy BMI and WFL z-scores was found in a Dutch study (N=2475) that examined possible determinants of weight gain patterns in infants in the first 2 years of life (Kupers et al., 2015). Contrary to our study's findings, the majority of these studies had significant results. It is possible that testing a larger sample can more effectively parse out the contributions of maternal risk factors on future infant-child weight gain. Moreover, measuring maternal weight and height may provide more accurate data than obtaining maternal weight and height retrospectively through self-report.

Although neither pregnancy weight gain nor a history of GDM predicted infant overweight in our study, data on our participants with GDM (n=18) (OR = 1.88; 95$^{\%}$ CI = 0.66, 5.33) suggested a positive direction in the odds of the baby's weight being > 85th percentile at 9-12-months compared to mothers not having GDM. Studies measuring the effects of pregnancy weight gain and GDM on infant WFL percentiles are sparse and inconclusive. In a study by Fuemmeler et al. (2016), children of mothers with GDM were 13% larger (p < 0.0001) in the first 24 months than children whose mothers did not have GDM, and growth curves were 5% higher in children of mothers who had more than the required pregnancy weight gain allowance (p = 0.04) compared to children of mothers with adequate weight gain, after controlling for confounding variables such as pre-pregnancy BMI. However, others found no correlation between GDM and 6-month infant WFL z-scores (Taveras et al., 2009), or between GDM, pregnancy weight gain and 2-year infant WFL z-scores (Kupers et al., 2015). The presence of

GDM and pregnancy weight gain in our study could have been underreported due to the mothers' inability to accurately recall this information at the 9-to-12-month well-baby visit.

In our study, infant birth weight (kg) was the only statistically significant variable associated with WFL > 85th percentile at the 9-to-12-month well-visit. Several studies share similar findings. In the study by Kupers and colleagues (2015), a positive association was found between the prenatal domain, i.e., birth weight and weight-for-length in infants from 6-to-12 months. Similarly, using child BMI ≥ 95th percentile, studies by Whitaker et al. (2004) and Gibbs and Forste (2013) found statistically significant associations between higher birth weights and a greater prevalence of child obesity by 24 months. Finally, significant correlations were found in studies examining birth WFL z-scores and BMI z-scores at 3 years of age (Taveras et al., 2009) and infant birthweight and the prevalence of obesity at 6 years of age (Barrera et al., 2016). Nevertheless, since infant feeding quantity and frequency was not measured prior to 6 months, nor diet type and quantity after 6 months, infant diet could be a potential confounder.

Although sociodemographic variables in this sample were not associated with infant weight status of > 85th percentile, being married (OR = 2.00; 95% CI = 0.37,10.91), having no insurance (OR = 1.81; 95% CI = 0.40, 8.26), having public insurance (OR= 1.39; 95% CI = 0.30, 6.40), and being unemployed (OR = 1.58; 95% CI = 0.61, 4.09), suggest a positive trend in the odds of the baby being > 85th percentile compared to not being married, having private insurance, and having part-time or full-time employment. Studies in low-income Hispanic mother-infant dyads, did not find maternal demographic factors such as maternal age and level of education to be predictive of child WFL z-scores in children aged 12-24 months (Barroso et al., 2012), or in infants aged 4-to-12 months (Cartagena et al. (2016). However, a study by Terling Watt and colleagues (2013) did find a significant correlation between mothers receiving SNAP, a food stamp program funded by Medicaid, and infant obesity through 12 months of age in a low-income Hispanic sample. This was also the case in which lower SES scores were found to be directly linked to increased formula feeding and subsequent higher rates of obesity in 24 month old children (Gibbs & Forste, 2013). It is possible that the small sample size in our study contributed to the overall null findings in this category of variables.

This study has several strengths. First, it examined multiple variables that have not been commonly studied concurrently in previous studies: infant feeding practices up to 5 months; maternal feeding beliefs and behaviors; and maternal physiologic and factors. Second, it examined these variables in a major subgroup of the Latino population in the US that has not been studied to date, Salvadoran mother-infant dyads. Third, infant birth weight and weight-for-length status at the 9-12-month well-visit were based on objective measurements, ensuring a greater degree of accuracy than if the data had been reported by the mother. Finally, we used a theory guided approach to select the target variables and included determinants believed to be predictive of weight gain in infants. Current research suggests that the causes of obesity in Latino children are multifaceted and that this problem is best addressed by adopting a broad, multi-dimensional perspective that considers the complex, but changing, cultural and social milieu in which Latinos live (Ndiaye et al., 2013; Williams, Kabukuru, Mayo, & Griffin, 2011). Because of these considerations, the ecological model was selected to guide the design of this study.

Limitations of the study include data collection from a small sample of Salvadoran mother-infant dyads (N=88) from two pediatric offices in suburban Long Island, thereby limiting generalizability to the other Latino populations in the US. The relatively small sample of homogenous participants may not have provided enough power to detect significant differences in infant overweight status. Additionally, the *IFSQ* and *IFS* were self-reported measures on infant feeding behaviors/beliefs and practices subject to recall bias since the information about the infants' first 5 months of life was collected retrospectively at the 9-12-month well-visit. The type of data collection was restrictive in that most of the questions on feeding practices required a yes/no response. Because all infants at the time of the study visit were receiving solid foods of varying types and amounts, it may have been difficult to accurately recall past feeding practices, such as duration of breastfeeding exclusivity or timing and types of solids within the first 5 months. In addition, quantity and frequency of feeding type within the first 5 months, e.g., the number of ounces of formula fed to formula-only infants, were not measured and doing so would have likely increased the potential for recall error as well as reduced participation due to greater time constraints. There was also the likelihood of recall bias of maternal physiologic risk factors, especially with self-reported pre-pregnancy weight and pregnancy weight-gain. Social desirability bias, or underreporting of potentially negative responses, may have occurred due to the possible tendency of participants to offer responses that meet professional expectations in order to present a favorable image of themselves (Polit & Beck, 2008).

In our study, only the *IFSQ* behaviors subscale and the pressuring behavior subscale had acceptable Cronbach alphas, 0.80 and 0.83, respectively. One possible reason for a low internal consistency in the other subscales could be due to fewer relevant questions for this age group of infants, e.g. questions referred to the feeding practices of toddlers (Polit & Beck, 2008; Wood et al., 2016). Moreover, although this tool is available in Spanish and has been tested in Latino populations (Cartagena et al., 2016; Perrin et al., 2014), it has never been tested with the Salvadoran population, and therefore variations within this group may not have been detected with this tool.

Finally, feeding frequency and amount was not measured prior to 6 months, nor was diet type, frequency and amount from 6-to-12-months of the infant's life. Poor diet quality and quantity during the first year of life is believed to contribute to child obesity in later years (Roess et al., 2018). Starting at 3 months of age up to 18 months, the intake of juice, soda, and tea has been seen to increase exponentially while the consumption of formula remained constant and the consumption of breastmilk diminished significantly (Thompson & Bentley, 2013). Another study examined 24-hour dietary patterns in infants aged 6-months-to-11.9-months (*n*=902), with a Hispanic sample of *n*=125. Within the total sample, there was a 34% intake of sweets and sugar-sweetened drinks (e.g., cakes, cookies, doughnuts, and sweetened beverages) and a 77% intake of snacks (e.g. chips, popcorn, and non-infant puffs) (Roess et al., 2018). From 6-to-12 months of age, a greater variety of acceptable foods are introduced, and the infant's feeding autonomy increases, often allowing for less than ideal dietary practices and weight gain. These findings suggest that consumption of inappropriate foods by infants after 6-months of age may place the child on an unhealthy growth trajectory. Considering that 43% of the total infant sample in our study was > 85th WFL percentile for sex at the 9-12-month well-visit, it may have been prudent to calculate infant BMI sooner in order to capture the potential for excess weight gain at the 6-month cut-point. Other researchers have found WFL > 85th percentile at 6 months to be predictive of future obesity (Smego et al., 2016). Moreover, future studies should examine infant dietary patterns from 6-to-12-months in addition to feeding practices during the first 6 months to obtain a more thorough assessment of the growth trajectory during the first year of life.

4.6 CONCLUSION

The results of this study did not indicate an association between infant feeding practices up to 5 months or maternal feeding beliefs or risk factors and infant weight status at 9-to-12-months in a sample of Salvadoran mother-infant dyads; however, birth weight was associated with WFL > 85^{th} percentile at this time. To date, the literature on risk factors of child obesity has focused primarily on children of Mexican descent (Adair, 2008; Dennison et al., 2006; Kumanyika, 2008); this is the first study to look at this phenomenon in the Salvadoran population. Since 43% of the sample was found to have a WFL > 85^{th} percentile by the 9-to-12-month visit, future studies should examine infant feeding patterns from 6-to-12-months in addition to feeding practices during the first 6 months to obtain a more complete picture of the growth trajectory during the first year of life. Additionally, future investigations in Salvadoran infants should assess infant weight at 6 months, as well as at 12-months, to assess weight trajectory. In doing so, anticipatory guidance targeting this age group could address potential barriers to healthy feeding behaviors and assist parents in promoting healthy feeding practices in their children (Norlin, Crawford, Bell, Sheng, & Stein, 2011; Sege, 2011).

Acknowledgments

We would like to thank Dr. William Gallo for his expertise with the statistical measures. We thank Dr. Juan Espinoza and Dr. David Sanchez, the pediatricians that made this study possible by allowing the recruitment of potential participants in their offices. We thank Natasha Sanchez and the office staff at the two pediatric offices for their timely assistance with patient recruitment. Finally, we thank the participants of this study for their willingness to share their experiences on infant feeding practices and beliefs.

Table 1.

Description of the Sample: Full Sample and by Feeding Practice

	Full sample (*N*=88)		Breast only (*n*=7)		Formula only (*n*=21)		Both (*n*=60)	
Mother's Physiologic and Demographic Characteristics								
Age*	28.5	5.9	30.9	8.8	27.3	6.1	28.6	5.5
Place of birth								
U.S. born	5	5.7%	1	14.3%	2	9.5%	2	3.3%
Salvadoran born	83	94.3%	6	85.7%	19	90.5%	58	96.7%
Years in the U.S.*	10.1	6.3	12.4	9.7	9.9	6.0	9.9	6.0
Primary language								
English	4	4.6%	1	14.3%	2	9.5%	1	1.7%
Spanish	84	95.4%	6	85.7%	19	90.5%	59	98.3%
Education*								
Less than HS graduate	55	62.5%	3	42.9%	14	66.7%	38	63.3%
HS graduate/higher	33	37.5%	4	57.1%	7	33.3%	22	36.7%
Marital status								
Unmarried	7	7.9%	0	0.0%	2	9.5%	5	8.3%
Married	81	92.1%	7	100%	19	90.5%	55	91.7%
Pre-pregnancy weight*	152.1	31.8	167.3	28.3	151.9	34.6	150.3	31.3
Weight gain*	27.2	16.1	22.3	15.9	28.8	16.9	27.2	16.0
BMI*	27.4	5.3	29.6	5.3	27.5	6.1	27.1	5.0
Gestational diabetes								
No GDM	70	79.5%	4	57.1%	17	80.9%	49	81.7%

	Full sample (*N*=88)		Breast only (*n*=7)		Formula only (*n*=21)		Both (*n*=60)	
GDM	18	20.5%	3	42.9%	4	19.1%	11	18.3%
Insurance status								
None	40	45.5%	3	42.9%	8	38.1%	29	48.3%
Public	39	44.3%	3	42.9%	10	47.6%	26	43.3%
Private	9	10.2%	1	14.3%	3	14.3%	5	8.3%
Employment status								
Not employed	41	46.6%	6	85.7%	7	33.3%	28	46.7%
Part-time	17	19.3%	1	14.3%	7	33.3%	9	15.0%
Full-time	30	34.1%	0	0.0%	7	33.3%	23	38.3%
Relative present								
Father present	80	90.9%	7	100%	19	90.5%	54	90.0%
Grandmother present	27	30.7%	2	25.6%	9	42.9%	16	26.7%
Other present	26	29.6%	4	57.1%	3	14.3%	19	31.7%
Baby Demographics								
Gender								
Male	48	54.5%	4	57.1%	12	57.1%	32	53.3%
Female	40	45.5%	3	42.9%	9	42.9%	28	46.7%
Other variables								
Birthweight in kg*	3.4	0.6	3.6	0.6	3.3	0.6	3.4	0.5
Birthweight in lbs*	7.5	1.2	7.67	1.21	7.19	1.4	7.4	1.2
Current weight in lbs*	21.6	3.1	22.9	3.0	21.9	3.8	21.5	2.9

	Full sample (N=88)		Breast only (n=7)		Formula only (n=21)		Both (n=60)	
Age in months*	10.5	1.4	10.9	1.5	11.2	1.5	10.3	1.4
Babies @ 9-month visit	45	51%	3	43%	6	28.6%	36	60%
Babies @ 12-month visit	43	49%	4	57%.	15	71.4%	24	40%
Baby's Overweight Status								
>85th percentile	38	43.2%	5	71.4%	7	33.3%	26	43.3%
< =85th percentile	50	56.8%	2	28.6%	14	66.7%	34	56.7%
Mean WFL Percentile*	72.7	24.4	84.2	16.9	68.7	27.1	72.63	23.9
Feeding Practices								
Primary Feeding Practices								
Breast only	7	8.0%	7	100%	-	-	-	-
Formula only	21	23.8%	-	-	21	100%	-	-
Both	60	68.2%	-	-	-	-	60	100%
Supplementary Feeding								
No other food	37	42.0%	3	42.9%	7	33.3%	27	45.0%
Other food	51	58.0%	4	57.1%	14	66.7%	33	55.0%
No other liquid	58	65.9%	5	71.4%	15	71.4%	38	63.3%
Other liquid	30	34.1%	2	28.6%	6	28.6%	22	36.7%
No juice	58	65.9%	5	71.4%-	15	71.4%	20	33.3%-
Apple juice	23	26.1%	2	28.6%-	3	14.3%-	18	30.0%
Other juice	7	8.0%	0	0.0%	3	14.3%	22	36.7%
No solids	36	40.9%	3	42.9%	6	28.6%	27	45.0%
Solids	52	59.1%	4	57.1%	15	71.4%	33	55.0%

	Full sample (N=88)		Breast only (n=7)		Formula only (n=21)		Both (n=60)	
No cereal in bottle	50	56.8%	5	71.4%	9	42.9%	36	60.0%
Cereal in bottle	38	43.2%	2	28.6%	12	57.1%	24	40.0%
Feeding Pressure								
Father pressures	8	9.1%	2	28.6%	2	9.5%	4	6.7%
Grandmother pressures	1	1.1%	0	0.0%	1	4.8%	0	0.0%
Other pressures	1	1.1%	0	0.0%	0	0.0%	1	1.7%
IFSQ Beliefs and Behaviors								
Behaviors score* (28-140)	62.2	6.8	62.4	8.5	65.1	7.4	61.2	6.1
Beliefs score*(23-115)	60.0	7.7	61.9	4.6	63.0	7.0	58.7	8.0
Total score*	122.2	11.3	124.3	12.5	128.1	10.8	119.9	10.7
Feeding Constructs								
Laissez faire* (11-55)	20.3	4.0	20.4	5.6	21.0	3.9	20.0	3.8
Pressuring* (17-85)	47.2	10.1	52.6	6.7	50.9	11.2	45.2	9.6
Restrictive* (11-55)	29.9	2.6	28.2	4.8	30.3	2.4	29.9	2.4
Responsive* (12-60)	25.0	5.4	21.9	1.1	36.0	6.3	25.1	5.3

*Frequencies and percentages are presented for all variables except those noted with an asterisk (*), for which means and standard deviations are presented.

Note. IFSQ=Infant Feeding Styles Questionnaire; IFSQ Behaviors and Beliefs: Lower scores represent healthier feeding beliefs/behaviors); WFL=Weight for Length; GDM=Gestational Diabetes Mellitus; HS=High School

Table 2.

Association Between Infant Overweight Status and Maternal Feeding Practices

	OR (95% CI)
Breast only	ref.
Formula only	0.20 (0.03, 1.30)
Both	0.31 (0.06, 1.70)
No other food	ref.
Other food	0.68 (0.29, 1.60)
No other liquid	ref.
Other liquid	0.85 (0.35, 2.10)
No juice	ref.
Apple juice	0.82 (0.31, 2.21)
Other juice	0.96 (0.20, 4.69)
No other solids	ref.
Solids	0.52 (0.22, 1.22)
No cereal in bottle	ref.
Cereal in bottle	0.54 (0.23, 1.30)
Feeding pressure	
Father pressures	4.5 (0.85, 23.71)
Father does not pressure	ref.
Grandmother pressures	1.0 (0.00, 0.00)
Grandmother does not pressure	ref.
Other relative pressures	1.0 (0.00, 0.00)
Other relative does not pressure	ref.

Table 3.

Association Between Infant Overweight Status and Mother's Physiology and Demographics

	OR (95% CI)
Age	1.02 (0.95, 1.10)
Place of birth	
U.S. born	ref.
Salvadoran born	0.77 (0.10, 5.70)
Years in the U.S.	1.00 (0.94, 1.07)
Primary language	
English	ref.
Spanish	0.75 (0.10, 5.58)
Education	
Less than HS graduate	ref.
HS graduate or higher	0.95 (0.40, 2.28)
Marital status	
Unmarried	ref.
Married	2.00 (0.37, 10.91)
Pre-pregnancy weight	1.00 (0.99, 1.02)
Weight gain	1.00 (0.98, 1.03)
BMI	1.03 (0.95, 1.12)
Gestational diabetes mellitus	
No GDM	ref.
GDM	1.88 (0.66, 5.33)
Insurance status	

None	1.81 (.40, 8.26)
Public	1.39 (.30, 6.40)
Private	ref.
Employment Status	
Not employed	1.58 (0.61, 4.09)
Part-time	0.63 (0.18, 2.23)
Full-time	ref.
Relative present	
Father present	0.74 (0.17, 3.17)
Father not present	ref.
Grandmother present	0.55 (0.21, 1.42)
Grandmother not present	ref.
Other present	0.60 (0.23, 1.56)
Other not present	ref.
Baby Demographics	
Gender	
Female	1.67 (0.71, 3.91)
Male	ref.
Other variables	
Birthweight in kg.	2.88 (1.25, 6.59) *
Age in months	1.33 (0.99, 1.80)

Table 4.

Association Between Infant Overweight Status and IFSQ Behaviors and Beliefs

Behaviors	1.02 (0.95, 1.08)
Beliefs	1.00 (0.95, 1.06)
Total	1.01 (0.97, 1.05)
Feeding Constructs	
Laissez faire	0.94 (0.84, 1.05)
Pressuring	1.00 (0.96, 1.04)
Restrictive	1.01 (0.86, 1.19)
Responsive	1.07 (0.99, 1.16)

Insufficient power (i.e. prevalence too low) to generate estimated logistic regression coefficient.

**p*<.05.

Note. Ref = Reference Group; OR=Odds Ratio; CI=Confidence Interval; IFSQ=Infant Feeding Styles Questionnaire; WFL=Weight for Length; BMI = Body Mass Index; HS=High School; kg=kilograms; GDM=Gestational Diabetes Mellitus

References

Adair, L. S. (2008).Child and adolescent obesity: Epidemiology and developmental perspectives. *Purdue University Ingestive Behavior Research Center Symposium. Influences on Eating and Body Weight over the Lifespan: Childhood and Adolescence, 94*(1), 8-16. doi:http://dx.doi.org.authenticate.library.duq.edu/10.1016/j.physbeh.2007.11.016

Ahluwalia, I., D'Angelo, D., Morrow, B., & McDonald, J. (2012).Association between acculturation and breastfeeding among Hispanic women: Data from the pregnancy risk assessment and monitoring system. *Journal of Human Lactation, 28*(2), 167-173.

American Academy of Pediatrics. (2012).Section on breastfeeding: Breastfeeding and the use of human milk. *Pediatrics, 115*, 496-506.

Anderson, S. E., & Whitaker, R. C. (2009).Prevalence of obesity among us preschool children in different racial and ethnic groups. *Archives of Pediatric & Adolescent Medicine, 163*. doi:10.1001/archpediatrics.2009.18

Azad, M. B., Vehling, L., Chan, D., Klopp, A., Nickel, N. C., McGavock, J. M., . . . Subbarao, P. (2018).Infant Feeding and weight gain: Separating breast milk from breastfeeding and formula from food. *Pediatrics, 142*(4). doi:10.1542/peds.2018-1092

Barlow, S. E. (2007).Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: Summary report. *Pediatrics, 120*(Supplement 4), S164.

Barrera, C., Perrine, C., Li, R., & Scanlon, K. (2016).Age at introduction to solid foods and child obesity at 6 years. *Childhood Obesity, 12*(3), 188-193.

Barroso, C. S., Roncancio, A., Hinojosa, M. B., & Reifsnider, E. (2012).The Association between early childhood overweight and maternal factors. *Childhood Obesity, 8*(5), 449-454. doi:10.1089/chi.2011.0094

Bowers, K., Laughon, S., Kiely, M., Brite, J., Chen, Z., & Zhang, C. (2013).Gestational diabetes, pre-pregnancy obesity and pregnancy weight gain in relation to excess fetal growth: Variations by race/ethnicity. *Diabetologia, 56*, 1263-1271.

Burdette, H. L., Whitaker, R. C., Hall, W. C., & Daniels, S. R. (2006).*American Journal of Clinical Nutrition, 83*(null), 550.

Cartagena, D., Ameringer, S., McGrath, J., Jallo, N., Masho, S., & Myers, B. (2014).Factors contributing to infant overfeeding with Hispanic mothers. *Journal of Obstetric, Gynecologic, and Neonatal Nursing, 43*(2), 139-159. doi:10.1111/1552-6909.12279

Cartagena, D., McGrath, J., & Masho, S. (2016).Differences in modifiable feeding factors by overweight status in Latino infants. *Applied Nursing Research, 30*, 210-215. doi:http://dx.doi.org/10.1016/j.apnr.2015.09.005

Dennison, B. A., Edmunds, L. S., Stratton, H. H., & Pruzek, R. M. (2006).Rapid Infant weight gain predicts childhood overweight. *Obesity, 14*(3), 491-499. doi:10.1038/oby.2006.64

Dinkevich, E., Leid, L., Pryor, K., Wei, Y., Huberman, H., & Carnell, S. (2015).Mothers' feeding behaviors in infancy: Do they predict child weight trajectories? *Pediatric Obesity, 23*(12), 2470-2476.

Doub, A. E., Moding, K. J., & Stifter, C. A. (2015).Infant and maternal predictors of early life feeding decisions. The timing of solid food introduction. *Appetite, 92*, 261-268. doi:https://doi.org/10.1016/j.appet.2015.05.028

Faul, F., Erdfelder, E., Buchner, A., & , & Lang, A.-G. (2009).Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*, 1149-1160.

Freedman, D., Sharma, A., Hamner, H., Pan, L., Panzera, A., Smith, R., ... (2017).Trends in weight-for-length among infants in WIC from 2000 to 2014. *Pediatrics, 139*(1), 1-11. doi:DOI: 10.1542/peds.2016-2034

Fuemmeler, B., Wang, L., Iversen, E., Maguire, R., Murphy, S., & Hoyo, C. (2016).Association between pre-pregnancy body mass index and gestational weight gain with size, tempo, and velocity of infant growth: Analysis of the newborn epigenetic study cohort. *Childhood Obesity, 12*(3), 210-218.

Garrow, J. S. (1988). *Obesity and related diseases*. Edinburgh: Churchill Livingstone.

Gibbs, B. G., & Forste, R. (2013).Socioeconomic status, infant feeding practices and early childhood obesity. *Pediatric Obestiy, 9*, 135-146. doi:10.1111/j.2047-6310.2013.00155.x

Gill, S., Reifsnider, E., & Tinkle, M. (2004).Assessing Infant breastfeeding beliefs among low-income Mexican Americans. *Journal of Perinatal Education, 13*(3), 39-50.

Gross, R., Mendelsohn, A., Fierman, A., Hauser, N., & Messito, M. (2014).Maternal and infant feeding behaviors and disparities in early childhood obesity. *Childhood Obesity, 10*(2), 145-152.

Health, N. I. o. (nd). *Bmi calculator*. Bethesda, MD Retrieved from https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmicalc.htm.

Horodynski, M., Olson, B., Baker, S., Brophy-Herb, H., Auld, G., Van Egeren, L., . . . Singleterry, L. (2011).Healthy babies through infant-centered feeding protocol: An intervention targeting early childhood obesity in vulnerable populations. *BMC Public Health, 11*(1), 868.

Houston, K., Waldrop, J., & McCarthy, R. (2011).Evidence to guide feeding practices for Latino children. *The Journal for Nurse Practitioners, 7*(4), 271-275.

Hulley, S., Cummings, S. B., W., Grady, D., & Newman, T. (2013). *Designing clinical research: An epidemiologic approach* (4th ed.). New York: Lippincott Williams & Wilkins.

Institute of Medicine and National Research Council. (2009). *Weight gain during pregnancy: Reexamining the guidelines*. Washington, DC.: Rasmussen KM, Yaktine AL (eds).

Kuczmarski, R., Ogden, C., & Grummer-Strawn, L. (2000). *CDC growth charts: United States. Advance data from vital and health statistics; no 314.* Hyattsville, Maryland Retrieved from URL:www.cdc.gov/growthcharts.

Kumanyika, S. K. (2008).Environmental influences on childhood obesity: Ethnic and cultural influences in context. *Purdue University Ingestive Behavior Research Center Symposium. Influences on Eating and Body Weight over the Lifespan: Childhood and Adolescence, 94*(1), 61-70. doi:http://dx.doi.org/10.1016/j.physbeh.2007.11.019

Kupers, L., L'Abee, C., Bocca, G., Stolk, R., Sauer, P., & Corpeleijn, E. (2015).Determinants of weight gain during the first two years of life – the gecko drenthe birth cohort. . *PLoS One, 10*(7), 1-15.

Liu, G., Hannon, T., Rong, Q., Downs, S., & Marrero, D. (2015).The obesity epidemic in children: Latino children are disproportionately affected at younger ages. *International Journal of Pediatrics and Adolescent Medicine, 2*, 12-18. doi:http://doi.org/10.1016/j.ijpam.2015.03.004

Mayer-Davis, E., Dabelea, D., Lamichhane, A., D'Agostino, R., Liese, A., Thomas, J., . . . Hamman, R. (2008).Breast-Feeding and type 2 diabetes in the youth of three ethnic

groups: The search for diabetes in youth case-control study. *Diabetes Care, 31*(3), 470-475.
Morbidity and Mortality Weekly Report MMWR. (2013). *Progress in increasing breastfeeding and reducing racial/ethnic differences — United States, 2000–2008 births*.
Moss, B., & Yeaton, W. H. (2014).Early childhood healthy and obese weight status: Potentially protective benefits of breastfeeding and delaying solid foods. *Maternal Child Health Journal, 18*, 1224-1232.
National Academies of Sciences Engineering and Medicine. (2016). *Obesity in the early childhood years: State of the science and implementation of promising solutions: Workshop summary.* Washington, DC: The National Academies Press.
National Center for Chronic Disease Prevention and Health Promotion. (2014). *Chronic diseases: The leading causes of death and disability in the United States*. Atlanta, GA.
National Center for Health Statistics. (2012). *National diabetes fact sheet: National estimates and general information on diabetes and pre-diabetes in the United States, 2011. Atlanta, ga.* . Hyattsville, MD.
National League for Nursing. (2016). *Nln research priorities in nursing education 2016-2019*. Chamberlain College of Nursing: Center for the Advancement of the Science of Nursing Education Retrieved from http://www.nln.org/docs/default-source/professional-development-programs/nln-research-priorities-in-nursing-education-single-pages.pdf?sfvrsn=2.
Ndiaye, K., Silk, K. J., Anderson, J., Horstman, H. K., Carpenter, A., Hurley, A., & Proulx, J. (2013).Using an ecological framework to understand parent–child communication about nutritional decision-making and behavior. *Journal of Applied Communication Research, 41*(3), 253-274. doi:10.1080/00909882.2013.792434
Ogden, C. L., Carroll, M. D., Lawman, H. G., Fryar, C. D., Kruszon-Moran, D., Kit, B. K., & Flegal, K. M. (2016).Trends in obesity prevalence among children and adolescents in the United States, 1988-1994 through 2013-2014. *Journal of the American Medical Association, 315*(21), 2292-2299. doi:10.1001/jama.2016.6361
Owen, C. G., Martin, R. M., Whincup, P. H., Smith, G. D., & Cook, D. G. (2005).Effect of Infant Feeding on the risk of obesity across the life course: A quantitative review of published evidence. *Pediatrics, 115*(5), 1367-1377. doi:10.1542/peds.2004-1176
Patel, N., Dalrymple, K., Briley, A., Pasupathy, D., Seed, P., Flynn, A., & Poston, L. (2018).Mode of infant feeding, eating behavior and anthropometry in infants at 6-months of age born to obese women - a secondary analysis of the upbeat trial. *BioMed Central Pregnancy and Childbirth, 18*(355), 1-11.
Pearce, J., Taylor, M., & Langley-Evans, S. (2013).Timing of the introduction of complementary feeding and risk of childhood obesity: A systematic review. *International Journal of Obesity, 37*, 1295-1306.
Perez-Escamilla, R., & Kac, G. (2013).Childhood obesity prevention: A life-course framework. *International Journal of Obesity Supplements, 3*(S1), S3-S5. doi:10.1038/ijosup.2013.2
Perrin, E. M., Rothman, R. L., Sanders, L. M., Skinner, A. C., Eden, S., Shintani, A., . . . Yin, H. S. (2014).Racial and etnic differences associated with feeding and activity related behaviors in infants. *Pediatrics, 133*, e857-e867.
Polit, D. (2010). *Statistics and data analysis for nursing research* (2nd ed.). New York: Pearson.

Polit, D., & Beck, C. (2008). *Nursing research: Generating and assessing evidence for nursing practice.* (8th ed. ed.). Philadephia, PA: Wolters Kluwer. Lippincott Williams & Wilkins:.

Raymond, J. (n.d.). Baby Infant growth chart calculator. Who 0-2 years: Weight for length percentile. Retrieved from http://www.infantchart.com/infantweightlength.php

Roess, A. A., Jacquier, E. F., Catellier, D. J., Carvalho, R., Lutes, A. C., Anater, A. S., & Dietz, W. H. (2018).Food consumption patterns of infants and toddlers: Findings from the Feeding infants and toddlers study (fits) 2016. *The Journal of Nutrition, 148*(suppl_3), 1525S-1535S. doi:10.1093/jn/nxy171

Roy, S. M., Spivack, J. G., Faith, M. S., Chesi, A., Mitchell, J. A., Kelly, A., . . . Zemel, B. S. (2016).Infant bmi or weight-for-length and obesity risk in early childhood. *Pediatrics*.

Savage, J. S., Hohman, E. E., Marini, M. E., Shelly, A., Paul, I. M., & Birch, L. L. (2018).Insight responsive parenting intervention and infant feeding practices: Randomized clinical trial. *International Journal of Behavioral Nutrition and Physical Activity, 15*(1), 64. doi:10.1186/s12966-018-0700-6

Schwartz, F., Hutchings, T., Friedman, A. J., Quartey, N. K., Urowitz, S., Wiljer, D., & Smith, R. E. (2010).Moving toward an organized approach to patient education in Canadian hospitals. *Healthcare Quarterly, 13*(4), 84-88.

Schwartz, R., Vigo, A., Dias de Oliveira, L., & Justo Giugliani, E. (2015).The effect of a pro-breast feeding and healthy complementary feeding intervention targeting adolescent mothers and grandmothers on growth and prevalence of overweight of preschool children. *PLoS One, 10*(7), 1-13.

Smego, A., Woo, J., Klein, J., Bansal, D., Bolling, C., Daniels, S., & Crimmins, N. (2016).High body mass index in infancy may predict severe obesity in early childhood. *The Journal of Pediatrics, 183*, 87-93. doi:http://dx.doi.org10.1016/j.jpeds.2016.11.020

Smith, Hulsey, T., & Goodnight, W. (2008).Effects of obesity in pregnancy. *The Association of Women's Health, Obstetrics, and Neonatal Nurses, 37*(2), 176-184.

Status, C. D. C. N. C. f. H. S. W. S. F. o. S., & Health. (2012). National diabetes fact sheet: National estimates and general information on diabetes and prediabetes in the United States. .

Suitor, C., & Gardner, J. (1992).Development of an interactive, self-administered computerized food frequency questionnaire for use with low-income women. *Journal of Nutrition Education, 24*, 82-86.

Taveras, E. M., Gillman, M. W., Kleinman, K., Rich-Edwards, J. W., & Rifas-Shiman, S. L. (2010).Racial/ethnic differences in early-life risk factors for childhood obesity. *Pediatrics, 125*(4), 686.

Taveras, E. M., Rifas-Shiman, S. L., Belfort, M. B., Kleinman, K. P., Oken, E., & Gillman, M. W. (2009).Weight status in the first 6 months of life and obesity at 3 years of age. *Pediatrics, 123*(4), 1177-1183. doi:10.1542/peds.2008-1149

Tenfelde, S., Finnegan, L., & Hill, P. (2011).Predictors of breastfeeding exclusivity in a WIC sample. *Journal of Obstetrics, Gynecologic, and Neonatal Nursing, 40*, 179-189.

Terling Watt, T., Appel, L., Roberts, K., Flores, B., & Morris, S. (2013).Sugar, stress, and the supplemental nutrition assistance program: Early childhood obesity risks among a clinic-based sample of low-income hispanics. *Journal of Community Health Nursing, 38*, 513-520. doi:10.1007/s10900-012-9641-1

Thompson, A., Mendez, M., Borja, J., Adair, L., Zimmer, C., & Bentley, M. (2009).Development and validation of the Infant Feeding Style Questionnaire. *Appetite, 53*(2), 210-221. doi:10.1016/j.appet.2009.06.010

Thompson, A. L., & Bentley, M. E. (2013).The critical period of infant feeding for the development of early disparities in obesity. *Social Science of Medicine, 97*, 288-296. doi:10.1016/j.socscimed.2012.12.007

U.S. Census Bureau. (2014). *American fact finder*. Retrieved from www.census.gov/acs/www.

Vaughn, L., Geraghty, S., Nino, V., & Valenzuela, J. (2010).Sociocultural inflences on the determinants of breast-feeding by Latina mothers in the Cincinnati area. *Family Community Health, 33*(4), 318-328.

Wang, L., C., C., Ratliff, M., Xie, B., & Wang, Y. (2017).Breastfeeding reduces childhood obesity risks. *Childhood Obesity, 13*(3), 197-204. doi:https://doi.org/10.1089/chi.2016.0210

Wen, L., Baur, L., Rissel, C., Wardle, K., Alperstein, G., & Simpson, J. (2007).Early intervention of multiple home visits to prevent childhood obesity in a disadvantaged population: A home-based randomised controlled trial (healthy beginnings trial). *BMC Public Health, 7*, 76.

Wen, X., Gillman, M., Rifas-Shiman, S., Sherry, B., Kleinman, K., & Taveras, E. (2012).Decreasing prevalence of obesity among young children in Massachusetts from 2004 to 2008. *Pediatrics, 129*(5), 823-831. doi:10.1542/peds.2011-1833

Whitaker, R. C. (2004).Predicting preschooler obesity at birth: The role of maternal obesity in early pregnancy. *Pediatrics, 114*(1), e29-e36. doi:10.1542/peds.114.1.e29

Williams, J., Kabukuru, A., Mayo, R., & Griffin, S. (2011).Commentary: A socio-ecological perspective on obesity among Latinos. *Ethnicity & Disease, 21*, 467-472.

Wong, M., Jones-Smith, J., Colantuoni, E., Thorpe Jr., R., & Bleich, S. (2017).The longitudinal assocation between early childhood obesity and father's involvement in caregiving and decision-making. . *Pediatric Obesity, 0*(0), 1-8.

Wood, C. T., Perreira, K. M., Perrin, E. M., Yin, H. S., Rothman, R. L., Sanders, L. M., . . . Thompson, A. L. (2016).Confirmatory factor analysis of the Infant Feeding Styles Questionnaire in Latino families. *Appetite, 100*, 118-125. doi:http://dx.doi.org/10.1016/j.appet.2016.02.018

World Health Organization (2010). [Who growth standards are recommended for use in the U.S. For infants and children 0 to 2 years of age].

World Health Organization, n. d. Baby Infant growth chart calculator. Who 0-2 years: Weight for length percentile. Retrieved from http://www.infantchart.com/infantweightlength.php