EARLY FRUIT AND VEGETABLE INTRODUCTION AND

ITS INFLUENCE ON LATER FRUIT AND VEGETABLE INTAKE IN

12-MONTH OLD LOW-INCOME MINORITY INFANTS

By

ELENA SANTIAGO

A thesis submitted to the

Graduate School-New Brunswick

Rutgers, The State University of New Jersey

In partial fulfillment of the requirements

For the degree of

Master of Science

Graduate Program in Nutritional Sciences

Written under the direction of

John Worobey, Ph.D.

And approved by

____

____

____

New Brunswick, New Jersey

May 2017

ABSTRACT OF THE THESIS

Early Fruit and Vegetable Introduction and its Influence on Later Fruit and Vegetable Intake in 12-Month Old Low-Income Minority Infants

By ELENA SANTIAGO

Thesis Director:

John Worobey, Ph.D.

During infancy and early childhood there is a shift in diet from formula or being breast- fed to being exposed to a variety of foods that have unfamiliar tastes and textures. The food preferences that are developed in early childhood can predict adulthood dietary habits and have implications for developing long-term health problems, such as obesity or cardiovascular disease. It is important to understand how early childhood dietary habits can contribute to unhealthy food preferences as well as undesirable weight status. Data from the 2011-2012 National Health and Nutrition Examination Survey (NHANES) suggests that 8.1% of infants and toddlers are obese in the United States. The prevalence of obesity is higher in low-income Hispanic and Black children than any other ethnic groups that reside in the United States. An adequate intake of fruits and vegetables consumed during early childhood has been linked to lowering the risk of obesity and diet-related chronic diseases. Current research has shown that introduction to various fruits and vegetables within the American Academy of Pediatrics recommended window of 4-6 months may increase the amount and variety of these healthy foods consumed during early childhood. The objective of this thesis was to analyze data from the Rutgers Infant Nutrition and Growth (RING) Project to examine fruit and vegetable introduction within the recommended 4-6 months and its influence on later fruit and vegetable consumption and weight status in 12-month old low-income minority infants (n=96). It was found that mothers who introduced fruits earlier also introduced vegetables earlier to their infants. However, no relationship was found between the age of introduction to fruits or vegetables during infancy and total fruit or vegetable intake per day at 12-months old. Neither was a relationship found between the age of introduction to fruits or vegetables during infancy and total variety of fruit or vegetable intake at 12-months. Mothers who exposed their infants to a greater variety of fruit to consume at 12-months also gave them more variety of vegetables to consume at 12-months. Only 'other Hispanic' infants were having approximately two servings of fruits and vegetables per day, which meets the minimum recommended amounts. Surprisingly, infants at 12-months who were above the 85^{th} percentile had a significantly greater total variety of fruit and vegetable intake than infants at a weight-for-length-percentile less than the 85^{th}. Furthermore, there was no relationship found between the age of introduction to fruits or vegetables during infancy and weight-for-length-percentile status at 12-months. Further research is needed to determine if introducing fruits and vegetables early can facilitate greater intake and variety of fruits and vegetables at 12-months.

ABBREVIATIONS

AAP: The American Academy of Pediatrics

BMI: Body mass index

CDC: Centers for Disease Control and Prevention

CHOP: Children's Hospital of Philadelphia

FFQ: Food Frequency Questionnaire

NHANES: National Health and Nutrition Examination Survey

PedNSS: Pediatric Nutrition Surveillance Survey

RING: Rutgers Infant Nutrition and Growth Project

SES: Socioeconomic Status

USDA: The United States Department of Agriculture

WHO: World Health Organization

WIC: Special Supplemental Nutrition Program for Women, Infants, and Children

ACKNOWLEDGEMENTS

Foremost, I would like to sincerely thank *Dr. John Worobey* for his continuous guidance and encouragement throughout the process of completing my thesis. You always kept an open door to my many concerns and questions that I had. I am eternally grateful to have your support and insights in the nutrition field.

I would like to thank my committee members in the Department of Nutritional Sciences at Rutgers University. In particular, I would like to thank *Dr. Carol Byrd-Bredbenner* and *Dr. Nurgül Fitzgerald*, for their support and guidance throughout my time here. They have pushed me intellectually and provided me with further nutritional knowledge.

Thank you, *Gerri McKay*, for your encouragement and support throughout this process. I would not be where I am today without your help, and because of you, I learned more about where I want to go in my career with nutrition. I will always have you to thank for that!

Thank you, *Barbara Tangel*, for supporting me through this process and teaching me so much throughout my undergraduate and graduate years. You were always there for me when I needed assistance or advice!

Thank you, *Kevin McCarthy*, for your assistance in administrative tasks throughout my time here.

Lastly, my graduate career would not be feasible without the love and support from my family and friends. They always push me to strive further and I would not be where I am without them.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

Worldwide, the prevalence of obesity has dramatically increased over recent years, especially during early childhood. There are approximately 41 million children under the age of five who are overweight or obese (“Obesity and overweight”, 2016). Weight status for adults and children over the age of two years is determined by body mass index (BMI) categories. However, for children under the age of two years BMI is not typically utilized. Instead, to define the term ‘obesity’, age- and gender-specific weight-for-length percentiles are used for children under the age of two because their body composition varies by gender and age (Pan, May, Wethington, Dalenius, & Grummer-Strawn, 2013). According to the CDC age- and gender-specific weight-for-length percentile growth charts, children under the age of two are considered to be ‘obese’ if their weight-for-length percentile is equal to or above the 95th percentile (CDC, 2015). On the other hand, children over the age of two are considered to be overweight when at or above the 85th percentile and obese when at or above the 95th percentile on the gender-specific BMI-for-Age percentile charts (Ogden, Carroll, Kit, & Flegal, 2014).

The prevalence of obesity is different across racial groups in the United States. According to the 2011 Pediatric Nutrition Surveillance Survey (PedNSS), low-income Hispanic origin groups and non-Hispanic black children <5 years have the highest prevalence for obesity at 22.4% and 20.2% respectively, compared to non-Hispanic whites at 14.1% (Ogden et al., 2014).

According to the 2011-2012 National Health and Nutrition Examination Survey (NHANES) data, the prevalence for obesity among infants is approximately 8.1% in the United States. There was a significant difference in the prevalence for obesity between infant girls and boys from birth to two years, at 11.4% and 5% respectively, wherein infant girls have a higher prevalence for obesity than infant boys. The prevalence for high weight-for-length percentiles (≥ 95th percentile) among infants and toddlers of both sexes under the age of two was highest among Hispanics at 9.4% and non-Hispanic blacks at 8.4%, compared to non-Hispanic whites at 6.6% (Ogden et al., 2014). Despite recent declines in obesity among 2- to 5-year-old children, from 2003-2004 through 2011-2012, there has been no significant change in obesity among infants and toddlers in regard to their weight-for-length percentile measurements (Ogden et al., 2014).

It is evident that there are significant racial and ethnic disparities that exist in childhood obesity, especially among the minority groups of Mexicans and non-Hispanic blacks (Dixon, Peña, & Taveras, 2012). In the United States, Mexican-American, other Hispanic origin, and non-Hispanic black infants have a higher obesity rates when compared to children of other racial/ethnic backgrounds (Ogden et al., 2014; Ogden, Carroll, Curtin, Lamb, & Flegal, 2010; Taveras, Gillman, Kleinman, Rich-Edwards, & Rifas-Shiman, 2013). This makes Mexican-Americans, Hispanics, and non-Hispanic blacks important groups to target due to their high risk for childhood obesity which contributes to racial or ethnic disparities later on in childhood. Moreover, there is a concern that obese children are more likely to become overweight or obese as adolescents and adults. This can lead to both short- and long-term consequences in adulthood if obesity is not prevented during early development (Goodell, Wakefield, & Ferris, 2009). These consequences include increased risks for obesity-related comorbidities. Type 2 diabetes mellitus and cardiovascular disease have a higher prevalence in non-Hispanic blacks and Hispanic populations (Qi, Wang, & Huang, 2009; Salvo, Frediani, Ziegler, &

Cole, 2012). Similarly, hypertension has a higher prevalence among Hispanic and non-Hispanic black children compared to other ethnic groups (Sorof, Lai, Turner, Poffenbarger, & Portman, 2004).

Diets that includes a greater intake of fruits and vegetables have been associated with preventing and reducing these obesity-related comorbidities (Di Noia et al., 2014; Moore et al., 2005; Ness et al., 2005; Nikolić, Niki, & Petrović, 2008). Fruits and vegetables provide numerous essential nutrients that are vital for the first two years of life. With the introduction of fruits and vegetables during infancy within The American Academy of Pediatrics (AAP) recommended window of 4-6 months, there is evidence of an association between increased consumption of fruits and vegetables during childhood and reduced risk of obesity-related chronic comorbidities as well as prevention of deficiencies in essential vitamins and minerals (Coulthard, Harris, & Emmett, 2010; Gibson, Wardle, & Watts, 1998; Sylvestre, O'Loughlin, Gray-Donald, Hanley, & Paradis, 2007; Wardle, Carnell, & Cooke, 2005). Unfortunately, the NHANES 1999-2002 data suggests that Hispanic and non-Hispanic black children and adolescents aged 2-18 years have a lower intake of fruits and vegetables compared to non-Hispanic white children and adolescents (Lorson, Melgar-Quinonez, & Taylor, 2009). These trends emphasize the importance of researching the numerous factors that may contribute to the early prevalence of pediatric obesity among these minority groups.

The first two years of life are crucial for establishing a child's healthy dietary habits and food preferences (Mallan, Fildes, Magarey, & Daniels, 2015). However, there has been a rising concern pertaining to low fruit and vegetable consumption during infancy that may contribute to a child's healthy dietary habits and food preferences. The literature reports that low fruit and vegetable consumption is evident early in infants' lives and that approximately 33% of infants under the age of twenty-four months in the United States have no daily fruit or vegetable intake (Coulthard et al., 2010). It is important to introduce infants to fruit and vegetables during infancy because it has been associated with increasing variety and frequency of fruit and vegetable intake in children later on (Mallan et al., 2015).

There are several environmental factors that contribute to the low intake of fruits and vegetables in multi-ethnic populations, such as genetic influences on food preferences, food insecurity, socioeconomic status (SES), inaccessibility to and unavailability of food at home and in the neighborhood, and parental food-related behaviors (Baker, Schootman, Barnidge, & Kelly, 2006; Caprio et al., 2008; Devine, Wolfe, Frongillo Jr, & Bisogni, 1999; Di Noia et al., 2014; Dixon et al., 2012; Larsen et al., 2015; Reinaerts, De Nooijer, Candel, & De Vries, 2007; Woo Baidal et al., 2016). It is important to understand that these environmental factors can influence fruit and vegetable consumption during early infancy, which shape food preferences and eating behaviors during early childhood. Food preferences are shaped early in life and if an infant has the pattern of a low fruit and vegetable consumption, this habit likely will continue until adulthood (Blandine de, 2013; Reinaerts et al., 2006). Not introducing fruits and vegetables according to the schedule recommended by AAP may instead reinforce food preferences for energy-dense foods or inhibit exposure to a variety of fruits and vegetables during early childhood.

Although there is abundant research that focuses on fruit and vegetable dietary habits of infants above the age of two, research on the introduction of fruit and vegetables and its effect on the dietary habits of infants in the first year of life for the Hispanic and non-Hispanic Black populations is limited (Fox, Pac, Devaney, & Jankowski, 2004; Lorson, et al., 2009; Mallan et al., 2015). Children from the Hispanic and Black population have a higher prevalence for obesity and metabolic syndrome. Therefore, this thesis will focus on examining early fruit and vegetable introduction between 4-6 months and its its influence on later fruit and vegetable intake and weight status during the first year of life in low-income minority (Black, Mexican, other Hispanic) infants.

II. REVIEW OF THE LITERATURE

Childhood obesity has increased over the past three decades and this trend continues to rise. The obesity epidemic has spread worldwide and has been a struggling problem in all but the poorest countries (Dixon et al., 2012). Numerous members of society, such as health professionals, politicians, and community leaders have begun to advocate for healthier lifestyles to help reduce the epidemic of obesity during early childhood. Since childhood obesity in the United States has become a major public health concern and has more than tripled over recent years, several recommendations, reports, social marketing campaigns, as well as new regulations were implemented to reduce its prevalence (Singh, Kogan, & Yu, 2009). Some examples are the Early Childhood Obesity Prevention Policies report by the Institute of Medicine (IOM) and the *Let's Move!* Campaign by First Lady Michelle Obama (IOM, 2011; *Let's move! America's move to raise a healthier generation for kids*, 2010). The aim for all of these interventions is to emphasize the roles of risk factors in the development of obesity and to reduce the overall population prevalence of obesity within a generation, particularly in young children because obesity during the childhood years often tracks into adulthood. The prevention of obesity can begin early because height, weight, and length can be monitored closely using percentile growth charts, even for infants and toddlers under the age of two. For children under the age of two, weight status can be determined by the CDC age- and gender- specific weight-for-length percentile growth charts (Pan et al., 2013). The CDC weight-for-length percentile growth chart considers children under the age of two to be 'obese' if they are above the 95th percentile. Overweight among children under the age of two was formerly labeled as being at risk for overweight while obese was formerly labeled as being overweight.

For children and teens aged 2- to 20- years old, growth should be monitored by using the 2000 CDC growth reference charts ("Overview of the CDC Growth Charts", 2015). Since breastfeeding became the recommended standard for infant feeding, the WHO's new international growth charts for children under the age of two years, which was released in 2006, reflected healthy children who were predominantly breastfed. The WHO growth charts are similar to the 2000 CDC growth reference charts because they both describe weight for length, weight for age, weight for age, and BMI for age (CDC, 2009). Likewise, the methods used to create the WHO growth charts and the CDC growth charts are similar for children who are aged 2- to 5- years old. However, the CDC charts are used as growth references and identify how typical children grow up during a specific time and place, whereas the WHO charts are used as growth standards and identifies how healthy infants and children should grow in conditions that are optimal (CDC, 2009). In clinical practice, it is currently recommended by CDC and AAP that health care professionals use the WHO growth standard charts to monitor the growth of children compared to CDC reference growth charts because the CDC typical growth patterns may not be the ideal growth patterns for children ("Overview of the CDC Growth Charts", 2015). However, at the time the data for this project was collected, CDC growth charts were used to monitor the growth of an infant because the new international WHO growth chart recommendations were not yet adopted until 2006.

There are numerous studies that have examined the prevalence of obesity among children as well as the importance of monitoring these trends (De Onis, Blossner, &

Borghi, 2010; Finkelstein, et al., 2012; Pan, Blanck, Sherry, Dalenius, & Grummer-Strawn, 2012). In the United States, high obesity prevalence still exists across all age groups, especially among young children. Despite the prevalence of obesity slightly declining in preschool-aged children aged 2-4 years, from 15.2% in 2003 to 14.9% in 2010, the epidemic has now been shifted and observed as early as infancy (Pan et al., 2012). According to NHANES data, about 8% of infants under the age of two years in the United States are at or above the 95th percentile on the CDC age- and gender- specific weight-for-length percentile growth charts, whereas 7% of infants under the age of two years are at or above the 97.7th percentile on the WHO growth charts (Ogden et al., 2014). In the PEDNSS 2011 report, the prevalence of obesity among children less than the age of 2 years in New Jersey ranked high at about 14.2% (CDC, 2012). Undoubtedly, the first two years of life are a sensitive and crucial time period for the development of obesity in infants.

Obesity that begins during early childhood has a growing impact on low-income populations (Woo Baidal et al., 2016). The prevalence of childhood obesity differs between racial/ethnic groups, and it is more common among certain racial/ethnic groups than others. Data from the United States Census Bureau shows that the Hispanic population in the United States is the largest ethnic/racial minority group and consists of individuals from South America, Central America, Mexico, Spain, and the Caribbean islands (with a large percentage from Cuba, Puerto Rico, and Dominican Republic). Also, because the Hispanic population is the largest ethnic/racial minority group in the United States with 64% of Mexican-Americans making up half of its population, Hispanic along with non-Hispanic black mother-infant dyads were recruited for the present investigation (United States Census Bureau, 2015).

As mentioned previously, rates of obesity are highest among non-Hispanic blacks and Hispanics (IOM, 2011). There are about 40% of non-Hispanic blacks and Hispanic children who are overweight or obese in the United States (*Let's move! America's move to raise a healthier generation for kids*, 2010). Studies have shown that the prevalence of obesity increases when Hispanic infants are from a low socioeconomic household in an urban area that participates in federally funded assistance programs (CDC, 2009; Goodell et al., 2009; Pan, McGuire, Blanck, May-Murriel, & Grummer-Strawn, 2015). Low-income Hispanic origin groups and non-Hispanic black children <5 years have the highest prevalence for obesity at 22% and 20% respectively, compared to non-Hispanic whites at 14% (Ogden et al., 2014; CDC, 2012). Non-Hispanic black children have a threefold and Hispanic children have a fivefold higher prevalence of obesity compared to non-Hispanic white children (Woo Baidal et al., 2016). Similarly, the prevalence for high weight-for-length percentiles ($\geq 95^{th}$ percentile) among infants and toddlers under the age of two is highest among Hispanics and non-Hispanic blacks compared to non-Hispanic whites (Ogden et al., 2010; Ogden et al., 2014). These results suggest that during the first two years of life, the differences in risk factors for childhood obesity among racial/ethnic groups may lead to the prevalence of racial/ethnic disparities experienced later on in childhood obesity. High weight-for-length percentiles during infancy increases the risk for obesity tracking into adulthood, especially in minority populations, which is also associated with early onsets of short- and long-term associated health problems.

During infancy, being exposed to overfeeding and exhibiting rapid growth can increase the risk for developing abdominal obesity and its related complications (Adair, 2007). According to the 1999-2004 NHANES data, the prevalence of abdominal obesity, determined by measuring an individual's waist circumference or waist-to-height ratio, has greatly increased among young children in the United States; approximately a 69% increase among girls (from 10.5% to 17.8%) and a 65% increase among boys (from 10.5% to 17.4). Having a higher prevalence of abdominal obesity also increases their risk for other metabolic complications (Li, Ford, Mokdad, & Cook, 2006; Taveras et al., 2013). There is a higher prevalence of metabolic complications, such as Type 2 diabetes mellitus, hypertension, and cardiovascular disease among the Hispanic and non-Hispanic black populations compared to other ethnic groups (Goran, Ball, & Cruz, 2003; Qi et al., 2009, Salvo et al., 2012; Sorof et al., 2004).

The SEARCH for Diabetes in Youth is a national study designed to gain more information about the diabetes epidemic among young children in the United States. Evidence from the SEARCH for Diabetes in Youth Population Study has shown that there is a higher prevalence of type 2 diabetes among Hispanic and non-Hispanic black children (Liese, 2006). Also, impaired glucose tolerance has also become more apparent in overweight and obese children. In one study, it was reported that 30% of non-Hispanic black children and 19% of Hispanic children had impaired glucose tolerance (Sinha et al., 2002). Vulnerability to obesity and its comorbidities have risen during early infancy, and it is important that parents and caregivers focus on their child's nutrition and health in order to combat these obesity-related diseases.

Fruit and vegetable intake in the diet: health and nutritional consequences

Fruit and vegetable consumption is important for overall health and reduces the onset of specific obesity-related diseases. Fruits and vegetables provide essential nutrients that are important for the first two years of life. There are approximately 33% of infants in the United States under the age of two years who have a low consumption of fruits and vegetables on a daily basis (Coulthard, Harris, & Emmett, 2010). Children under the age of two years tend to consume a greater amount of foods that are poor in nutrients and higher in added sugar, saturated fat, and sodium (Mallan, 2015; Siega-Riz, Deming, Reidy, Fox, Condon, & Briefel, 2010). Following a diet that is unhealthy and poor in nutrients has led to excess weight gain and obesity during infancy (Mallan, 2015). Throughout this review, when referring to fruit consumption, orange juice and other types of 100% fruit juices are excluded due to their high sugar content. The AAP does not recommend parents give fruit juices or sugar-sweetened beverages to infants under the age of six months (AAP, 2016).

In the first year of life, nutrient needs are high for growth and maintenance, thus exposure to a balanced nutritional diet during infancy is essential for good health later in life. When infants are not being introduced to fruits and vegetables in their diet during their first year of life, there may be a risk for not obtaining the essential vitamins and micronutrients that may reduce risks for obesity-related diseases. It is important to consume fruits and vegetables because it provides essential nutrients for growth and development, such as dietary fiber, folate, potassium, vitamin A, vitamin C, and vitamin D (Grimm, Kim, Yaroch, & Scanlon, 2014).

Also, due to the rise in prevalence of obesity-related comorbidities, healthy eating habits and early exposure to a variety of fruits and vegetables are important to introduce to prevent these obesity-related diseases from occurring (Birch & Ventura, 2009; Schwartz, Scholtens, Lalanne, Weenen, & Nicklaus, 2011). Unfortunately, there are no specific feeding pattern recommendations from the current Dietary Guidelines that apply to children under the age of two and existing literature is limited for this age group. Regardless, over the years, a few studies have shown that beneficial health outcomes will occur when there is a greater intake of fruits and vegetables in the diet early on. Some outcomes are that it may prevent deficiencies in essential vitamins and minerals and lowers the risks of obesity and its related comorbidities, such as blood pressure and cardiovascular disease (Blandine de et al., 2013; Di Noia & Byrd-Bredbenner, 2014; Grimm et al., 2014; Moore et al., 2005; Ness et al., 2005; Wardle et al., 2005). Similarly, a study reported that there was an association between a higher intake of fruits and vegetables and the reduction in the risk of coronary heart disease among adults (Nikolić et al., 2008). It was found that when individuals consumed more than five servings of fruit per day and more than three servings of vegetables per day, there was a lower risk of developing coronary artery disease by 60% and 70%, respectively, compared to individuals who consumed less than one fruit or vegetable daily (Nikolić et al., 2008).

A greater consumption of fruits and vegetables in the diet is a major factor in the prevention of these specific diseases. However, among the minority populations, Hispanics and non-Hispanic black infants are not consuming an adequate amount of fruits and vegetables each day. More specifically, there are approximately 66% of Mexican American children and 72% of non-Hispanic black children who are not consuming an adequate fruit intake, while 83% and 86% are not consuming an adequate vegetable amount, respectively (Lorson et al., 2009). Thus, Hispanics and non-Hispanic black infants are not consuming an adequate amount of fruits and vegetables during infancy or being exposed to a variety of these foods.

Early fruit and vegetable introduction and its long-term impact on healthy eating

As mentioned previously, introducing fruits and vegetables during the AAP's recommended window of 4-6 months is crucial due to developmental readiness to digest and absorb the foods and for the infants to become familiar with the variety of tastes and textures. Introducing solids foods too early (< 4 months) may increase the risk for choking hazards, metabolic problems, and chronic diseases, such as obesity (Kuo, Inkelas, Slusser, Maidenberg, & Halfon, 2011). It is important for parents or caregivers to understand infants' early feeding patterns are a precursor to dietary habits later on in childhood. Infants should be introduced to a variety of nutrient-dense foods, especially fruits and vegetables, during the transitioning period to table foods at 4-6 months (Grummer-Strawn, Scanlon, & Fein, 2008). In 2000, the National Survey of Early Childhood Health (NSECH) analyzed the health and development of children (4-35 months) and their parents. There were approximately 62% of parents that introduced solid foods to their infants between the ages of 4-6 months while African-American mothers and English-Speaking Hispanic mothers were not as likely to introduce solids early (Kuo et al., 2011; Blumberg, Halfon, & Olson, 2004). For infants to experience different tastes and textures of fruits and vegetables, a variety of fruits and vegetables should be offered to increase acceptance. In addition, during the introduction period of solid foods, infants may need exposure to a new fruit and vegetable approximately eight to ten times before increasing its acceptance and intake (Addessi, Galloway, Visalberghi, & Birch, 2005; Birch, Gunder, Grimm-Thomas, 1998; Blanchette & Brug, 2005; Coulthard et al., 2010; Gerber, 2015; Savage, Fisher, & Birch, 2007; Sullivan & Birch, 1994). When infants do not get exposed to a variety of fruits and vegetables or do not consume an adequate amount of these foods each day, there is a risk for not obtaining the essential vitamins and nutrients that are needed to prevent obesity-related comorbidities as well as development. Also, by not consuming an adequate amount, there is a risk for decreased frequency and variety consumed during later childhood. Emphasis should focus on gradually including fruits and vegetables on a daily basis in infants aged 4-6 months to increase the amount and variety of these healthy foods consumed during childhood.

Currently, there are no dietary guidelines for infants and toddlers under the age of two years, hence there are no official recommendations for fruit and vegetable servings for 6-month- olds and 12-month-olds in the United States. However, there are several unofficial resources that provide fruit and vegetable recommendations from experts in the field for infants and toddlers under the age of two years. The recommendations from Johns Hopkins University School of Medicine and the Children's Hospital of Philadelphia (CHOP) follow similar food guideline principles for children two years and older that offer nutritious food sources at these stages. They agree that 4-6 month olds are to consume a minimum 1-2 tablespoons of fruits 1-2 times per day and a minimum 1-2 tablespoons of vegetables 1-2 times per day (each is equivalent to a daily intake of about ¼ cup). At 12-months-old, most experts agree that infants are to consume a minimum 2-4 tablespoons of fruits 2 times per day and a minimum 2-4 tablespoons of vegetables 2 times per day (each is equivalent to a daily intake of about ½ cup) (Johns Hopkins Medicine, 2016; CHOP, 2016; Gerber, 2015). Other experts have suggested "5-A-DAY" guidelines, which apply to individuals two years of age and older, might be used to measure fruit and vegetable intake in toddlers. The "5-A-DAY" guidelines were used in one study to analyze fruit and vegetable intake among 2- and 5-year old children. The study found that the children had an intake of less than 0.5 servings of vegetables per day. Also, if the children had an intake of more than 0.5 servings of vegetables per day then there was a higher chance of eating vegetables on more than one occasion throughout the day (Dennison, Rockwell, & Baker, 1998).

A majority of the population in the United States does not consume an adequate amount of fruits and vegetables on a given day (Yeh et al., 2008; Krebs-Smith, Guenther, Subar, Kirkpatrick, & Dodd, 2010). About one-third of children aged 0-3 years that do not consume fruits or vegetables, with 80%-90% of the foods consumed during infancy having poor nutritional value (Mallan et al., 2015). Thus, it is important to introduce fruit and vegetables early to increase variety of fruits and vegetables consumed during childhood as well as encourage healthy dietary patterns. A few studies have found that fruit and vegetable consumption decreases as age increases and that early exposure to a variety of these foods at 6 months was associated with increased frequency and amount consumed during later childhood at ages 6 to 8 years (Birch & Doub, 2014; Cooke et al., 2003; Harris & Coulthard, 2016; Skinner, Carruth, Bounds, Ziegler, & Reidy, 2002). In a recent longitudinal study, a higher exposure and greater intake of fruits and vegetables in 14-month- old infants predicted a higher intake of fruits and vegetables at 3.7-years-old as well as a healthier dietary pattern (Mallan et al., 2015). A wider variety of fruit and vegetable introduction during infancy at 4-6 months has been positively associated with healthier dietary patterns and food preferences.

In 2008, the Feeding Infants and Toddlers Study (FITS) analyzed dietary patterns and nutrient intake among infants and toddlers in the United States. FITS is a cross-sectional and descriptive national survey. Within the FITS study, results showed that infants were not consuming an adequate amount of fruits and vegetables at an early age. Only 40% of infants aged 4-6 months that were consuming any vegetable at least once in a day while only about 42% were consuming any fruit at least once in a day (Fox et al., 2004). In their analysis, infants consumed more fruits than vegetables, which is typical because infants are more accepting of sweet tasting foods (such as fruits) and rejecting of bitter tasting foods (such as vegetables) (Savage et al., 2007). About 1 in 4 infants did not have an intake of more than one vegetable each day (Forestell & Mennella, 2007). More specifically, it was found that at 12-months-old, 76.5% of infants were consuming any vegetable at least once in a day and about 77% were consuming any fruit at least once in a day. Infants were more likely to be consuming foods that were higher in fat and sugar than dark-green vegetables. There were fewer than 10% of infants aged 4-14 months who consumed dark green vegetables once a day (Fox et al., 2004).

Furthermore, according to the FITS study, the top five vegetables consumed by 4-6 month old infants were baby food carrots, sweet potatoes, squash, green beans, and peas while for 12 month old infants, the top five vegetables consumed were cooked green beans, French fries/other fried potatoes, cooked carrots, mashed/whipped potatoes, and cooked peas. The shift over time of consuming deep yellow vegetables to starchy vegetables and potatoes began to increase as age increased. French fries/other fried potatoes were the second most commonly consumed vegetable among 9- to 11-month-olds. The top five fruits consumed by 4-6 month olds were baby food applesauce, bananas, pears, peaches, and fresh banana while the top five fruits consumed for 12 month old infants were fresh banana, canned applesauce, fresh grapes, fresh apples, and canned peaches/fruit cocktail (Fox et al., 2004; Siega-Riz et al., 2010). Fresh fruit was the form most frequently consumed by infants of all ages, which was then followed by canned fruit. Hence, it is apparent that parents/caregivers should offer more nutrient-dense food items as opposed to energy dense food items that are high in fat or sodium.

As the FITS study focused mostly on Caucasian infants from families that are of middle-socioeconomic status, research on the dietary habits of low socioeconomic status, low-income Hispanic and Black infants under the age of two years is limited. Although the FITS study focuses on a large sample (N=3,022 infants aged 4- to 24- months), there were only about 12% of Hispanics and 7% of Black infants as part of the national representative survey (Briefel, Reidy, Karwe, & Devaney, 2010). More importantly, the findings from the FITS study were not separated by race or ethnicity, thus it is not known if there are differences in fruit and vegetable intake across the subsample. It is important to identify the dietary habits of Hispanic and Black infants because they are populations at high-risk for chronic diseases and have a lower consumption of fruits and vegetables compared to non-Hispanic white populations (Lorson et al., 2009).

These trends emphasize the importance of researching and understanding the numerous factors that may be the source of early prevalence for pediatric obesity or the influences that may affect the introduction of fruits and vegetables during early infancy among these minority groups.

Determinants that influence eating healthy

Fruit and vegetable intake is influenced by several factors, such as food insecurity, socioeconomic status (SES), genetic influences on food preferences, inaccessibility and unavailability to food at home and in the neighborhood, and parental food-related behaviors (Woo Baidal et al., 2016; Caprio et al., 2008; Baker et al., 2006; Larsen et al., 2015; Di Noia et al., 2014; Dixon et al., 2012; Reinaerts et al., 2007; Devine et al., 1999).

Genetic Influences on Food Preferences. It is important to understand that genetic predispositions may affect the dietary patterns and eating experiences from early infancy through childhood. Previous researchers have found that obesity and determinants of the diet have a strong genetic relationship (Martin, Lee, Couch, Morrison, & Woo, 2011). Other heritable factors that may affect obesity and diet are taste preferences and perceptions; these are strongly associated with influencing fruit and vegetable consumption and dietary behavior (Ventura & Worobey, 2013; Blanchette et al., 2005). These particular taste preferences and perceptions towards food items may be a mechanism underlying genetic influences towards food preferences.

Infants and children have an innate preference for foods that are sweet while some have a dislike towards foods with a bitter and sour taste. Genetic markers for taste preference are associated with the consumption of fruits and vegetables. In one study, mothers and their adult children's BMI and fruit and vegetable intake, calories, and macronutrients (fat, protein, carbohydrates) were analyzed to see if the genetics of obesity could perhaps overlap with heritable dietary intakes. There was a negative relationship between consumption of fruits and vegetables and BMI (Martin et al., 2011).

Also, the consumption of both fruits and vegetables exhibited heritability, which may be explained by taste preferences. Thus, the consumption of fruits and vegetables and obesity have an underlying genetic relation (Martin et al., 2011).

Furthermore, having sensitivity towards the taste of certain fruits and vegetables is a trait that is heritable. The substances, 6-n-propylthiouracil (PROP) or phenylthiocarbamide (PTC), are usually used in research to determine the difference in sensitivity among individuals and whether these substances taste ‘strongly bitter’, ‘moderately bitter’ or ‘tasteless’ (Ventura et al., 2013). In one study, preschool-aged children classified as being either a ‘taster’ or ‘nontaster’ of the substance PROP. The preschool aged children who were ‘tasters’ of PROP had a lower consumption of the bitter vegetables and consumed more nonbitter vegetables (carrots and red peppers). On the other hand, the preschool children who were ‘nontasters’ of PROP consumed a higher amount of the bitter vegetables (black olives, raw broccoli, cucumber) (Bell & Tepper, 2006). Thus, along with genetic factors, having a greater sensitivity towards the bitterness of PROP may significantly impact children to have a lower preference and consumption of healthy foods that have a bitter taste (Keller & Tepper, 2004; Keller, Steinmann, Nurse, & Tepper, 2002).

Socioeconomic status. Several studies haven shown an association between socioeconomic status (SES) and obesity across different population groups that may vary by age and sex (Paeratakul, White, Williamson, Ryan, & Bray, 2002; Wang, 2001). In the National Health Interview Survey (NHIS) conducted between 1991-2008, the analyzed data showed that for families with an income of <$10,000, there was a higher prevalence for obesity compared to a family with a higher income. There was also a substantial increase in the prevalence of obese (BMI $\geq$ 30) and overweight (BMI $\geq$ 25) ethnic-immigrant adults, which were 42% and 19%, respectively (Singh, Siahpush, Hiatt, & Timsina, 2011). Within this dataset, US-born blacks and Mexicans had a higher prevalence for obesity, 60% and 64% respectively, compared to non-Hispanic US-born whites (Singh et al., 2011). In this study, there was no segregation of family income by each ethnic minority subpopulation to show if there would be any significant differences between the groups.

Over the years, it has been generally accepted that there is a higher prevalence of overweight and obese children among minority groups with a low SES status. However, this perception changed when it was found in the 1971 to 2002 NHANES (NHANES I, II, III) data that there was only a weak association between obesity and SES status, which also differed among the ethnic groups in children and adolescents (Wang et al., 2006). Unlike the previous study by Singh et al. (2011), there was segregation of family income by different ethnic subpopulations. The results showed that in Mexican-American and non-Hispanic Black children, low SES status was not consistently associated with obese or weight status, but that low SES status among non-Hispanic Whites was significantly associated with obese or overweight status, though this association for non-Hispanic Whites weakened over time (Wang et al., 2011; Wang et al., 2006).

There is also a relationship shown between low SES and a lower diet-quality. In other words, families with children who have a lower SES status tend to consume more energy dense foods (such as refined grains or foods with added fat or sugar) due to their lower costs rather than higher cost foods, such as fruits and vegetables (Darmon & Drewnowski, 2008; Dubowitz et al., 2008). Thus, although the prevalence of obesity and its association with SES status has weakened over time, the focus should be to address the obesity problem among all SES groups in different ethnic populations.

Food Insecurity. Food insecurity is "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" (Dave, Evans, Pfeiffer, Watkins, & Saunders, 2010; Campbell, 1991). It is hypothesized that families who are food insecure do not have the resources to buy nutritionally adequate foods (Matheson, 2008; National Research Council, 2006). As of 2014, 14% of households (approximately 17.4 million households) in the United States were food insecure at any time during the year. In 2014, there were about 9% of children in the United States households that suffered from food insecurity. Among these households, Blacks and Hispanics with incomes below the Federal poverty line of 185% had significantly higher rates of food insecurity at 26% and 22% respectively, compared to the average nationwide (USDA, 2015).

Food insecurity occurs more often in low-income minority populations of Hispanics and Blacks (Asfour et al., 2015; Hiza, Casavale, Guenther, & Davis, 2013; Mello et al., 2010). Non-Hispanic Black and Mexican-American low-income children (aged 1 to 5 years) who were food insecure with a family income less than or equal to 130% of the poverty line had a higher prevalence for poor health status (such as headaches, colds, ear infections, stomach aches, iron deficiency) compared to non-Hispanic White children (Alaimo, Olson, Frongillo, & Briefel, 2001). There is a significant association between food insecurity and consumption of fruits in vegetables in young children aged 2-5 years old (Asfour et al., 2015). In one study, the consumption of fruits and vegetables declined as food insecurity in households with children worsened

(Kendall, Olson, & Frongillo Jr, 1996). Similarly, in a recent study, when compared to food secure mothers, the 2-year-old toddlers of food insecure mothers were over three times as likely to have an intake of soda and 70% less likely to have an intake of fruits and vegetables (Cunningham, Barradas, Rosenberg, May, Kroelinger, & Ahluwalia, 2012).

Some literature has suggested that a child's overweight or obese status is associated with food insecurity. A study analyzing the data from NHANES 1999-2002 showed that non-Hispanic Black and Mexican-American children were at risk for being overweight or obese when food insecure, 35% and 42.2% respectively (Casey et al., 2006). Toddlers and children who live in a food insecure household with low-income families may have poorer health and nutrition consequences, lower intake of fruits and vegetables, and higher risks for pediatric obesity.

Inaccessibility and unavailability of food at home and in the neighborhood. The home food environment and the surrounding social neighborhood environment have been insinuated as influencing the quality of an infant's diet, early dietary practices, and health outcomes, such as obesity. The home environment affects the access to and availability of nutritious fruits and vegetables due to a family's inability to purchase certain high cost food items. Fast food and energy-dense food items were frequently consumed more among Black and Hispanic adolescents in a low SES household when there was less fruit and vegetable availability at home (Boutelle, Fulkerson, Neumark-Sztainer, Story, & French, 2007). But, for low-income Hispanic parents that promoted the intake of fruits and vegetables, there was more access and availability of these food items in the household for infants and children to consume (Dave et al., 2010).

It has been suggested that neighborhood SES is positively associated with fruit and vegetable intake, as the neighborhood environment can affect the physical access to local food stores (Darmon et al., 2008; Dubowitz et al., 2008; Moore & Diez Roux, 2006). Access and availability to fruits and vegetables in the social environments of these neighborhoods can impact an infant's consumption of these foods at home during the first year of life.

One study showed that the location of a particular food store was positively correlated with neighborhood ethnic groups. Neighborhoods that consisted predominantly of Black and Hispanic groups and had a lower income with no access to a vehicle, tended to have fewer supermarkets, natural food stores, and fresh fruit and vegetable markets than non-Hispanic white neighborhoods (Moore et al., 2006; Dubowitz et al., 2008).

Families of low income children who have limited access to fruits and vegetables may be eligible to apply for government aid through The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) program to receive supplemental foods. There are approximately 50% of infants in the United States who are WIC participants (State of New Jersey Department of Health, 2016). The food packages WIC provides to low-income pregnant, breastfeeding, non-breastfeeding postpartum women, infants, and children up to 5 years of age with a nutritional risk, offers supplemental foods choices that are healthy and nutritious from WIC approved grocery stores or certified farmers. The new packages offered by the New Jersey WIC are more restrictive on energy-dense foods and encourage the participants to eat more variety of fruits and vegetables, higher fiber intake, lower saturated fat intake, and drink less sweetened juices or beverages. In New Jersey, non-breastfeeding low-income mothers and their 6-month-old infants are provided with WIC checks to purchase 32 jars (4-oz) of baby fruit and vegetables (with no added sugars, salt, or starches) while the mother is able to receive $10 cash value voucher for fruits and vegetables (fresh, canned, or frozen). On the other hand, children under 5-years-old are able to receive $6 cash value voucher for fresh fruit and vegetables as well as 128 ounces of vitamin C-rich juice. The variety of fruit and vegetable choices that are provided by WIC can help low and no income families with infants meet their nutritional needs (State of New Jersey Department of Health, 2016).

Parental Modeling and Control. As previously mentioned, parents or caregivers influence infants and young children's eating habits and patterns. Indeed, these guardians decide the amount and types of food to purchase and how to prepare it, but it is their own food-related behaviors that may also influence an infant's food preferences during the first year of life until childhood. Parental modeling and control of food intake affects an infant's long-term consumption of certain foods and typically occurs when a child models the food intake of their parents (Larsen et al., 2015). Literature has found that parental modeling of consuming fruits and vegetables is a relevant factor for their child's intake of these food items and eating behavior (Wardle et al., 2005; Blanchette et al., 2005; Reinaerts et al., 2007). Zive et al. (1998) found that when Mexican-American parents encouraged intake of healthier food items, it reduced their child's salt and fat intake. In another study, the strongest predictor of a child's fruit and vegetable intake was the amount of fruits and vegetables the mother consumed (Cooke et al., 2003). Similarly, mother-child dyads were seen in a study by Fisher, Mitchell, Smiciklas-Wright, and Birch (2002), which reported that fruit and vegetable intake among non-Hispanic white mothers was significantly associated with their 5-year-old daughters' intake of fruits and vegetables. In another study, mothers that tried and liked more fruits and vegetables was positively related to their young daughters trying and liking of fruits and vegetables more, although the same was not found for mothers and their sons. However, mothers who liked more fruits and vegetables offered more fruits and vegetables to their sons (Worobey, Ostapkovich, Yudin, & Worobey, 2010).

Parents or caregivers that try to exert control over their child's eating habits and patterns may be another factor that influences their food choices later on in childhood. Whether its restricting certain types of snacks and sweets or pressuring an infant to eat healthier foods, it can still impact a child's diet and eating behavior (Benton, 2004; Vereecken, Rovner, & Maes, 2010). In one study, maternal feeding practices impacted their child's fruit and vegetable intake at an early age. Infants at 12-months-olds had a greater frequency of vegetable consumption at 2-years-old when their mothers modeled healthy eating behaviors to them (Gregory, Paxton, & Brozovic, 2011). Birch and Fisher (2000) found an association between a mother's feeding restriction on their diet that predicted their 5-year-old daughters' poor short-term eating habits. Parental restriction of certain foods resulted in an increase in the 5-year-old daughters' weight-for-height percentile due to consuming a higher amount of palatable foods after lunch even when they did not have an appetite. Parental control over restricting certain food items may lead to a child developing an increased food preference for those palatable restricted foods (Rodgers et al., 2013; Ventura et al., 2013; Vereecken, 2004). These studies mostly focus on white mother-child dyads, and there are only a few researchers that have assessed these feeding styles among minority groups (Worobey, Borrelli, Espinosa, &

Worobey, 2013). In one study comparing parental control over feeding and child-centered strategies among Hispanic and non-Hispanic Black parents, the Hispanic parents had more control of what the preschool-aged child consumed (Hughes et al., 2006). Similarly, in a recent study, middle-income non-Hispanic white mothers of preschool-aged children reported less restriction and pressure to eat certain foods compared to low-income Hispanic mothers (Ventura, Gromis, & Lohse, 2010). As these studies examine preschool-aged children, there is a gap in the literature for an association between parental modeling and control of food intake among infants and toddlers, which would be interesting to examine because it is a crucial time period for the development of an infant's food preferences. Hence, it is still important for parents or caregivers to comprehend the significance of incorporating fruit and vegetables during the first year of life to promote healthy eating behaviors and patterns.

Summary and Hypotheses

Childhood obesity has increased over the past three decades and this trend continues to rise in the United States. It is important for researchers to investigate dietary intake among infants to combat the obesity epidemic and its related diseases (Mallan et al., 2015). A greater intake of fruits and vegetables has been shown to reduce the onset of obesity-related diseases (Coulthard et al., 2010). Some determinants of low fruit and vegetable intake are genetic influences on food preferences, food insecurity, socioeconomic status (SES), inaccessibility and unavailability to food at home and in the neighborhood, and parental food-related behaviors.

The first two years of life are crucial for establishing a child's healthy food preferences and eating patterns. In the United States, there are approximately 33% of infants under the age of two years who have a low consumption of fruits and vegetables, but instead consume foods that are high in added sugar, saturated fat, and sodium (Coulthard et al., 2010; Mallan et al., 2015; Siega-Riz et al., 2010). Thus, the exposure and introduction of tasting various fruits and vegetables is vital in infants within the recommended window of 4-6 months. Exposing infants to fruits and vegetables during the first two years of life has been associated with increasing frequency and variety of fruits and vegetables consumed later on (Mallan et al., 2015).

Research has shown that the Hispanic and non-Hispanic black populations have a lower intake of fruits and vegetables and higher prevalence for obesity compared to non-Hispanic white populations (Lorson et al., 2009). However, research on the introduction of fruits and vegetables and its influence on later fruit and vegetable intake among minority infants during the first year of life is scarce. Therefore, in contrast to the FITS study, this thesis will focus on examining the early fruit and vegetable introduction and its influence on later fruit and vegetable intake and weight status in low-income minority infants. The results from this thesis project can add to the understanding of early fruit and vegetable introduction and its influence on later fruit and vegetable patterns among low-income Black and Hispanic ethnic groups to prevent future pediatric obesity.

Using data from the Rutgers Infant Nutrition and Growth (RING) Project, in a sample of minority infants (Black, Mexican, other Hispanic) and based on diet analyses at 6 months and 12 months, the following hypotheses were tested:

1) Earlier introduction to fruits and vegetables will be correlated with higher total fruit and vegetable intake per day at 12 months.

2) Earlier introduction to fruits and vegetables will be correlated with higher variety of fruits and vegetables at 12 months.

3) Earlier introduction to fruits and vegetables will be correlated with lower weight-to-length status at 12 months.

4) Participants will not meet the fruit and vegetable recommendations set by Johns Hopkins University School of Medicine and the CHOP at 12 months.

III. METHODS

Subjects

The subjects for this thesis were drawn from the Rutgers Infant Nutrition and Growth (RING) Project subject pool. The RING Project was funded by the National Institutes of Child Health and Human Development (NICHD) and approved by the Rutgers University Institutional Review Board prior to recruitment. This project used a longitudinal design, which consisted of each child's anthropometrics, dietary intake, motor activity, as well as maternal perceptions of infant behavior that were collected after the birth of the infant until the age of 5 years. The WIC program located in New Brunswick, New Jersey gave permission for recruitment of mothers and their infants in the RING Project. All of the participants enrolled in the RING project were mothers with a Hispanic or Black background, of whom many were recent immigrants from various Latin American countries. To be eligible for WIC services, its guidelines require that a family falls below the poverty line or has a gross income that does not exceed the poverty line by 185% (WIC guidelines-USDA, 2016). Therefore, the population being served was comprised of low-income family households.

Recruitment

The staff receptionist at WIC screened each mother's eligibility to participate in the RING Project after recording her demographic information and method of feeding during their first intake interview. If a mother specified that she was formula-feeding, the research recruiter was notified about her eligibility to participate and approached the mother after the WIC visit was complete. The research recruiter informed the mother about the RING Project, describing its focus on maternal feeding practices and the growth and development of infants. If the mother was willing to participate in the study, she was given a $10 gift certificate to use at a local grocery store.

A written informed consent form, provided in English or Spanish, was signed by each participating mother (Appendix A). The mothers then filled out a demographic form and, if needed, a bilingual research assistant assisted in the process (Appendix B). The form collected their demographic information, that is, ethnicity, language preference, highest level of education, address, number of years residing in the United States, as well as their contact information. Through the WIC client database, information about each infants' birth and current weight and length measurements as well as each mother's current measurements were obtained along with her age and pre-pregnancy measurements of weight, height, and body mass index (BMI) (Appendix C).

With each mother's continued consent given during the process of recruitment, she was informed that scheduled home visits would take place at 3 months, 6 months, 12 months, and then afterwards once a year around the child's birthday until 5 years of age. For participation in the RING Project, each mother was compensated at the conclusion of each of the two-day home visits.

The recruitment information gathered at the time of enrollment and the data from both the 6-month home visit and the 12-month home visit were used for this thesis. The data consists of 96 subjects at 6 months and 12 months who met the criteria for having at least one 24-hour recall, a food frequency questionnaire, and complete anthropometric measures at both ages. The mothers and their infants included in the present study were self-identified as Mexican (N=46), Black (N=26), or of other Hispanic origin (i.e., Dominican Republic, Peruvian, Puerto Rican, Colombian, Nicaraguan, and Honduran (N=24).

Instruments

Anthropometrics

At WIC, infants were weighed and measured by trained staff using a Health-o-Meter digital infant scale (Beford Heights, Ohio). For the anthropometric measurements during home visits, weight and length was obtained for each infant using a portable digital infant scale, Tanita Model BD-585 (Tanita Corporation of America, Arlington Heights, IL), and measure mat. These measurements were collected and plotted after each home visit onto a sex specific infant growth chart from the Centers for Disease Control and Prevention (2000) to calculate each infant's weight-for-length percentiles. At the time these data were collected, the WHO growth chart recommendations had not yet been adopted and moreover, all the infants in the RING Project were formula fed.

Procedure for the home visits and the collection of data

Mothers were reminded about their participation in the RING project one month prior to each planned visit. The home visits were scheduled when the project manager contacted the mother to confirm participation of both the mother and the infant as well as to remind her that data collection occurred over two consecutive days. Two research assistants that had Human Subject Certifications were scheduled to see the mother and her child during each visit. Over the 2-day home visits the infant's information was obtained, which included their age and anthropometric measurements (i.e., as length, weight, arm circumference), as well as their 24-hour dietary recall, food diary, and food frequency questionnaire (only recorded at 12 months). For mothers who spoke Spanish as their primary language, a bilingual research assistant attended their home visits to assist with the collection of data in Spanish. The materials brought to the home visits were available in English and Spanish. If Latina mothers could not read Spanish, the questions were read to them by the research assistants. For the purpose of this thesis, only the 24-hour dietary recall and food frequency questionnaire were used when the data was analyzed during the 3-, 6-, and 12-month home visits.

Home Visit: Day 1

Anthropometric data was collected and recorded on a home visit report form by research assistants on Day 1 of the 3-, 6-, and 12-month home visit with the infant. Infants were weighed and measured twice to improve accuracy. Anthropometric measurements included weight (kilograms), height (centimeters), and arm circumference (Appendix D). A 24-hour diet recall form (Appendix E) was used to assess the infant's formula and food intake for the preceding 24-hours during the 3-, 6-, and 12-month home visits. The mothers of the infants were asked by the research assistants to recall what their infant ate or drank from the day prior until the present time of the home visit. Alternatively, the mothers could begin with what their infant consumed most recently the day of the visit and then continue backwards. Also recorded was the approximate time during the day that the infant consumed food or drinks, if it could be recalled by the mother. To ensure that the data collected were representative of a typical 24-hour diet, research assistants asked the mothers if this food recall and the infant's behavior was typical of what they usually consume in a day. To conclude the first home visit, the research assistants put an accelerometer on each infant, reminded the participants about the home visit the following day and then explained instructions for completing a food diary of what her infant was consuming over the next 24 hours.

Home Visit: Day 2

During Day 2 of the 3-, 6-, and 12-month home visits, research assistants collected the food diaries and again asked the mother if her infant displayed typical behavior over the past 24 hours from when they left their home the previous day until the present time of this home visit. This information was recorded on the home visit report that was previously used. The Feeding Interview form (Appendix F) was administered by the research assistants on Day 2 to determine the age infants were introduced to fruits and vegetables, how frequently after introduction each were given, and how much was given after the initial introduction (only during the 3- and 6-months home visits). Similarly, only during the 12-month home visit, a Food Frequency Questionnaire (FFQ) from the Infant's Eating Behavior Form (Appendix G) was obtained from the mother. The accelerometers were returned and the caregiver was compensated with a payment of $30 once all of the information was obtained at the end of the two consecutive day home visit.

Data Processing and Analysis

To evaluate each infant's dietary intake, the data collected with the diet recalls during each of the home visits were entered into Nutritionist Pro^{TM} Diet Analysis (Axxya Systems, Stafford, TX). This software assesses all of the food and beverages consumed by the infant and provides total nutrient intakes. Nutritionist Pro^{TM} Diet Analysis 2010 contains thousands of ethnic food items, ingredients, and brand-name foods. If there was a particular food or beverage that was not brand-named (e.g. generic soup) in the diet recall, other sources were consulted to enter the suitable information into the nutrient database.

Introduction to Fruits and Vegetables

Fruit and vegetable introduction was determined by noting the age when any type of fruit or vegetable was introduced in the infants' diet (excluding 100% fruit juice), how frequently after introduction each were given, and how much was given after the initial introduction, which was all obtained from the Feeding Interview form, completed by the mother at 3 months and 6 months during the second home visit. To verify the information given by the mother, the interview data was compared to the recall data available at 3 months, 6 months, and 12 months (provided the details of the food/drinks, quantity, frequency, and the age infants were introduced to it) to validate the specific time point fruits and vegetables were introduced in the infants' diet.

24-hour dietary recalls

Although a 24-hour dietary recall and a food diary were collected during the RING project at 3-, 6- and 12-month home visits, for this thesis only the 24-hour dietary recall was utilized. This was due to the fact that some mothers did not provide sufficient information for the Day 2 food diary, whether it was due to the child following an atypical diet or that the child was feeling ill for that particular day. The 24-hour dietary recalls were used to analyze the total number of fruits and vegetables consumed by an infant each day at 6- and 12-months. An infant's total fruit and vegetable intake was computed by counting each separate fruit and vegetable serving (excluding 100% fruit juices) that was listed on the 24-hour dietary recall, then adding them to determine the total number of fruits and vegetables consumed in one day.

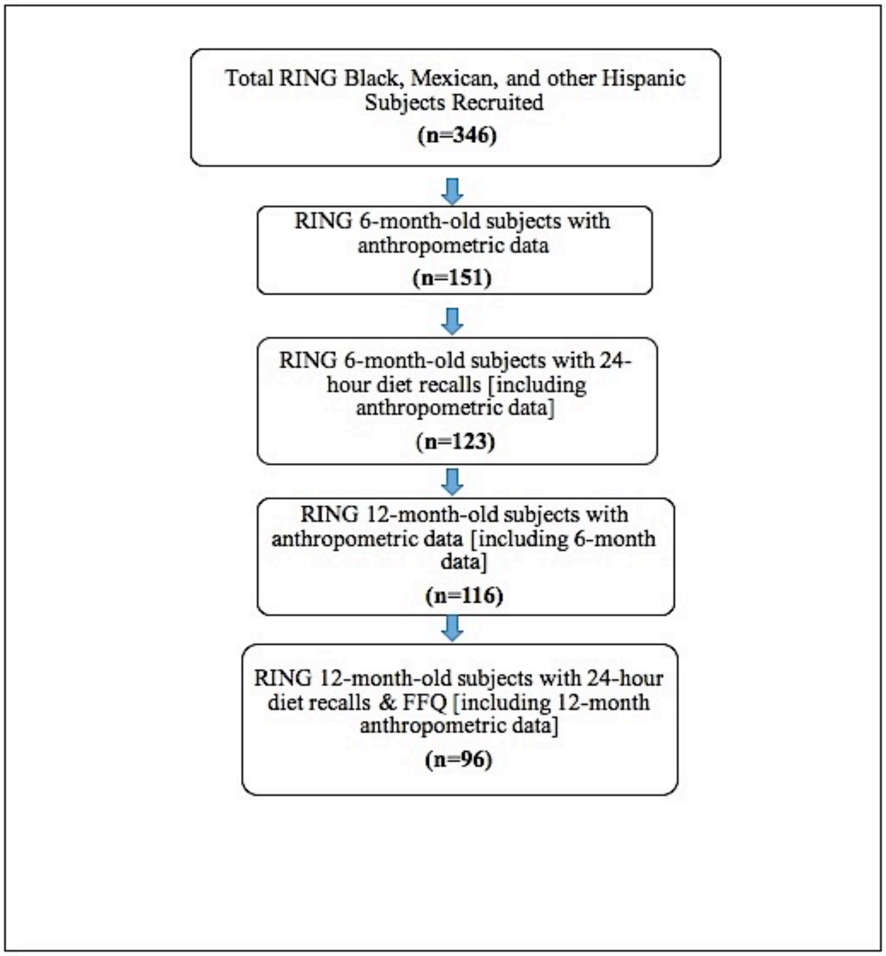
Food Frequency Questionnaire:

The FFQ was used to analyze the total number of different fruits and vegetables the infant has ever been fed in a typical week (also referred to as variety). The FFQ from the Infant's Eating Behavior Form was filled out by the mother when the infant was 12-months old. The FFQ form included a check-off list of numerous foods/beverages under several categories (dairy, meat, beans, breads and cereals, fruit, juices, vegetables, and other foods/beverages) that the infant ate/drank at least once during a typical week. This FFQ form was used solely at 12 months to determine the total variety of fruits and vegetables (excluding 100% juice) consumed during a typical week. An infant's total variety of fruit and vegetable intake was computed from the FFQ by counting each fruit and vegetable checked off by the mother that was consumed during a typical week.

RING subjects' exclusion criteria

The data collected from the RING project consisted of 96 subjects who had complete anthropometric measurements at 6 months and 12 months, a 24-hour dietary recall, a completed FFQ, and had a Black, Mexican, or 'other Hispanic' background, which were all necessary criteria to be included in this study. Thus, for the purpose of this analysis 96 subjects, unless otherwise specified, were included after exclusions were taken into account due to not meeting the criteria (such as having incomplete anthropometric measurements or having an incomplete FFQ).

Figure 1. Exclusion criteria for RING subjects.



Statistical Analyses

For this study, all of the data collected was entered into the IBM Statistical Package for Social Sciences Software (IBM SPSS version 19.0, Armonk, NY) for statistical analyses, with figures generated using Microsoft Excel for Mac (Version 15.12.3). The differences in anthropometric characteristics, the date of fruit and vegetable introduction, and fruit and vegetable consumption among the infants at 6 months and 12 months were analyzed using paired sample t-tests and Pearson correlations. For all analyses, the statistical significance level at $p < .05$ was used.

IV. RESULTS

Maternal and Infant Demographic and Anthropometric Characteristics

In Table 1, the maternal and infant demographic and anthropometric characteristics are shown. The mean years of the mother's highest school grade implied that a majority of the mothers did not complete secondary school (9th grade). Mother's pre-pregnancy Body Mass Index (BMI; kilograms per meter squared) was obtained from the WIC's database using the mother's weight and height. The mother's mean pre-pregnancy BMI was 26.0 and standard deviation was 4.8.

For the infants at age 6 months and 12 months, between group analysis (not shown) was used to compare the weight, length, and weight-for-length percentiles in Table 1. As would be expected, there was a significant increase in their weight and length as the infants aged (p<0.001). However, in a paired-sample t-test that compared weight-for-length-percentiles between 6- and 12-month-olds (not shown), there was a significant increase in the sample's weight-for-length-percentiles as the infant grew (p<0.001), namely, an increase of 11 percentile points from 58.1 to 69.1.

Table 1. Maternal characteristics at time of recruitment and infant characteristics (N=96, unless otherwise specified).

Measurements	*Mean*	*Standard Deviation*
Mother		
Age (years) (N=93)	26.3	5.8
Highest school grade completed (N=91)	9.5	3.3
Years in US (N=64)	6.6	5.4
Pre-pregnancy BMI (N=82)	26.0	4.8
Weight gained during pregnancy (kg)	14.2	6.0
Infant (birth)		
Weight (kg)	3.2	0.6
Length (cm)	49.6	4.3
Infant (3 months)		
Weight (kg)	6.2	0.8
Length (cm)	60.9	4.0
Weight-for-length percentile for age and sex	60.7	33.0
Infant (6 months)		
Weight (kg)	8.0	1.0
Length (cm)	67.5	3.3
Weight-for-length percentile for age and sex	58.1	33.5
Infant (12 months)		
Weight (kg)	10.2	1.2
Length (cm)	75.2	4.0
Weight-for-length percentile for age and sex	69.1	28.0

Note. Some missing data at time of recruitment, see adjusted N sizes.

As for the sample breakdown in Table 2, 27% were non-Hispanic Black, 48% of the infants were Mexican, and 25% were 'other Hispanic'. Also shown in Table 2, the mean age for introduction to fruits and vegetables among all the subpopulations were 4.2

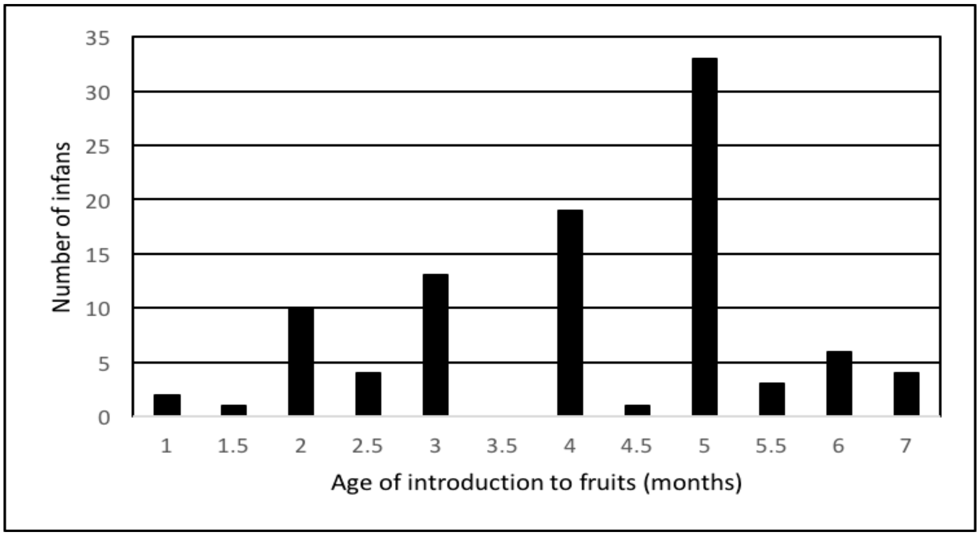
months and 5.1 months, respectively. Non-Hispanic Blacks were introduced earlier to fruits and vegetables compared to Mexican and 'other Hispanic' infants.

Table 2. Age of fruit and vegetable introduction among subpopulations (N=96).

Measurements	***Mean***	***Standard Deviation***
Infancy exposures		
Age fruits introduced (months)	4.2	1.4
Mexican (N=46)	4.3	1.4
Black (N=26)	3.8	1.4
Other Hispanic (N=24)	4.3	1.3
Age vegetables introduced (months)	5.1	1.6
Mexican (N=46)	5.4	1.7
Black (N=26)	4.9	1.6
Other Hispanic (N=24)	4.9	1.5

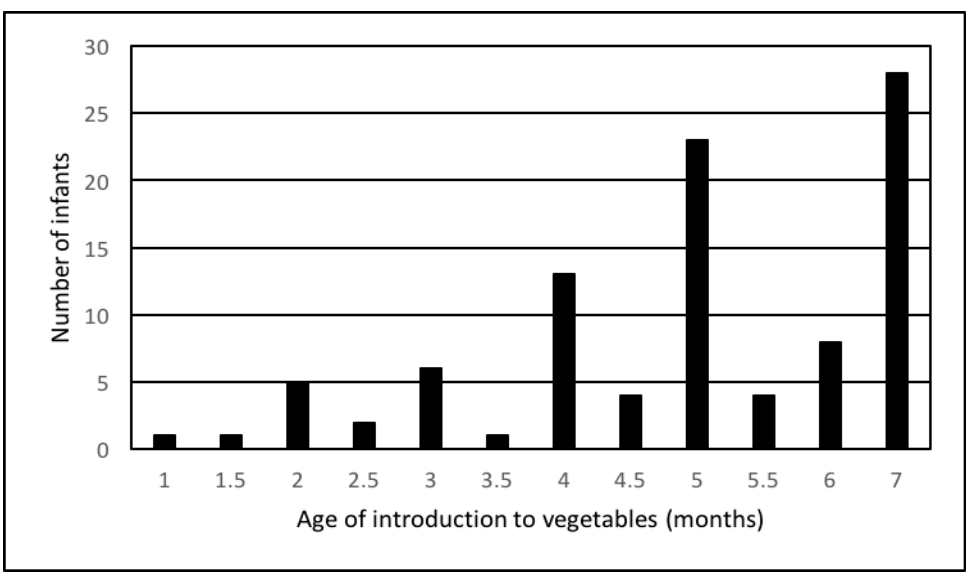
As shown in Figure 2, 30 infants were introduced to fruits before the age of four months. A majority of the infants (n=53) were introduced to fruits between 4-5 months, while there were only four infants who were introduced to fruits at seven months. Fruits were most frequently introduced at five months.

Figure 2. Infant's age at introduction to fruits (N=96).



Similar to Figure 2, Figure 3 visually displays the age when infants were introduced to vegetables. The results show that while many mothers first introduced vegetables at 5 months (n=23), the modal mother introduced vegetables to her infant at the age of 7 months (n=28). There were 16 infants who were introduced to vegetables before the age of four months. However, the majority of the infants (n=63) were introduced to vegetables at 5-7 months.

Figure 3. Infant's age at introduction to vegetables (N=96).



Analysis of infant characteristics and fruit and vegetable intake

Table 3 shows the differences in age of introduction to fruits and vegetables, total number of fruits and vegetables consumed by race/ethnic groups, and the total variety of fruits and vegetables that infants were exposed during a typical week at 12-months old. These variables were tested for differences across the three ethnic groups (Black, Mexican, and Other Hispanic). There were no significant differences detected between the three groups. Other Hispanic infants consumed a slightly larger number of total fruits and vegetables per day according to the 24-hour dietary recall (about 2.2 whole fruits and vegetables) compared to Mexican and Black infants. Only 'other Hispanic' infants at 12-months were having approximately two servings of fruits and vegetables per day. But, there was a larger variety of different fruits and vegetables that Hispanic infants were fed during a typical week at 12-months old (about 14).

Table 3. Age of introduction to fruits and vegetables, total number of fruits and vegetables served per day (based off 24-hour dietary recall), and exposure to a variety of fruits and vegetables per week (based off FFQ) at 12 months (N=96, unless otherwise specified).

	Black n=26 Mean (SD)	Mexican n=46 Mean (SD)	Other Hispanic n=24 Mean (SD)	p-value
Age of introduction to fruits	3.8 (1.4)	4.3 (1.4)	4.3 (1.3)	0.263
Age of introduction to vegetables	4.9 (1.6)	5.3 (1.7)	4.9 (1.5)	0.334
Total fruit and vegetable intake per day	1.8 (1.5)	1.7 (1.3)	2.2 (1.4)	0.435
Total variety of fruit and vegetables intake[a]	12.3 (7.2)	14.1 (7.1)	12.8 (5.9)	0.535

Notes.

[a] Total number of different varieties of fruits and vegetables an infant has ever been fed during a typical week, N=87.

SD= Standard Deviation

As shown in Table 4, the timing of the introduction to fruits was positively and significantly correlated with the introduction to vegetables. In other words, mothers who introduced fruits earlier to their infants also introduced vegetables earlier ($r = 0.397$, $p < 0.001$). However, there was no relationship between the age of introduction to fruits during infancy and total fruit intake per day at 12-months-old ($r = -0.068$, $p = 0.508$). Likewise, no relationship was found between the age of introduction to vegetables during infancy and total vegetable intake per day at 12-months-old ($r = -0.032$, $p = 0.758$). Mothers who exposed their infants to a greater variety of fruit to consume at 12-months also gave them more variety of vegetables to consume at 12-months ($r = 0.500$, $p < 0.001$). However, age of fruit introduction and total variety of fruit intake were not correlated. Similarly, the age of vegetable introduction and total variety of vegetable intake were not correlated. In addition, there was a statistically significant positive correlation between total variety of fruit intake and weight-for-length percentile ($r = 0.234$, $p = 0.029$). There was also a statistically significant positive correlation between weight-for-length percentile and total variety of fruit and vegetable intake ($r = 0.235$, $p = 0.028$). However, there was no relationship found between weight-for-length percentile and introduction to fruits ($r = -0.045$, $p = 0.665$).

Table 4. Correlations between age of fruit and vegetable introduction, total fruit intake and total vegetable intake per day (based of 24-hour dietary recall), total variety of fruit and vegetable intake and caloric intake variables at 12 months (based off FFQ), and the infants' and mothers' anthropometric variables (N=96, unless otherwise specified).

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Age fruits introduced	1	0.397**†	-0.068	-0.152	-0.143[a]	-0.003[b]	-0.075[a]	-0.069	-0.045	0.174[c]	0.130[d]
2. Age vegetables introduced		1	0.001	-0.032	-0.016[a]	-0.106[b]	-0.082[a]	-0.090	0.011	0.153[c]	-0.119[d]
3. Total fruit intake per day			1	0.064	0.076[a]	-0.003[b]	0.032[a]	0.161	-0.132	0.034[c]	0.057[d]
4. Total vegetable intake per day				1	-0.302**[a]	-0.101[b]	-0.246*[a]	-0.005	-0.101	-0.078[c]	0.077[d]
5. Total variety of fruit intake					1	0.500**[a]†	0.888**[e]†	-0.065[a]	0.234*[a]	0.035[f]	-0.200[g]
6. Total variety of vegetable intake						1	0.809**[a]†	0.048[b]	0.169[b]	0.151[h]	0.038[c]
7. Total variety of fruit and vegetable intake							1	-0.052[a]	0.235*[a]	0.108[f]	-0.069[g]
8. Caloric intake								1	-0.032	0.165[c]	0.004[d]
9. Weight-for-length-percentile									1	-0.012[c]	-0.098[d]
10. Mother's pre-pregnancy BMI										1	-0.044[i]
11. Mother's weight gain during pregnancy											1

Notes. Total number of different fruits and vegetables refers to the total variety of fruits and vegetables an infant has ever been fed during a typical week.
* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
† P-value is <0.05 and statistically significant
[a] N=87 [b] N=88 [c] N=82
[d] N=90 [e] N=86 [f] N=75
[g] N=81 [h] N=76 [i] N=80

Analysis of fruit and vegetable consumption between 6- and 12-month-olds

Table 5 shows the number and percentage of infants who consumed different types of fruit (excludes all fruit juices) as individual food items at least once in a day. The major source of fruit intake in a 6-month-olds' diet was through baby foods (about 55%), which was then followed by fresh fruit. By 12-months old, the percentages of infants consuming baby food fruits decreased to about 24%, followed by an increase in fresh fruit and canned fruit. As infants aged, they consumed fresh fruits and canned fruits more often.

Table 5. Number and percentage of infants consuming their total intake of fruits at least once a day based on the 24-hour dietary recall (N=96).

	6-month-olds		12-month-olds	
Food group/food item	**n**	**%**	**n**	**%**
Any fruit				
Baby food fruit	53	55.2	23	23.9
Nonbaby food fruit	13	13.5	40	41.7
Types of nonbaby food fruit				
Canned fruit	0	0.0	6	6.3
Fresh fruit	13	13.5	35	36.5
Types of fruit[a,1,2]				
Bananas	24	25.0	24	25.0
Apples	20	20.8	17	17.7
Pear	8	8.3	8	8.3
Peaches	4	4.8	6	6.3
Mango	3	3.1	3	3.1
Berries	2	2.1	2	2.1
Prunes	2	2.1	0	0.0
Citrus fruits	0	0.0	7	7.3
Grapes	0	0.0	6	6.6
Melons	0	0.0	3	3.1
Guava	0	0.0	1	1.0
Avocado	0	0.0	1	1.0
Fruit cocktail/mixed fruit	4	4.2	4	4.2

Note.
[a] The totals include the number of all baby and nonbaby food fruits consumed in one day.

Of infants who had fruit each day, bananas, apples, and pears were the most commonly consumed fruits at least once in a day for both age groups. Citrus fruits, grapes, melons, guava, and avocado were not consumed among 6-month olds, but were more commonly consumed among 12-month olds. Among infants at 6-months old, 7 different fruits were consumed (excluding other fruits, such as fruit cocktails). In contrast, among infants at 12-months old, 12 different fruits were consumed (excluding other fruits).

The percentage of infants who consumed different types of vegetables as individual food items at least once in a day is shown in Table 6. Estimates for the vegetables consumed among each age group does not include vegetables that are in mixed meals or dishes, such as vegetable soups or pizza, because there were very few infants who had an intake of mixed dishes. The major source of vegetables consumed were from commercial baby foods among 6-month olds, while cooked vegetables were more commonly consumed than baby foods among 12-month olds. For both age groups, raw vegetables were not consumed as often.

As for the types of vegetables, less than 5% of infants in both age groups consumed dark green vegetables at least once in a day. In contrast, red and orange vegetables as well as starchy vegetables were consumed more frequently among both age groups at least once in a day and increased in percentage as age increased. Beans and peas consumption increased drastically as age increased from 6-months to 12-months, 1.0% and 17.7%, respectively. Only one mother reported that her 12-month old consumed French-fries.

Table 6. Number and percentage of infants consuming their total intake of vegetables at least once a day based off the 24-hour dietary recall (N=96).

Food group/food item	*6-month-old* n	%	*12-month-old* n	%
Any vegetable				
Baby food vegetable	17	17.7	12	12.5
Cooked vegetables	12	12.5	45	46.9
Raw vegetables	2	2.1	7	7.3
Types of vegetables[a]				
Red and orange vegetables[b]	10	10.4	19	19.8
Starchy vegetables[c]	10	10.4	20	20.8
Bean and peas	1	1.0	17	17.7
Dark green vegetables[d]	1	1.0	4	4.2
Fried potatoes	0	0.0	1	1.0
Other vegetables[e]	5	5.2	9	9.4

Notes.
[a] The totals include the number of all baby food, cooked, and raw vegetables consumed in one day.
[b] Reported red and orange vegetables include carrots, tomatoes, sweet potatoes, and squash.
[c] Reported starchy vegetables include corn, green peas, and white potatoes.
[d] Reported dark green vegetables include broccoli, greens, and spinach.
[e] Reported other vegetables include cabbage, cauliflower, celery, green beans, lettuce, onions, and zucchini.

The top five vegetables consumed by infants at least once in a day are shown in Table 7. The top five vegetables consumed among 6-month olds are carrots, peas, potatoes, sweet potatoes, and zucchinis. The vegetable consumed more frequently (i.e., at least once a day) among the whole sample of 6-month-old infants was carrots (6.3%). In the FITS study, the top five vegetables consumed among 6-month olds are carrots, sweet potatoes, squash, green beans, and peas. The vegetable that was consumed more frequently (i.e., at least once a day) among the FITS sample of 6-month-old infants was carrots (9.6%).

The top five vegetables among 12-month olds were potatoes, beans, carrots, tomatoes, and green beans. The vegetable consumed more frequently (i.e., at least once a day) among the whole sample of 12-month-old infants was potatoes (which increased to 17.7% as aged increased). In the FITS study, the top five vegetables consumed among 12-month olds were green beans, French fries/other fried potatoes, carrots, mashed/whipped potatoes, and peas. The vegetable consumed more frequently (i.e., at least once a day) among the FITS sample of 12-month-old infants were green beans (which increased to 18.2% as aged increased).

Table 7. Number and percentage of top five vegetables consumed by infants at least once in a day based off 24-hour dietary recall (N=96).

6-month-old			*12-month-old*		
Top vegetables[a]	**n**	**%**	**Top vegetables[a]**	**n**	**%**
Carrot	6	6.3	Potato	17	17.7
Pea	5	5.2	Bean	16	16.7
Potato	5	5.2	Carrot	8	8.3
Sweet potato	3	3.1	Tomato	8	8.3
Zucchini	3	3.1	Green bean	6	6.3

FITS Data

6-month-old		*12-month-old*	
Top vegetables[a]	**%**	**Top vegetables[a]**	**%**
Carrots	9.6	Green beans	18.2
Sweet potatoes	9.1	French fries/other fried potatoes	12.9
Squash	8.1	Carrots	11.5
Green beans	7.2	Mashed/whipped potatoes	10.3
Peas	5.0	Peas	8.4

Note.
[a] Includes all baby food, cooked vegetables, and raw vegetables

To observe if weight-for-length-percentile was associated with total fruit and vegetable intake at 12-months old, an independent sample t-test was used. As shown in Table 8, there was a high percentage of infants who were above the 85th percentile (n=37). There was a statistically significant difference between the mean total variety of fruit and vegetable intake for infants above the 85th percentile and infants below the 85th

percentile *(t*=2.15, *p*=0.034*)*. The infants who had a weight-for-length-percentile greater than or equal to the 85th percentile had a significantly greater total variety of fruit and vegetable intake than infants who had a weight-for-length-percentile less than 85, with means of 15.03 ± 6.665 and 11.98 ± 6.429, respectively.

Table 8. Infant's total variety of fruit and vegetable intake by weight-for-length-percentile for age and sex (N=87).

	Total Variety of Fruit and Vegetable Intake		
Weight-for-length-percentile for age and sex	**n**	**Mean***	**SD†**
<85th percentile	50	11.98	6.429
≥ 85th percentile	37	15.03	6.665

Notes.
* Mean of total number of different fruits and vegetables an infant has ever been fed during a typical week is significantly different between weight-for-length-percentile categories (*p<0.034*).
†SD= Standard Deviation

An independent t-test was used to determine whether a mother's pre-pregnancy BMI was associated with her infant's total variety of fruit and vegetable intake at 12 months. As shown in Table 9, there was not a statistically significant difference between the mean total number of different fruits and vegetables an infant was ever fed during a typical week and the mother's pre-pregnancy BMI (*t*= 1.03, *p*=0.309). The overweight mothers' fed their infants one more fruit or vegetable on average than healthy weight mothers, with means of 13.80 ± 6.4 and 12.21 ± 6.8, respectively, though this was not significant.

Table 9. Infant's total variety of fruit and vegetable intake by their mother's pre-pregnancy BMI (N=75).

	Total Variety of Fruit and Vegetable Intake		
Mother's pre-pregnancy BMI	**n**	**Mean**	**SD†**
<25 kg/m²	39	12.21	6.8
≥ 25 kg/m²	36	13.80	6.4

Note.
†SD= Standard Deviation

V. DISCUSSION

The development of a child's healthy eating habits and food preferences are crucial in the first two years of life. Developing healthy eating patterns should start with a higher intake of fruits and vegetables during early infancy. Moreover, despite the prevalence of obesity increasing among Hispanic and non-Hispanic black infants throughout the United States, there still seems to be a failure of getting this health education message across to high-risk populations (Ogden et al., 2014; Ogden et al., 2010; Taveras et al., 2013). Research has shown these high-risk populations have an increased risk for the prevalence of obesity and lower fruit and vegetable consumption, yet the current literature is still limited in researching these subpopulations and their eating patterns before the age of two years (Lorson et al., 2009). The data for this thesis offers insights about fruit and vegetable introduction and its effect on later fruit and vegetable consumption as well as weight status in 12-month old low-income minority infants.

In this thesis, the data showed that within this sample of infants, the modal age for introduction to fruits and vegetables across all the subgroups was about 5 months and 7 months, respectively. Non-Hispanic Blacks introduced fruits and vegetables slightly earlier at about 4 months and 5 months, respectively, compared to Mexican and 'other Hispanic' infants. Based on their averages, all the subgroups introduced fruits and vegetables within AAP's recommended window of 4 and 6 months. On the other hand, there were about 4% of infants who had a late introduction to fruits at 7 months while there were about 29% of infants who had a late introduction to vegetables at 7 months. As predicted, fruits were introduced earlier to infants than vegetables. There were about

31% of infants introduced to fruits before the age of 4 months and there were about 17% of infants introduced to vegetables before 4 months. Approximately 65% of infants were introduced to fruits within the AAP's recommended window of 4 and 6 months and 60% of infants were introduced to vegetables between 4-6 months. This is consistent with a study that also showed infants had a later response to liking vegetables because they are less sweet and not liked as much as fruits (Dovey, Staples, Gibson, & Halford, 2008). Infants are born with genetically innate tastes and likings, in which they prefer sweet food items and tend to reject food items that may have a distinct bitter taste (Ventura & Worobey, 2013).

Contrary to the hypotheses, no relationship was found between the age of introduction to fruits or vegetables during infancy and total fruit and vegetable intake per day at 12-months-old. However, the timing of the introduction to fruits was positively and significantly correlated with the introduction to vegetables. In other words, mothers who introduced fruits earlier also introduced vegetables earlier to their infants. There was also no relationship between the age of introduction to fruits or vegetables during infancy and total variety of fruit or vegetable intake. There was a statistically significant positive correlation between weight-for-length percentile and total variety of fruit and vegetable intake at 12-months. However, there was no relationship between introduction to fruits or vegetables and weight-for-length percentile at 12 months.

Although the results were not significant between the three ethnic groups in this study, the trend suggests that Mexican and Black infants consumed a lower amount of total fruits and vegetables per day compared to 'other Hispanic' infants. However, the trend suggests Mexican infants had a larger variety of different fruits and vegetables during a typical week at 12-months-old. Only ‘other Hispanic’ infants at 12-months were having approximately two total pieces of fruits and vegetables per day, which meets the minimum recommendation amount provided by Johns Hopkins University School of Medicine and the CHOP.

Because fruits and vegetables influence factors in obesity and its related comorbidities, the daily consumption of fruits and vegetables were examined in the present study. There was a substantial proportion of infants who consumed no vegetable or fruits as distinct food items at least once in a day. There were about 68% of infants at 6-months and about 33% of infants at 12-months who did not have any vegetable as a distinct food item at least once in a day. Although the percentages decreased as infants aged, the proportion of infants who had no vegetable intake in a day was still high compared to the FITS study, which was 60% at 6-months and 24% at 12-months. Similar to the FITS study, there was a low intake of dark green vegetables, which are high in micronutrients and vitamins, but low in energy (Fox et al., 2004). The inadequate consumption of dark green vegetables may increase the risk for diseases, such as heart disease and cancer, later on in life due to missing essential vitamins and nutrients (Van Duyn & Pivonka, 2000). Infants at both ages in this study consumed a larger amount of starchy vegetables, which are lower in micronutrients and vitamins, but higher in energy.

At 6-months and 12-months old, about 31% and 34% of infants, respectively, did not have any fruit as a distinct food item at least once in a day. In contrast to vegetable intake, the fruit percentage decreased slightly as the infants aged. In the FITS study, there were about 58% of infants at 4-6 months and about 23% at 12-14 months that did not have any fruit as a distinct food item at least once a day. Although the infants had an increased percentage of any fruit as a distinct food item at least once a day compared to the FITS study at 6-months, the infants had a decreased percentage of any fruit at least once a day compared to the FITS study at 12-months. Similar to the FITS study at both time points, bananas and apples were consumed more frequently among infants at least once in a day. However, there was also a low percentage of infants at 6-months and 12-months consuming summer fruits, such as different types of berries and melons, which was also similar to the FITS study (Fox et al., 2004). The low intake of these specific summer fruits may have been influenced by the season or less access to fresh fruits and vegetables. A majority of fruits and vegetables are in season during the summer, thus WIC offers low-income mothers a larger cash value to purchase a larger amount of these food items. Besides receiving WIC checks for healthy and nutritious foods to pregnant, breastfeeding and postpartum women, infants and children up to the age of 5, WIC participants could also receive more money for fruits and vegetables during the summer season. Each WIC participant is eligible to receive a total of $20 for the season to purchase locally grown fruits, vegetables, and herbs from authorized farmers' markets that participate in the WIC Farmers' Market Nutrition Program (FMNP). The program operates from June 1st to November 30th each year, which may have increased the consumption of these summer fruits if mothers took advantage of this opportunity (State of New Jersey Department of Health, 2016).

The low intake of fruits and vegetables during infancy has been associated with lower intake during childhood. In support of these results, one study showed that a 2-year olds frequency of consuming fruits and vegetables was positively predicted by their consumption of these food items one year earlier (Gregory et al, 2011). In a similar longitudinal study, the amount and variety of fruits and vegetables infants consumed during their first two years of life were shown to influence the amount that they were consuming at ages 6, 7, and 8 years (Skinner et al., 2002).

As mentioned previously, vegetable intake in this study was lower than fruit intake. In this study and in the FITS study, details on the ounces of fruits or vegetables consumed on average was not obtained because no specific feeding pattern recommendations apply to children under the age of two years. However, some of the highest consumed vegetables at least once in a day were carrots, peas, beans, and potatoes at both time points. What may be interesting is that only one mother reported that her infant consumed French Fries by 12-months, although there was still a higher increase in starchy vegetables (Fox et al., 2004; Siega-Riz et al., 2010). In contrast, French fries increased among the infants from 0.7% at 4-6 months to 13% at 12-14 months in the FITS study. While it is promising that only one mother was feeding her infant French Fries, national statistics suggest that number will likely increase when these infants become toddlers. If the consumption of French fries follows the FITS trend after the first two years of life, the low-income toddlers may be at a higher risk for poor health and eating patterns.

The data showed the infants' weight and length increased as they grew older, which was expected to be seen during development. However, the infants had an increase in their mean weight-for-length percentile from 58.1 at 6-months to 69.1 at 12-months. Thus, if this trend continued, these infants may become overweight as they reach childhood. Surprisingly, infants who were above the 85^{th} percentile had a significantly greater total variety of fruit and vegetable intake than infants with a weight-for-length-percentile less than the 85^{th}. One possible explanation of this relationship could be that the infant was consuming a diet rich in calorie dense foods as well as a high fruit and vegetable intake (higher total caloric intake) rather than substituting the calorie dense foods with fruits and vegetables (lower total caloric intake) (Field, Gillman, Rosner, Rockett, & Colditz, 2003). However, total caloric intake did not correlate with the 12-month old infants total fruit and vegetable intake. Another possible explanation of this relationship could be that infants were consuming starchier vegetables, such as peas and potatoes. One study showed that a greater intake of lower-fiber, higher-glycemic load vegetables was associated with weight gain among adult men and women (Bertoia et al., 2015). Although several studies have reported an association with increased variety of fruit and vegetable intake and weight gain among children and adults, existing literature has not addressed infants in the first year of life within these findings (Ledoux, Hingle, & Baranowski, 2011; Russel et al., 2016; Washington, Reifsnider, Bishop, Ethington, & Ruffin, 2010).

The mothers' mean prepregnancy BMI was 26 ± 4.8SD and their infants had a mean increase in weight-for-length-percentile from about 58^{th} at 6-months'-old to 69^{th} percentile at 12-months'-old. Having a BMI between 25.0-29.9 kg/m^2 is considered overweight, which indicates that a large number of the women were overweight prior to being pregnant. One study examined the relationship between maternal prepregnancy BMI and infant growth during their first year of life. Infants who had a morbidly obese mother (prepregnancy BMI $\geq$40 kg/m^2) had a higher weight-for-length percentile at 3-months old through 12-months old compared to mothers with a prepregnancy BMI of overweight or normal weight (Heerman, Bian, Shintani, & Barkin, 2014). Similarly, in another study, Hispanic mothers who were identified as overweight/obese increased her child's risk of obesity by 1.4 times at 2 to 4 years of age (Panagiota, Pawloski, & Gaffney, 2010). However, in this study there was an inverse relationship between the mother's prepregnancy BMI and infants' weight-for-length percentile at 12-months' old. Also, there was no statistically significant difference between the mean total number of different fruits and vegetables an infant was ever fed during a typical week and the mother's pre-pregnancy BMI. Although not significant, the overweight mothers' fed their infants a higher total variety of fruit and vegetables than healthy weight mothers.

Strengths

There are very few studies that focus on low-income Mexican and non-Hispanic Black populations. This is particularly true for low-income Mexican and non-Hispanic infants under the age of two years in the United States. One major strength of this study is its contribution to the literature pertaining to this demographic population. In previous studies, early introduction to fruits and vegetables and its influence on later dietary patterns in the first year of life for these ethnic groups was relatively unknown and may have been limited. The findings from the homogenous cohort of subjects in this study may help nutrition educators in the future target low-income minority infants for introduction to a variety of fruits and vegetables early during infancy. Another strength of this study was the longitudinal data as it permitted an analysis of a sample over a period of time. Also, a dietary recall was obtained by trained research assistants during the home visit interviews. In contrast to the FITS study that administered interviews over the phone to gather diet recall information, the research assistant during the home visits in the RING Project helped personalize the dietary records for each mother, with respect to their Spanish dialect given they differ from one another. A bilingual research assistant also was readily available to help reduce the language barrier when communicating with the mother and her children.

Limitations

The sample size for this study was relatively small. However, research involving infants is labor intensive and involves commitment from the researchers as well as the parents because the collection of longitudinal data is time consuming. The retention process was challenging due to needing to have repeated contact and communication with the families to keep track of who moved, being able to schedule times when a pair of researchers (at least one bilingual researcher) could complete the home visits, as well as being able to factor in the time it took to travel to each family's house. Thus, from the time of recruitment to the 2-day home visits at both 6 and 12 months, numerous subjects were lost and this resulted in limits on the collection of data. Another limitation is that this study focused on low-income Hispanic and Black infants under the age of one year, therefore the findings from this study could only be applied to this age-specific population. An additional limitation in this study was in the inability to collect 48-hour diet recalls for all the infants. A 24-hour diet recall was deemed to be sufficient for the subjects in this study due to the inability to obtain complete diet records. When the diet recalls were collected, accuracy of being able to analyze the diet recalls was limited due to the information provided by the mother, such as the mother not accurately estimating food portions that were given to the infant on the second day. For some subjects, having only a 24-hour diet recall also may have reduced the variability in fruits and vegetables consumed by the infant because the 24-hour diet recall merely captures a snapshot in time. Lastly, another limitation is that this study did not collect a dietary record from the infant's mother. Observing what the mother eats and how her eating patterns related to her child's food intake would have provided further understanding of the relationship between maternal fruit and vegetable intake and their child's intake of these food items.

Conclusion

Recent research shows that early introduction to fruits and vegetables within the recommended window of 4- to 6-months old influences fruit and vegetable consumption at 12-months old. This study has validated these findings. As seen in one study, having tried a larger number of fruits and vegetables at 14-months old predicted a higher intake of fruits and vegetables at 3.7 years old (Mallan et al., 2015). A greater intake of fruits and vegetables also reduces the onset of obesity and its related diseases (Coulthard et al., 2010). Hence, exposing and introducing infants to the taste of various fruits and vegetables is important in the development of healthy eating habits, especially because these specific subpopulations were consuming a lower amount than the infants in the FITS study.

Although not within the scope of the present study, could substituting foods with higher sugar content or processed carbohydrates and consumption of sugar-sweetened beverages for whole fruit and vegetable intake have contributed to 40-69% of infants not consuming any fruit or vegetable at least once in a day at both time points? These poor substitutions and eating patterns may lead to infants having a higher weight-for-length-percentile and other health consequences in the future.

There are numerous factors that influence fruit and vegetable intake. One factor is that parental fruit and vegetable intake and their own food-related behaviors are associated with a child's intake of fruits and vegetables. More specifically, parental modeling of consuming fruits and vegetables influences their child's intake of these food items. In one study (Cooke et al., 2003), a child's fruit and vegetable intake was strongly affected by the amount the mother consumed. Unlike the FITS study, these specific subpopulations are at a higher risk for food insecurity, lower socioeconomic status, as well as inaccessibility and unavailability to food at home or in the neighborhood, which influence fruit and vegetable intake.

Future studies should explore associations between the factors mentioned above and their effects on fruit and vegetable consumption. More specifically, to observe if the factors (e.g., parental modeling, food insecurity, socioeconomic status, inaccessibility and unavailability to food at home or in the neighborhood) affects the relationship between the introduction of fruits and vegetables and its influence on later fruit and vegetable intake among low-income minority infants. Given these findings, future studies should also focus on preventing the loss of participants over the years. A thorough and adaptive 72-hour diet recall should be developed for the low-literacy population to obtain more accurate and detailed data as well as increase variability of fruit and vegetable intake. A larger sample size among these minority groups at multiple ages would have been useful to gather more information. There should be more dietary information given for this age group in the future due to there being no official specific feeding pattern recommendations from the current Dietary Guidelines that apply to children under the age of two years. Thus, having these dietary recommendations would be useful for assessing their diet recalls and food frequency questionnaires because low-income Mexican and non-Hispanic black infants under the age of two are at high risk for low fruit and vegetable consumption and obesity. Also, it has been shown that fruit and vegetable intake decreases as age increases into childhood (Krebs-Smith et al., 2010). Overall, the results from this study may provide future investigators with a better understanding at the importance of early fruit and vegetable introduction and its effects on later fruit and vegetable consumption among these lower SES and low-income specific subpopulations. These findings may aid in improving or developing nutrition intervention plans for low-income minority groups under the age of two years.

VI. REFERENCES

Adair, L. (2007). Child and Adolescent Obesity: Epidemiology and Developmental Perspectives. *Physiology and Behavior, 94*, 8-16.

Addessi, E., Galloway, A.T., Visalberghi, E., & Birch, L.L. (2005). Specific Social Influences on the Acceptance of Novel Foods in 2–5-year-old Children. *Appetite, 45*, 264-271.

Alaimo, K., Olson, C.M., Frongillo, E.A., & Briefel, R.R. (2001). Food Insufficiency, Family Income, and Health in US Preschool and School-Aged Children. *American Journal of Public Health, 91(5)*, 781-786.

American Academy of Pediatrics. (2016). *Infant Food and Feeding*. Retrieved July 18, 2016, from https://www.aap.org.

Asfour, L., Natale, R., Uhlhorn, S., Arheart, K.L., Haney, K., & Messiah, S.E. (2015). Ethnicity, Household Food Security, and Nutrition and Activity Patterns in Families with Preschool Children. *Journal of Nutrition Education and Behavior, 47(6)*, 498-505.

Baker, E.A., Schootman, M., Barnidge, E., & Kelly, C. (2006). The Role of Race and Poverty in Access to Foods That Enable Individuals to Adhere to Dietary Guidelines. *Center for Disease Control and Prevention: Preventing Chronic Disease, 3(3)*, 1-11.

Bell, K.I., & Tepper, B.J. (2006). Short-term Vegetable Intake by Young Children Classified by 6-n-propylthoiuracil Bitter-Taste Phenotype. *The American Journal of Clinical Nutrition, 84*, 245-251.

Benton, D. (2004). Role of Parents in the Determination of the Food Preferences of Children and the Development of Obesity. *International Journal of Obesity, 28,* 858-869.

Bertoia, M.L., Mukamal, K.J., Cahill, L.E., Hou, T., Ludwig, D.S., Mozaffarian, D.,…Rimm, E.B. (2015). Changes in Intake of Fruits and Vegetables and Weight Change in United States Men and Women Followed for Up to 24 Years: Analysis from Three Prospective Cohort Studies. *PLOS Medicine, 12(9),* 1-20.

Birch, L.L., & Doub, A.E. (2014). Learning to Eat: Birth to Age 2 y. *The American Journal of Clinical Nutrition, 99,* 723S-728S.

Birch, L.L., & Fisher, J.O. (2000). Mothers' Child-Feeding Practices Influence Daughters' Eating and Weight. *The American Journal of Clinical Nutrition, 71,* 1054-1061.

Birch, L.L., Gunder, L., & Grimm-Thomas, K. (1987). Infants' Consumption of a New Food Enhances Acceptance of Similar Foods. *Appetite, 30*, 283-295.

Birch, L.L., & Ventura, A.K. (2009). Preventing Childhood Obesity: What Works? *International Journal of Obesity, 33*, S74-S81.

Blanchette, L., & Brug, J. (2005). Determinants of Fruit and Vegetable Consumption Among 6–12-year-old Children and Effective Interventions to Increase Consumption. *The Journal of Human Nutrition and Dietetics, 18*, 431-443.

Blandine de, L., Jones, L., Oliveira, A., Moschonis, G., Betoko, A., Lopes, C., … Charles, M.A. (2013). The Influence of Early Feeding Practices on Fruit and Vegetable Intake Among Preschool Children in 4 European Birth Cohorts. *The American Journal of Clinical Nutrition, 98*, 804-812.

Blumberg, S.J., Halfon, N., & Olson, L.M. (2004). The National Survey of Early Childhood Health. *Pediatrics, 113(5*), 1899-1906.

Boutelle, K.N., Fulkerson, J.A., Neumark-Sztainer, D., Story, M., & French, S.A. (2007). Fast Food for Family Meals: Relationships with Parent and Adolescent Food Intake, Home Food availability and Weight Status. *Public Health Nutrition, 10(1)*, 16-23.

Briefel, R.R., Reidy, K., Karwe, V., & Devaney, B. (2010). Feeding Infants and Toddlers Study: Improvements Needed in Meeting Infant Feeding Recommendations. *Journal of the American Dietetic Association, 104*, S31-S37.

Campbell, C.C. (1991). Food insecurity: A Nutritional Outcome or A Predictor Variable. *Journal of Nutrition, 121(3)*, 408-415.

Caprio, S., Daniels, S.R., Drewnowski, A., Kaufman, F.R., Palinkas, L.A., Rosenbloom, A.L., & Schwimmer, J.B. (2008). Influence of Race, Ethnicity, and Culture on Childhood Obesity: Implications for Prevention and Treatment. *Diabetes Care, 31(11)*, 2211-2221.

Casey, P.H., Simpson, P.M., Gossett, J.M., Bogle, M.L., Champagne, C.M., Connell, C.,…Weber, J. (2006). The Association of Child and Household Food Insecurity with Childhood Overweight Status. *Pediatrics, 118(5),* e1406-e1413.

Centers for Disease Control and Prevention. (2015, June 19). *Childhood Obesity Facts*. Retrieved July 18, 2016, from http://www.cdc.gov/obesity/data/childhood.html.

Centers for Disease Control and Prevention. (2015, May 1). Overview of the CDC Growth Charts. Retrieved October 18, 2016, from http://www.cdc.gov/nccdphp/dnpao/growthcharts/training/overview/index.html.

Centers for Disease Control and Prevention. (2009, July 24). *Morbidity and Mortality Weekly Report: Obesity Prevalence Among Low-Income, Preschool-Aged Children-United States, 1998-2008*. Retrieved July 18, 2016, from http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5828a1.htm.

Centers for Disease Control and Prevention. (2010, September 10). *Morbidity and Mortality Weekly Report: Use of World Health Organization and CDC Growth Charts for Children Aged 0-59 Months in the United States.* Retrieved October 31, 2016, from https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5909a1.htm.

Centers for Disease Control and Prevention. (2012, June 19). *2011 Pediatric Nutrition Surveillance National Summary of Demographic Indicators*. Retrieved July 18, 2016, from http://www.cdc.gov/nccdphp/dnpao/.

Cooke, L.J., Wardle, J., Gibson, E.L., Sapochnik, M., Sheiham, A., & Lawson, M. (2003). Demographic, Familial and Trait Predictors of Fruit and Vegetable Consumption by Pre-school Children. *Public Health Nutrition, 7(2)*, 295-302.

Coulthard, H., Harris, G., & Emmett, P. (2010). Long-term Consequences of Early Fruit and Vegetable Feeding Practices in the United Kingdom. *Public Health Nutrition, 13(12)*, 2044-2051.

Cunningham, T.J., Barradas, D.T., Rosenberg, K.D., May, A.L., Kroelinger, C.D., & Ahluwalia, I.B. (2012). Is Maternal Food Security a Predictor of Food and Drink Intake Among Toddlers in Oregon? *Maternal and Child Health Journal, 16*, S339-S346.

Darmon, N., & Drewnowski, A. (2008). Does Social Class Predict Diet Quality? *The American Journal of Clinical Nutrition, 87*, 1107-1117.

Dave, J.M., Evans, A.E., Pfeiffer, K.A., Watkins, K.W., & Saunders, R.P. (2010). Correlates of Availability and Accessibility of Fruits and Vegetables in Homes of Low-Income Hispanic Families. *Health Education Research, 25(1)*, 97-108.

De Onis, M., Blossner, M., & Borghi, E. (2010). Global Prevalence and Trends of Overweight and Obesity Among Preschool Children. *The American Journal of Clinical Nutrition,* 1-8.

Dennison, B.A., Rockwell, H.L., & Baker, S.L. (1998). Fruit and Vegetable Intake in Young Children. *Journal of the American College of Nutrition, 17(4)*, 371-378.

Devine, C.M., Wolfe, W.S., Frongillo Jr, E.A., & Bisogni, C.A. (1999). Life-course Events and Experiences: Association with Fruit and Vegetable Consumption in 3 Ethnic Groups. *Journal of the American Dietetic Association, 99(3)*, 309-314.

Di Noia, J., & Byrd-Bredbenner, C. (2014). Determinants of Fruit and Vegetable Intake in Low-Income Children and Adolescents. *Nutrition Reviews, 72(9)*, 575-590.

Dixon, B., Peña, M.M., & Taveras, E.M. (2012). Lifecourse Approach to Racial/Ethnic Differences in Childhood Obesity. *Advances in Nutrition, 3*, 73-82.

Dovey, T.M., Staples, P.A., Gibson, E.L., & Halford, J.C.G. (2008). Food Neophobia and 'Picky/Fussy' Eating in Children: A Review. *Appetite, 50(2-3)*, 181-193.

Dubowitz, T., Heron, M., Bird, C.E., Lurie, N., Finch, B.K., Basurto-Dávila, R., … Escarce, J. (2008). Neighborhood Socioeconomic Status and Fruit and Vegetable Intake Among Whites, Blacks, and Mexican-Americans in the United States. *The American Journal of Clinical Nutrition, 87(6)*, 1883-1891.

Field, A.E., Gillman, M.W., Rosner, B., Rockett, H.R., & Colditz, G.A. (2003). Association Between Fruit and Vegetable Intake and Change in Body Mass Index Among a Large sample of Children and Adolescents in the United States *International Journal of Obesity, (27)*, 821-826.

Finkelstein, E.A., Khavjou, O.A., Thompson, H., Trogdon, J.G., Pan, L., Sherry, B., & Dietz, W. (2012). Obesity and Severe Obesity Forecasts Through 2030. *The American Journal of Preventive Medicine, 42(6)*, 563-570.

Fisher, J.O., Mitchell, D.C., Smiciklas-Wright, H., & Birch, L.L. (2002). Parental Influences on Young Girls' Fruit and Vegetable, Micronutrient, and Fat Intakes. *Journal of the American Dietetic Association, 102(1)*, 58-64.

Forestell, C.A., & Mennella, J.A. (2007). Early Determinants of Fruit and Vegetable Acceptance. *Pediatrics, 120(6)*, 1247-1254.

Fox, M.K., Pac, S., Devaney, B., & Jankowski, L. (2004). Feeding Infants and Toddlers Study: What Foods Are Infants and Toddlers Eating? *The Journal of the American Dietetic Association, 104*, S22-S30.

Gerber. (2015). *Introducing Baby's First Foods*. Retrieved July 18, 2016, from https://www.gerber.com/supported-sitter/articles/introducing-fruit-and-veggie-baby-food.

Gibson, E.L., Wardle, J., & Watts, C.J. (1998). Fruit and Vegetable Consumption, Nutritional Knowledge and Beliefs in Mothers and Children. *Appetite, 31*, 205-228.

Goodell, S.L., Wakefield, D.B., & Ferris, A.M. (2009). Rapid Weight Gain During the First Year of Life Predicts Obesity in 2-3 Year Olds from a Low-income, Minority Population. *The Journal of Community Health, 34*, 370-375.

Goran, M.I., Ball, G.D.C., & Cruz, M.L. (2003). Obesity and Risk of Type 2 Diabetes and Cardiovascular Disease in Children and Adolescents. *The Journal of Clinical Endocrinology and Metabolism, 88(4)*, 1417-1427.

Gregory, J.E., Paxton, S.J., & Brozovic, A.M. (2011). Maternal Feeding Practices Predict Fruit and Vegetable Consumption in Young Children. Results of a 12-month Longitudinal Study. *Appetite, 57(1*), 167-172.

Grimm, K.A., Kim, S.A., Yaroch, A.L., & Scanlon, K.S. (2014). Fruit and Vegetable Intake During Infancy and Early Childhood. *Pediatrics, 134(1)*, S63-S69.

Grummer-Strawn, L.M., Scanlon, K.S., & Fein, S.B. (2008). Infant Feeding and Feeding Transitions During the First Year of Life. *Pediatrics, 112*, s36-s42.

Harris, G., & Coulthard, H. (2016). Early Eating Behaviours and Food Acceptance Revisited: Breastfeeding and Introduction of Complementary Foods as Predictive of Food Acceptance. *Current Obesity Reports, 5*, 113-120.

Heerman, W.J., Bian, A., Shintani, A., & Barkin, S.L. (2014). The Interaction Between Maternal Pre-Pregnancy BMI and Gestational Weight Gain Shapes Infant Growth. *Pediatrics, 14*(5), 463-470.

Hiza, H.A.B., Casavale, K.O., Guenther, P.M., & Davis, C.A. (2013). Diet Quality of Americans Differ by Age, Sex, Race/Ethnicity, Income, and Education Level. *The Journal of the Academy of Nutrition and Dietetics, 113(2)*, 297-306.

Hughes, S.O., Anderson, C.B., Power, T.G., Micheli, N., Jaramillo, S., & Nicklas, T.A. (2006). Measuring Feeding in Low-Income African–American and Hispanic parents. *Appetite, 46*, 215-223.

Institute of Medicine. (2011). *Early Childhood Obesity Prevention Policies*. Washington, DC: Shelley McGuire.

Johns Hopkins Medicine. *Feeding Guide for the First year*. (2016). Retrieved July 18, 2016, from http://www.hopkinsmedicine.org/healthlibrary/conditions/pediatrics/feeding_guide_for_the_first_year_90,P02209/.

Keller, K.L., Steinmann, L., Nurse, R.J., & Tepper, B.J. (2002). Genetic taste sensitivity to 6-n-propylthiouracil influences food preference and reported intake in preschool children. *Appetite, 38*, 3-12.

Keller, K.L., & Tepper, B.J. (2004). Inherited Taste Sensitivity to 6-n-Propylthiouracil in Diet and Body Weight in Children. *Obesity Research, 12(6)*, 904-912.

Kendall, A., Olson, C.M., & Frongillo Jr, E.A. (1996). Relationship of hunger and food insecurity to food availability and consumption. *Journal of the American Dietetic Association, 96(10),* 1019-1024.

Krebs-Smith, S.M., Guenther, P.M., Subar, A.F., Kirkpatrick, S.I., & Dodd, K.W. (2010). Americans Do Not Meet Federal Dietary Recommendations. *The Journal of Nutrition, 140*, 1832-1838.

Kuo, A.A., Inkelas, M., Slusser, W.M., Maidenberg, M., & Halfon, N. (2011). Introduction of Solid Food to Young Infants. *Maternal and Child Health Journal, 15*, 1185-1194.

Larsen, J.K., Hermans, R.C.J., Sleddens, E.F.C., Engels, R.C.M., Fisher, J.O., & Kremers, S. (2015). How Parental Dietary Behavior and Food Parenting Practices Affect Children's Dietary Behavior. Interacting Sources of Influence? *Appetite, 89*, 246-257.

Ledoux, T.A., Hingle, M.D., & Baranowskin, T. (2011). Relationship of Fruit and Vegetable Intake with Adiposity: A Systematic Review. *Obesity Reviews, 12(5),* 143-150.

Let's move! America's move to raise a healthier generation for kids. (2010, May). Retrieved July 2, 2016, from http://www.letsmove.gov/white-house-task-force-childhood-obesity-report-president.

Li, C., Ford, E.S., Mokdad, A.H., & Cook, S. (2006). Recent Trends in Waist Circumference and Waist-Height Ratio Among US Children and Adolescents. *Pediatrics, 118(5)*, 1390-1398.

Liese, A.D. (2006). The Burden of Diabetes Mellitus Among US Youth: Prevalence Estimates From the SEARCH for Diabetes in Youth Study. *Pediatrics, 118(4)*, 1510-1518.

Lorson, B.A., Melgar-Quinonez, H.R., & Taylor, C.A. (2009). Correlates of Fruit and Vegetable Intakes in US Children. *Journal of the American Dietetic Association, 109*, 474-478.

Mallan, K.M., Fildes, A., Magarey, A.M., & Daniels, L.A. (2015). The Relationship between Number of Fruits, Vegetables, and Noncore Foods Tried at Age 14 Months and Food Preferences, Dietary Intake Patterns, Fussy Eating Behavior, and Weight Status at Age 3.7 Years. *Journal of the Academy of Nutrition and Dietetics, 116(4)*, 630-637.

Martin, L.J., Lee, S., Couch, S.C., Morrison, J., & Woo, J.G. (2011). Shared Genetic Contributions of Fruit and Vegetable Consumption with BMI in Families 20 y After Sharing a Household. *The American Journal of Clinical Nutrition, 94*, 1138-1143.

Matheson, D. (2008). Factors Influencing Food Intake of Hispanic Children. *Progress in Pediatric Cardiology, 25(2)*, 143-146.

Mello, J.A., Gans, K.M., Risica, P.M., Kirtania, U., Strolla, L.O., & Fournier, L. (2010). How is Food insecurity Associated with Dietary Behaviors? An analysis with Low Income, Ethnically Diverse Participants in a Nutrition Intervention Study. *Journal of the American Dietetic Association, 110(12)*, 1906-1911.

Moore, L.L., Singer, M.R., Bradlee, M.L. Djoussé, L., Proctor, M.H., Cupples, L.A., & Ellison, R.C. (2005). Intake of Fruits, Vegetables, and Dairy Products in Early Childhood and Subsequent Blood Pressure Change. *Epidemiology, 16(1)*, 4-11.

Moore, L.V., & Diez Roux, A.V. (2006). Associations of Neighborhood Characteristics with the Location and Type of Food Stores. *The American Journal of Public Health, 96(2)*, 325-331.

National Research Council. (2006). *Food Insecurity and Hunger in the United States: An Assessment of the Measure*. Retrieved from http://www.nap.edu. Accessed July 2, 2016.

Ness, A.R., Maynard, M., Frankel, S., Davey Smith, G., Frobisher, C., Leary, S.D.,…Gunnell, D. (2005). Diet in Childhood and Adult Cardiovascular and All Cause Mortality: the Boyd Orr Cohort. *Heart, 91*, 894-898.

Nikolić, M., Niki, D., & Petrović, B. (2008). Fruit and Vegetable Intake and the Risk for Developing Coronary Heart Disease. *Central European Journal of Public Health, 16(1)*, 17-20.

Obesity and overweight. (2016). Retrieved October 18, 2016, from http://www.who.int/mediacentre/factsheets/fs311/en/

Ogden, C.L., Carroll, M.D., Kit, B.K., & Flegal, K.M. (2014). Prevalence of Childhood and Adult Obesity in the United States, 2011-2012. *JAMA: The Journal of the American Medical Association, 311(8)*, 806-814.

Ogden, C.L., Carroll, M.D., Curtin, L.R., Lamb, M.M., & Flegal, K.M. (2010). Prevalence of High Body Mass Index in US Children and Adolescents, 2007-2008. *JAMA: The Journal of the American Medical Association, 303(3)*, 242-249.

Paeratakul, S., White, M.A., Williamson, D.A., Ryan, D.H., & Bray, G.A. (2002). Sex, Race/Ethnicity, Socioeconomic Status, and BMI in Relation to Self-Perception of Overweight. *Obesity Journal, 10(5)*, 345-350.

Pan, L., Blanck, H.M., Sherry, B., Dalenius, K., & Grummer-Strawn, L.M. (2012). Trends in the Prevalence of Extreme Obesity Among US Preschool-Aged Children Living in Low-Income Families, 1998– 2010. *JAMA: The Journal of the American Medical Association, 308(24)*, 2563-2565.

Pan, L., May, A.L., Wethington, H., Dalenius, K., & Grummer-Strawn, L.M. (2013). Incidence of Obesity Among Young US Children Living in Low-Income Families, 2008-2011. *Pediatrics, 132(6)*, 1006-1013.

Pan, L., McGuire, L.C., Blanck, H.M., May-Murriel, A.L., & Grummer-Strawn, L.M. (2015). Racial/Ethnic Differences in Obesity Trends Among Young Low-Income Children. *The American Journal of Preventive Medicine, 48(5)*, 570-574.

Panagiota, K., Pawloski, L.R., & Gaffney, K.F. (2010). Maternal Prepregnancy Body Mass Index in Relation to Hispanic Preschooler Overweight/Obesity. *The European Journal of Pediatrics, 169*, 1361-1368.

Reinaerts, E., De Nooijer, J., Candel, M., & De Vries, N. (2007). Explaining School Children's Fruit and Vegetable Consumption: The Contributions of Availability, Accessibility, Exposure, Parental Consumption and Habit in Addition to Psychosocial Factors. *Appetite, 48*, 248-258.

Rodgers, R.F., Paxton, S.J., Massey, R., Campbell, K.J., Wertheim, E.H., Skouteris, H., & Gibbons, K. (2013). Maternal Feeding Practices Predict Weight Gain and Obesogenic Eating Vehaviors in Young Children: A Prospective Study. *International Journal of Behavioral Nutrition and Physical Activity, 10(24)*, 1-10.

Russell, C.G., Taki, S., Laws, R., Azadi, L., Campbell, K.J., Elliott, R.,…Denny-Wilson, E. (2016). Effects of Parent and Child Behaviours on Overweight and Obesity in Infants and Young Children from Disadvantaged Backgrounds: Systematic Review with Narrative Synthesis. *BioMed Central Public Health, 16(151),* 1-13.

Salvo, D., Frediani, J.K., Ziegler, T.R., & Cole, C.R. (2012). Food group intake patterns and nutrient intake vary across low-income Hispanic and African American preschool children in Atlanta: a cross sectional study. *Nutrition Journal, 11(62)*, 1-9.

Savage, J.S., Fisher, F.O., & Birch, L.L. (2007). Parental Influence on Eating Behavior. *The Journal of Law, Medicine, and Ethics, 35(1)*, 22-34.

Schwartz, C., Scholtens, P.A.M.J., Lalanne, A., Weenen, H., & Nicklaus, S. (2011). Development of Healthy Eating Habits Early in Life. Review of Recent Evidence and Selected Guidelines. *Appetite, 57*, 796-807.

Siega-Riz, A.M., Deming, D.M., Reidy, K.C., Fox, M.K., Condon, E., & Briefel, R.R. (2010). Food Consumption Patterns of Infants and Toddlers: Where Are We Now? *Journal of the American Dietetic Association, 3(10)*, S38-S51.

Singh, G.K., Kogan, M.D., & Yu, S.M. (2009). Disparities in Obesity and Overweight Prevalence Among US Immigrant Children and Adolescents by Generational Status. *The Journal of Community Health, 34*, 271-281.

Singh, G.K., Siahpush, M., Hiatt, R.A., & Timsina, L.R. (2011). Dramatic Increases in Obesity and Overweight Prevalence and Body Mass Index Among Ethnic-Immigrant and Social Class Groups in the United States, 1976–2008. *The Journal of Community Health, 36*, 94-110.

Sinha, R., Fisch, G., Teague, B., Tamborlane, W.V., Banyas, B., Allen, K., …Caprio, S. (2002). Prevalence of Impaired Glucose Tolerance Among Children and Adolescents with Marked Obesity. *The New English Journal of Medicine, 346(11)*, 802-810.

Skinner, J.D., Carruth, B.R., Bounds, W., Ziegler, P., & Reidy, K. (2002). Do Food-Related Experiences in the First 2Years of Life Predict Dietary Variety in School-Aged Children? *The Journal of Nutrition Education and Behavior, 34(6)*, 310-315.

Sorof, J.M., Lai, D., Turner, J., Poffenbarger, T., & Portman, R.J. (2004). Overweight, Ethnicity, and the Prevalence of Hypertension in School-Aged Children. *Pediatrics, 113(3)*, 475-482.

Sullivan, S.A., & Birch, L.L. (1994). Infant Dietary Experience and Acceptance of Solid Foods. *Pediatrics, 93(2)*, 271-277.

Sylvestre, M., O'Loughlin, J., Gray-Donald, K., Hanley, J., & Paradis, G. (2007). Association Between Fruit and Vegetable Consumption in Mothers and Children in Low-Income, Urban Neighborhoods. *Health Education and Behavior, 34(5)*, 723-734.

Taveras, E.M., Gillman, M.W., Kleinman, K.P., Rich-Edwards, J.W., & Rifas-Shiman, S.L. (2013). Reducing Racial/Ethnic Disparities in Childhood Obesity: The Role of Early Life Risk Factors. *JAMA Pediatrics: The Journal of the American Medical Association Pediatrics, 167(8)*, 1-15.

The Children's Hospital of Philadelphia. (2016). *Feeding Guide for the First Year*. Retrieved July 18, 2016, from http://www.chop.edu/conditions-diseases/feeding-guide-first-year#.V4Qug6OAOko.

United States Department of Agriculture. (2015). *Household Food Security in the United States in 2014* (Economic Research Report No. 194). Washington, DC: Economic Research Service.

United States Department of Agriculture (2016). *WIC Income Eligibility Guidelines*. Retrieved July 18, 2016, from http://www.fns.usda.gov/wic/wic-income-eligibility-guidelines.

Qi, Z., Wang, Y., & Huang, E.S. (2009). Chances in Racial/Ethnic Disparities in the Prevalence of Type 2 Diabetes by Obesity Level among U.S. Adults. *Ethnicity and Health, 14(5)*, 439-457.

United States Census Bureau. (2015, September 14). *Hispanic Heritage Month 2015*. Retrieved July 25, 2016, from http://www.census.gov/newsroom/facts-for-features/2015/cb15-ff18.html.

State of New Jersey Department of Health. (2016, July). *WIC Program Information*. Retrieved July 25, 2016, from http://www.state.nj.us/health/fhs/wic/proginfo.shtml.

Van Duyn, M.A.S., & Pivonka, E. (2000). Overview of the Health Benefits of Fruit and Vegetable Consumption for the Dietetics Professional: Selected Literature. *Journal of the American Dietetic Association, 100(12)*, 1511-1521.

Ventura, A.K., Gromis, J.C., & Lohse, B. (2010). Feeding Practices and Styles Used by a Diverse Sample of Low-income Parents of Preschool-age Children. *Journal of Nutrition Education and Behavior, 42(4)*, 242-249.

Ventura, A.K., & Worobey, J. (2013). Early Influences on the Development of Food Preferences. *Current Biology, 23(9)*, R401-R408.

Vereecken, C.A., Keukelier, E., & Maes, L. (2004). Influence of Mother's Educational Level on Food Parenting Practices and Food Habits of Young Children. *Appetite, 43*, 93-103.

Vereecken, C., Rovner, A., & Maes, L. (2010). Associations of Parenting styles, Parental Feeding Practices and Child Characteristics with Young Children's Fruit and Vegetable Consumption. *Appetite, 55*, 589-596.

Wang, Y. (2001). Cross-national Comparison of Childhood Obesity: The Epidemic and the Relationship Between Obesity and Socioeconomic Status. *International Journal of Epidemiology, 30*, 1129-1136.

Wang, Y. (2011). Disparities in Pediatric Obesity in the United States. *Advances in Nutrition: An International Review Journal, 2*, 23-31.

Wang, Y., & Zhang, Q. (2006). Are American Children and Adolescents of Low Socioeconomic Status at Increased Risk of Obesity? Changes in the Association Between Overweight and Family Income Between 1971 and 2002. *The American Journal of Clinical Nutrition, 84*, 707-716.

Wardle, J., Carnell, S., & Cooke, L. (2005). Parental Control Over Feeding and Children's
Fruit and Vegetable Intake: How Are They Related? *Journal of the American Dietetic Association, 105*, 227-232.

Washington, P.S., Reifsnider, E., Bishop, S.L., Ethington, M.D., & Ruffin, R.E. (2010). Changes in Family Variables among Normal and Overweight Preschoolers. *Issues in Comprehensive Pediatric Nursing, 33(1),* 20-38.

Woo Baidal, J.A., Locks, L.M., Cheng, E.R., Blake-Lamb, T.L., Perkins, M.E., & Taveras, E.M. (2016). Risk Factors for Childhood Obesity in the First 1,000 Days. *The American Journal of Preventive Medicine,50(6)*, 761-779.

Worobey, H., Ostapkovich, K., Yudin, K., & Worobey, J. (2010). Trying Versus Liking Fruits and Vegetables: Correspondence Between Mothers and Preschoolers. *Ecology of Food and Nutrition, 49(2)*, 87-97.

Worobey, J., Borrelli, A., Espinosa, C., & Worobey, H. (2013). Feeding Practices of Mothers from Varied Income and Racial/Ethnic Groups. *Early Child Development Care, 183(11)*, 1661-1668.

Yeh, M., Ickes, S.B., Lowenstein, L.M., Shuval, K., Ammerman, A.S., Farris, R., & Katz, D.L. (2008). Understanding Barriers and Facilitators of Fruit and Vegetable Consumption Among a Diverse Multi-Ethnic Population in the USA. *Health Promotion International, 23(1)*, 42-51.

Zive, M.M., Frank-Spohrer, G.C., Sallis, J.F., McKenzie, T.L., Elder, J.P., Berry, C.C….Nader, P.R. (1998). Determinants of Dietary Intake in a Sample of White and Mexican-American Children. *Journal of the American Dietetic Association, 98*, 1282-1289.

VII. APPENDIX

Appendix A: *Informed Consent Form*

Informed Consent Form
Project Title: Rutgers Infant Nutrition and Growth Project
Principal Investigator: John Worobey, Ph.D.

You are invited to participate in a research study that is being conducted by Dr. John Worobey, a professor in the Nutritional Sciences Department at Rutgers University. The purpose of this research is to look at growth patterns among 100 infants and children and to see how these relate to levels of activity and food intake. The information collected in this research will help us to better understand the growth and development of children like yours. This letter contains information about the study and the conditions of your participation.

Participation in this study will involve the following:

1) Allow us to visit you at home for about an hour three times during the first year of age of your child (at 3, 6 and 12 months), and one time when s/he is 2, 3, 4 and 5 years of age.
2) Let your child wear a tiny computer the day of the visit and keep it on his/her leg for one day. This computer keeps a record of your child's leg movements.
3) At the time of the visit answer some questions about your child's personality and behavior, and your attitudes towards feeding; allow us to measure your child; keep a record of how much your child eats, and let us observe when you are feeding your child. We will also answer any questions that you may have about the results.
4) Your participation is voluntary (you do not have to be in this study if you do not want to).
5) You can stop participating in this study or to refuse to participate in any procedure or to answer any question at any time you want without having any penalties or repercussions for you or your child.
6) Your identity and your child's identity will remain confidential in any reports of the investigation. The research team and the Institutional Review Board at Rutgers University are the only parties that will be allowed to see the data, except as may be required by law. If a report of this study is published, or the results are presented at a professional conference, only group results will be stated. All study data will be kept for 5 years.
7) There are no foreseeable risks to participation in this study. You may benefit from taking part in this study by having the opportunity to ask questions about your infant's development. As a direct benefit you will receive $30 cash for every 2-day home visit for a total of $210 if you complete the entire study.

Please sign below if you agree to participate in this study. You will be given a copy for your records. If you have any further questions about your participation contact Dr. John Worobey, Department of Nutritional Sciences 26 Nichol Ave., New Brunswick, NJ (worobey@rci.rutgers.edu) Tel: 732-932-6517. If you have any other questions about your rights as a participant in a research study you may contact the Sponsored Programs Administrator at:

Rutgers University Institutional Review Board for the Protection of Human Subjects
Office of Research and Sponsored Programs
3 Rutgers Plaza. New Brunswick, NJ 08901-8559
Tel: 732-932-0150 ext. 2104 Email: humansubjects@orsp.rutgers.edu

"I have read and understood the above description, I have been given the opportunity to ask questions regarding my child's and my participation and I agree to participate in the research":

Signatures:____________________ ___________________________ __________
Participant Staff Witness Date

Appendix B: *Recruitment Information Form*

RECRUITING INFORMATION FORM-RING PROJECT

Name of Recruiter:____________________ Recruiting date: ________________

BABY'S INFORMATION *(INFORMACION DEL BEBE)*

First Name: ________________________ Last Name: ______________________
(Nombre) *(Apellido)*
Date of Birth : Dia de Nacimiento:

MOTHER'S INFORMATION *(INFORMACION DE LA MAMA)*

First Name: ________________________ Last Name: ______________________
(Nombre) *(Apellido)*

Best time to contact:______________________ Speaks English?: __________
(mejor hora para contactarla) *(Habla Ingles?)*

Address: ________________________
(Dirección) ________________________
____

Phone #: ________________________
(Teléfono)

ALTERNATE CONTACT INFORMATION
(Datos de la persona con quien se le puede localizar)

Name: ________________________
(Nombre)

Relationship to the baby's mother?:______________
(Relación que tiene con la mamá del bebé?)

Phone #: ________________________
(Teléfono)

PARENTS' DEMOGRAPHICS
Mother's Place of Origin: ______________________ Father's Place of Origin: ______________

Mother's level of schooling:______________ Father's level of schooling: ___________

Time living in the U.S.________________

Mother employed?:______________ Father employed? ________________
______________________________ ______________________________

Best time to contact: ________________________ 08/19/02

Appendix C: *General Information Form*

GENERAL INFORMATION FORM- RING

(Data obtained from WIC records)
Household WIC ID #: ____________________

INFANT'S INFORMATION
First Name: ____________________ Last Name: ____________________

Female____ Male ____ Race/Ethnicity:____________________

Date of Birth: ______________ Birth Weight: ______________ Birth Length: ______________

Gestation Weeks: ____________ Birth order:______

MEASUREMENT INFORMATION

Date	Age at Measurement	Weight	Length	BMI	Hemoglob.

MOTHER'S INFORMATION
First Name: ____________________ Last Name:____________________

Date of Birth: ______________ Race/Ethnicity:____________________

PREGNANCY INFORMATION
Pre-Pregnancy Weight: ___________ Weight at delivery: ____________

Weight gained during pregnancy: __________

Measurement DURING pregnancy

Date	Pregnancy week	Weight	Height	BMI	Hemoglob.

Measurement AFTER pregnancy

Date	Age at Measurement	Weight	Height	BMI	Hemoglob.

FEEDING INFORMATION
Formula provided :______________________________

Ever Breastfed? ________ End Date________________

Reason for formula feeding? ______________________________

Age Formula Introduced: ______________ # of Ounces a day ________

09/23/2002

Appendix D: *Home Visit Report*

Home-Visit Report-Ring Project

Subject #:________________ Date: ____________

Home visitors: ____

Measurements:

Arm (cm):_________ Weight (kg):________ Height (cm):_________

Before you leave the house ask:

1. Was the child's behavior in the past 24 hours typical? ____________ (yes/no)
a. If "No", why not? ____
____

b. What do you think might have contributed to such an atypical behavior? (e.g. baby just had shots, baby was sick, etc.)____

2. Will your telephone number and address be the same for the next three months?
____
a. If answer is "No", new address: _______________ new tel. #_________
____
____

3. Thank you very much for your help and remember that we will contact you again in three months/one year (depending on the baby's age). If you have any questions please contact us at (732) 932-2766.

SUMMARY OF EVENTS:

____
____
____
____

EMERGENCY CONTACTS for the Home Visitors:

(732) 932-2766	**and/or**	**John Worobey, Ph.D. (732) 932-6517**
RING Project Office		**Principal Investigator**

Appendix E: *24-hour Dietary Recall*

24-hr Diet Recall RING

Subject #: ____________________ Fecha: ____________________

Directions for Research Assistants:

Indicate **Brands** if not generic (e.g Tropicana, Dannon, Dorritos, Skippy's PB).

Use food models to get accurate amounts.

List all ingredients if homemade (e.g. , Type of oil use, what vegetables, beef broth or chicken broth,).

***** If recording 2 days, and the visit is on a weekend, make sure one of the days is a weekday *****

Method of Preparation		**Cantidades/ Quantities**
* fresh	* raw	* onzas/ ounces(ej. 2 onzas de pure de manzana)
* frozen	* panfried	* puño/ handful (ej. 1 puño de cheerios)
* fried	* steamed	* cucharaditas/ teaspoon (ej. 4 cucahardítas de pure papa)
* baked	* grilled	* cucharada/ tablespoon (ej. 1 cucharada de miel de abeja)
* canned	* hard-cooked/ boiled	* tazas/ cups (ej. ¼ taza de jugo de naranja natural)

Typical day(s): Yes ▢ No ▢

Time	Food/ Drink	Type/Description	Preparation	Amount
Example				
8:00 AM	*Bagel*	*Cinnamon Raisin*	*Toasted*	*half*
Noon	*Chicken*	*Leg and thigh*	*fried*	*1 each*
	Juice	*Tropicana OJ*	*100 % Juice*	
4:00 PM	*Soup*	*Chicken broth*	*Homemade*	*3/4 cup*
		Carrots		*1 Tbsp*
		Potatoes		*1.5 Tbsp*
		Meat only, chicken		*1 oz*
**				

Appendix F: *Feeding Interview Form*

FEEDING INTERVIEW- RING PROJECT

Infant's name: ______________________ Infant's age: ______________
Answered by: ________________________ Date: _______________

Let's talk about your baby and feeding **during the past three months**…..

1) Which of the following best describes your baby's eating routine?
____ You fed the baby whenever he or she cried or got fussy
____ Your baby was on a rigid feeding schedule (for example, You awakened the sleeping baby to eat on time)
____ Your baby was on a flexible feeding schedule (for example, "approximately" every 3 or 4 hours).

2) How many times a day does your baby usually eat during a 24 hour period? _____________

3) How much does your baby eat each time? (specify amount) ________________________

4) Who would you say usually determines your baby's eating routine?
_____ You or caregiver
_____ The baby
_____ Both

5) During the past three months what have you been giving your baby?
_____ Formula only
_____ Formula with something added (for example, flavoring, cereal). Specify:

TYPE OF FOOD	SINCE WHEN	HOW FREQUENT	HOW MUCH

__________ Formula *and* something else (for example, juice, solid food) Specify:

TYPE OF FOOD	SINCE WHEN	HOW FREQUENT	HOW MUCH

6) Who regularly feeds the baby? (If not mother specify who and the amount of time the baby spends with the caregiver)

____

Appendix F: *Feeding Interview Form*

FEEDING INTERVIEW- RING PROJECT

7) How would you classify your feeding philosophy?
_____ feeding on demand (for example, when the baby cries or seems to be hungry)
_____ feeding on a schedule (for example, every 3-4 hours)

8) How many daily naps did your baby take during the past 3 months? _____________

9) How many times did your baby awaken during night sleep during the past 3 months? ___________

10) What did you usually do when your baby fussed or cried?

11) How did you get your baby to sleep for naps or at night time?

OBSERVATIONS (for whatever the mother mentions relevant to feeding that has not been asked or home-visitor's comments)

Appendix G: *Food Frequency Questionnaire*

DAIRY GROUP

How much total per day of:

MILK *(amount):* ____________

whole____

2 % ____

Do you add something to the milk?

Cereal? (type and amount):__________

Flavoring (e.g. qwik) (type and amount):__________

Other: (type and amount):__________

FORMULA*(amount):* ____________

Type:______________

Do you add something to the formula?

Cereal? (*type and amount*):______________

Flavoring (e.g. qwick) (*type and amount*):__________

Other: (*type and amount*):__________

CHEESE ***(amount):*** __________

What kind?: ________________

YOGURT*(amount):* ____________

Please indicate type:

Plain____

Plain with fresh fruit_____

Flavored____

Low fat_____

MEAT GROUP

*How much total per day:*______________

Indicate if it is:

Baby food?:_____ Pureed or chopped adult food?:____

Check all that apply:

Pork____ chicken____ Turkey____

Beef____ fish____ Liver/kidney____

Other (*indicate*):______________

____

BEANS GROUP

*How much total per day:*__________

Check all that apply:

black beans____ pinto beans____

lentils_____ chick peas____

Lima beans____ bayo beans____

kidney beans_____ green peas____

white beans_____

other (indicate type):____________

EGGS

How much total ***per week****:*____

Indicate if: white only_____ yolk only___

white and yolk______

BREAD AND CEREAL

How much total per day of:

BREAD ***(amount):***__________

whole grain?:_____ white?:____

Other (indicate):____________

PASTA *(amount):* __________

home-cooked?:____ canned?:____

RICE*(amount):* ________

TORTILLA*(amount):* __________

Corn?:____ wheat?_____

CEREAL*(amount):* ____________

sweetened?(*e.g. Frosted flakes*)_____

*unsweetened? (e.g. Corn Flakes, Cheerios)*____

baby cereal *(type)*: ____________

PANCAKE/WAFFLE *(amount):*________

COOKIES (*type and amount*):______________

CRACKERS (*type and amount*):______________

FRUITS

How much total per day:

____

Check all that apply:

orange____ apple____

banana____ peach____

pear____ prunes____

plantain____ guava____

watermelon___ plum____

Strawberries____

mango___ pineapple____

grapes____ papaya____

cantaloupe/honeydew____

other (*indicate*)________

____

JUICE

How much total per day:

____

Type:______________

VEGETABLES:

How much total per day:

____

Check all that apply:

carrots___ potatoes____

squash____ broccoli___

spinach____ corn____

Zucchini___ beets____

green beans_____

chayote_____ tomato____

other (*indicate*) __________

____

Please name any other foods and beverages (e.g. kool-aid, chips, ice-cream, etc) that your child eats/drinks at least once a week (indicat amounts and frequency):______________________________

____