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Maternal Depression, Infant Feeding Practices, and Weight Gain Among African American and Hispanic Women

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Abstract

Depression and the Feeding and Weight Gain of Infants

of African American and Hispanic Women

by

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BSc University of Akron, 1985

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Abstract

Childhood overweight and obesity are public health concerns that have negative health consequences and affect many children. Efforts are needed to identify children who are at a higher risk of developing overweight and obesity so that early detection and treatment may be offered. The intent of this study was to investigate the differences in the effects of postpartum depression on infant feeding practices and infant weight gain between Hispanic and African American women. Data were obtained from Infant Feeding Practices Study 11, a longitudinal study involving mothers in their third trimester through infants first year of life. The overall test of model coefficient of complete cases (N = 192, missing = 443) was not statistically significant (x^2 = 4.842, df =2, p = 0.089). The result of the overall test after multiple imputation (n = 289) remained insignificant (on average x^2 = 4.031, df = 2, p = 0.133). However, results indicated a significant association between excessive infant weight gain and feeding practices (breast feeding vs. formula feeding; r = 0.207, p = 0.01), supporting previous research on the protective effect of breast feeding on excess infant weight gain. Positive social change implications include an understanding of how maternal and infant characteristics may identify early symptoms of maternal depression, through increased awareness and reduced incidents of childhood obesity and maternal postpartum depression.

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Chapter 1: Introduction to the Study

Introduction

The rise in childhood overweight and obesity in the past three decades have resulted in a national epidemic of obesity (Ogden, Carroll, Kit, & Flegal, 2012), which has become a major public health concern. The foods women choose to feed their infants coupled with the manner in which they feed them create the foundation for the child's food consumption throughout life (Scaglioni, Arrizza, Vechi, & Tedeschi, 2011). Childhood overweight or obesity is a public health problem accompanied by many chronic conditions that predict a wide range of morbidity and mortality (Jansen et al., 2012). Childhood overweight and obesity are associated with cardiovascular diseases, type 2 diabetes mellitus, hypertension, osteoporosis, certain cancers, and psychosocial problems (Jansen et al., 2012). Considering the extensive knowledge available regarding the occurrence of childhood obesity and the levels of risk it presents for chronic diseases, advancing the understanding of childhood obesity etiology is essential.

The review of literature identified many determinants for childhood overweight, including maternal pre-pregnancy body mass index (BMI) and children's lack of physical activity (Frederick, Williams, Sales, Martin, & Killien, 2008; Olson, Strawderman, & Dennison, 2009). Such factors seem modifiable by mothers. Behavioral research has provided information on the modifiable factors of childhood overweight by suggesting that infant's eating behaviors, patterns, and styles are associated with BMI, (Jansen et al., 2012). In the United States, about 10% of infants have excess body weight associated with higher BMI (Gaffney, Kitsantas, Brito, & Swamidoss, 2014), and growing evidence

in the literature supports the belief that early infant feeding practices form the basis of lifelong eating habits (Karp, Lutenbacher & Dietrich, 2010).

Background

One study showed that rapid weight gain may be associated with later obesity, and poor health status including chronic diseases (Leunissen, Kerkhof, Stijnen, & Hokken-Koelega, 2009). There are a number of studies in the literature that attempt to investigate the association of maternal depression and maternal infant feeding practices such as breastfeeding and formula feeding. However, these studies only included European American women, primarily those of moderate to high incomes, moderate education, and with infants at 6 months of age (Gaffney et al., 2014). Understanding how maternal depression associates with infant feeding practices in infants less than 1 year of age remains unclear among African American and Hispanics. This is significant because the protective effect of breastfeeding for infants has been documented (Ludlow et al., 2012), and existing evidence has shown that breastfeeding accounts for a 10% to 30% reduction in childhood obesity risk through adulthood (DiSantis, Collins, Fisher, & Davey, 2011).

.The causes of childhood obesity and overweight can be divided into genetic factors and lifestyle factors such as physical activity and eating habits (Birch, L.L., and Fisher, J.O., 2015). Several epidemiologic studies have shown that infant lifestyle is primarily controlled by the parents and that childhood obesity is related to family variables such as socioeconomic status, employment status, and education levels (Birch, L.L, and Fisher, J.O., 2015).

Childhood obesity is related to a variety of maternal factors (Shirasawa et al., 2012). Among parental variables, maternal perceptions of a child's large sizes may result in a failure to model a healthy lifestyle for the child, which could be a major determinant of the child's future lifestyle (Lampard Franckle & Davison, 2012). While the reasons for the rapid increase in childhood overweight and obesity during the past 3 decades has not been fully understood (Wang et al., 2013), several factors associated with maternal infant feeding practices may help shed light (Butte, 2009). One such factor may be depressive symptoms in the mother developed a few weeks after giving birth (Kakyo, Muliira, Mbalinda, Kizza, & Muliira, 2011), Maternal postpartum symptoms may include mild insomnia, tearfulness, and poor concentration, a depressive affect known as postpartum blues (Kakyo et al., 2011).

Maternal depression affects about 50% of women of childbearing age, which may contribute to the development of childhood obesity (Wang et al., 2013). Depression was shown to interfere significantly with self-care and parenting, including infant feeding practices, and this may contribute to increased risk of childhood overweight (Wang et al., 2013) . In the United States, 10% to 15% of mothers suffer postpartum depression (PPD) (Ramos-Marcuse et al., 2009). However, 35% to 67% of African American and Hispanic women experience depression after giving birth, particularly single, young, and poorly educated mothers (Kavanaugh et al., 2006). PPD in the mother may have long-lasting effects on the child's cognitive and language development (Kersten-Alvarez et al., 2012).

In their first year, about 13% of all children are exposed to maternal depression, resulting in increased risk for impaired mother-child interactions and insecure mother-

infant attachment (Kersten-Alvarez et al., 2012). Increased levels of maternal PPD tend to have a significant effect on the mother's ability to effectively and adequately care for the infant (Ertel, Rich-Edwards, & Koenen, 2011), which may impair cognitive and language development and lead to high rates of comorbidity associated with the general wellness of infants The purpose of this study was to investigate the relationship/differences between African American and Hispanic mothers in regard to infant feeding practices and infant weight gain. Mothers with and without depression, and those who breastfed as well as those who formula fed their infants were studied in order to assess the impact of those factors on infant weight status. By better understanding the influence of PPD on maternal early infant feeding practices and the effect this has on infant weight gain, interventions that promote screening for depression in new mothers may be developed and programs that teach appropriate infant feeding practices instituted. Such interventions may result in a reduction in childhood overweight and obesity.

Problem Statement

Studies show that a great number of children in the United States may be exposed to maternal depression (Freed, Boger, Chan & Tompson, 2012). For example, Flykt, Kanninen, Sinkkonen, and Punamaki (2010) indicated that transitioning to motherhood comes with profound challenges and new responsibilities that may lead to maternal depression. Depressed mothers face challenges that include disorganized interaction, attachment problems, and inappropriate feeding practices (Mason, Briggs, & Silver, 2011). The pressure of responding to the nutritional needs of the infant may bring on negative maternal feelings, which could result in a break in or cessation of infant

breastfeeding practices and early introduction of formula milk and solid foods (Ertel et al., 2011). The adverse effects of maternal depression on parenting practices have been documented (Haycraft, Farrow, & Blissett, 2013). Maternal depression is associated with signs of hostility, coercion, withdrawal, and lower parental self-efficacy in mother-child interactions (Eriksen et al., 2011; Hurley, Surkan, & Black, 2012).The quality of infant feeding practices (breastfeeding vs. formula feeding) may explain the impact of maternal depressive symptoms on infant excessive weight gain (Fraser et al., 2010). This study may fill the gap in the literature by investigating the possible differences of feeding practices among African American and Hispanic mothers with or without depression and may assist in crafting public health strategies for reducing or preventing both maternal depressive symptoms and childhood obesity.

Purpose of the Study

The purpose of this study was to examine the effects of PPD on early infant feeding practices, including breastfeeding at two months of age, formula feeding at two months of age, and early introduction of solid foods before four months of age. This study attempted to explore the contributions of sociodemographic and maternal behavioral factors on infant feeding practices for mothers with and without PPD and examined the relationship between those practices and excessive infant weight gain at one year of age.

The specific objectives of this study were to (a) compare the infant feeding practices (breastfeeding vs. formula feeding) in African American and Hispanic women; (b) determine the contributions of sociodemographic and behavioral factors on infant

feeding practices; and (c) examine the relationship between infant feeding practices and weight gain at one year of age for mothers with and without PPD in African American and Hispanic populations.

Scope of the Study

This study used a quantitative approach with secondary data collected by the U. S. Food and Drug Administration (FDA) and the Centers for Disease Control and Prevention (CDC) for Infant Feeding Practices Study II (IFPS II) of maternal and child health. The IFPS II study collected longitudinal data over a two year period from May 2005 to June 2007 using a survey format. Maternal depression was assessed by 10-item Edinburgh Postnatal Depression Scale (EDPS) incorporated into IFPS II 2-month postpartum surveys (Tashakori, Behbahani, & Irani, 2012).

Descriptive and inferential statistical analyses were conducted and reported for both independent and dependent variables. A nonparametric Pearson chi-square test of association was conducted to determine any significant association between PPD, infant feeding practices, and weight gain at 1 year of age, along with other maternal and infant characteristics. Logistic regression was used to estimate the impact of PPD and other maternal and infant characteristics on breastfeeding at 2 months of age, formula feeding at 2 months of age, and the age when solid foods were introduced. Multivariate linear regression was conducted to estimate the impact of early infant feeding practices on infant weight gain at 1 year of age from mothers with and without depression. A repeated measure of analysis of variance (ANOVA) was conducted to compare means of the two groups.

Hypotheses of the Study

The hypotheses of the study are as follows:

1. Postpartum depressed mothers are not likely to have increased rates of breastfeeding cessation and early formula feeding initiation.
2. Postpartum depressed mothers in African American and Hispanic populations are not likely to introduce solid foods to infants younger than 4 months of age.

Significance of the Study

This study is significant because understanding the association of maternal depression, infant feeding practices, and infant weight gain may suggest new intervention strategies for the prevention and reduction of postpartum depressive symptoms and childhood obesity (Turcksin, Bel, Gajaard & Devilieger, 2012). Infants of mothers with postpartum depression are at a greater risk for delayed physical, behavioral, and cognitive development and more likely to have experienced breastfeeding cessation and initiation of formula food at an earlier age (Field, 2010; Huang et al., 2014; Klainin & Arthur, 2009; Pearlstein et al., 2009; Vericker et al., 2010;). In addition, this study addressed the under-researched relationship between childhood obesity etiology and maternal postpartum depression within a population that has experienced significant rates of obesity in the past three decades (Ogden et al., 2012).

Previous studies on obesity focused mainly on maternal weight gain during pregnancy, as well as breast feeding intention and duration. It is unclear in African American and Hispanics populations without comparing breastfeeding and formula feeding among depressed and non-depressed mothers. Epidemiologic studies comparing

the difference between depressed and non-depressed African American and Hispanic women's infant feeding practices (breastfeeding vs. formula feeding) and as they relate to infant excessive weight gain have been inconclusive. As a result, there is a need to investigate and understand the health consequences for this population that may result from a high prevalence of maternal depression, particularly regarding childhood obesity (Pawloski, Curtin, Gewa & Attaway, 2012). The findings of this study may provide direction for better interventions to assess depression and its subsequent association or non-association with infant feeding practices and infant bodyweight.

Chapter 2: Literature Review

Introduction

This chapter concentrates on the review and synthesis of literature pertinent to the development of the conceptual framework guiding this study. The main objective of this study was to investigate whether an association exists between maternal postpartum depression, infant feeding practices, and infant excessive weight gain in African American and Hispanic women. A gap exists in the literature regarding maternal postpartum depression, infant feeding practices, and infant excessive weight gain in African American and Hispanic women. Maternal depressive symptoms, infant feeding practices (breast feeding vs. formula feeding), and infant excessive weight gain were used as a reference to identify important variables and their relationships in order to help develop the conceptual framework for this project.

The concept of infant feeding practices (breast feeding vs. formula feeding) and maternal PPD emerged as the key independent variables of interest, particularly in relation to the idea of infant excessive weight gain (dependent variable). Literature related to ecological theory, the theory of planned behavior, and social cognitive theory were used to evaluate how previous researchers had conceptualized and operationalized the Maternal Role Competence (MRC). Further review of the literature related to adolescent mothers and their infant feeding practices guided the development of the framework. This project attempted to determine how maternal psychosocial factors and infant feeding practices (breastfeeding vs. formula feeding) along with the mother's overall feelings and perceptions of her child's weight status influence infant weight gain.

Mothers' infant feeding practices were defined as the mother's ability, knowledge, skills, and attitudes related to appropriate infant feeding.),. Nishioka et al. (2011) hypothesized that a mother's depressive symptoms influence infant's actual feeding method and weight status. This chapter presents findings from various studies and provides support for this dissertation study.

Weight Change

Maternal depression is a disorder that impacts mother-child interactions and disorganizes mother-child attachment Ertel et al., 2011). For example, cessation of breastfeeding, early introduction of solid foods, and introduction of inappropriate unhealthy foods to infants may lead to overweight and obesity (Mason, Briggs, & Silver, 2011). Obesity and underweight are prevalent products of overfeeding or under nutrition in infants and contribute to numerous preventable long-term health problems (Rondinell et al., 2011). Current studies focus more on the relation of obesity to malnutrition in addressing the prevalence of obesity over the past three decades (Ogden et al., 2012).

Childhood obesity has received more recent attention due to these high rates of obesity. Wijlaars, Johnson, Jaarsveld and Wardle (2011) in an observational study using longitudinal weight data of 2,402 families taking part in the Gemini Study; a twin birth study between March and December 2007 in England and Wales, revealed no significant differences in socioeconomic status (SES) in birth weight but showed significant weight gain at lower SES ($p<0.01$). The findings of the study indicated that lower socioeconomic status contributed to large birth weight. In our study, the findings showed statistical significant effect on weight gain.

. Epidemiologic studies indicated strong evidence that obesity is hereditary (Rooney & Ozanne, 2011), in conjunction with environmental factors and/or a person's live-in environment. For instance, a cohort study involving 854 participants (Rooney & Ozanne) showed that individuals whose parents are obese have a double risk of adult obesity. However, the association of maternal obesity and offspring obesity is stronger than paternal obesity (Ojha, Saroha, Symonds, & Budge, 2013). Among 6 – 11 year olds in the United States, about 15.3% are either overweight or obese, which has been noted as a risk predictor for cardiovascular disease, type 2 diabetes, sleep apnea, osteoporosis, and certain cancers (Ogden et al., 2012). In a population-based twin birth cohort study with about 2,402 participants, Wijlaars et al. (2011) showed clear evidence of socioeconomic gradient in early infant growth in their British sample, consistent with other studies revealed that socioeconomic status predicts childhood overweight and obesity.

Many epidemiologic studies have shown that maternal factors such maternal BMI are associated with childhood overweight and obesity (Rodgers et al., 2013; Wijlaars et al., 2011), and obesogenic feeding behaviors in children two years of age or older has become the focus of obesity interventions (Gibson et al., 2007; Horodynski, Baker, Coleman, Auld, & Lindau, 2011). To explore the feasibility of in-home feeding intervention with Native American Indians (NAI), Horodynski et al. employed 42 NAI mothers in 12 focus groups, and investigated maternal knowledge, beliefs, attitudes, values, and family norms related to infant feeding practices. The researchers found several implications for the development of nutrition intervention, for example that how and when mothers transition their infants to solid food can enable the promotion of

unhealthy infant growth This findings called for the incorporation of culturally appropriate messages such as appropriate feeding methods in infant feeding practices among new mothers (Horodynski et al., 2010). Inclusion of cultural-congruent messages may enhance successful changes in infant feeding practices, and provide normative influences that help address potential barriers to the adoption of the American Academy of Pediatricians (AAP) and World Health Organization (WHO) recommendations for introduction of solid food to infants after they have reached four to six months of age (Wojcicki et al., 2011; Woo et al., 2012).

Greater parental involvement promotes better child weight-related outcomes for children receiving family-based interventions (Faith et al.). These may result in negative consequences such as isolation and acute confinement for mothers and adverse emotional, behavioral, and developmental effects on children (Eriksen et al., 2011; Hurley et al., 2012; Pearlstein et al., 2009; Field, 2010; Vericker et al., 2010).

Studies have shown that 17% to 19% of mothers of child bearing age experience symptoms of depression, which can lead to higher risk of delayed cognitive and language development in infants (Ertel et al., 2011; Freed et al., 2012; Pearlstein et al., 2009). Mothers undergoing extensive stress or depressive symptoms in their maternal role pose significant risks for disorganization of maternal infant interaction, (Flykt, Kanninen, Sinkkonen, & Punamaki, 2010; Hartley et al., 2010; Mason et al., 2011; Wang, Wu, Anderson, & Florence, 2011). Disorganized infant feeding practices and delayed cognitive development in infants may explain the impact of maternal infant feeding practices (breast feeding vs. formula feeding) on poor infant weight status.

Lower-socioeconomic status, depressive symptoms, and high maternal BMI typify maternal factors that contribute to significant effects in infant weight status (Sealy, 2010; Wijlaars et al., 2011). This highlights the importance of managing maternal depressive symptoms as they impact infant feeding practices and infant weight status by screening postpartum women for depressive symptoms (McManus and Poehlmann, 2011). Increased maternal depressive symptoms lead to increased risk for child psychopathology and dysfunctional psychosocial development (Freed et al., 2012). Early recognition of maternal depression may enhance and promote healthy infant development and prevent adverse health outcomes like excessive weight gain in infants due to inappropriate feeding practices. Manson et al. (2011), in their study examining whether positive results in maternal postpartum depression screening was associated with maternal reports of poorer infant social-emotional development, found that negative outcomes for infants were due to maternal depression and disorganized infant feeding practices that resulted in overfeeding or under-nutrition (Rondinelli et al., 2011; Sejourne, Vaslot, Beaume, Goutaudier, & Chabrol, 2012). Other studies reported that maternal factors such as high BMI, lower SES, and depressive symptoms are associated with more controlling and less sensitive feeding styles and more hospitalizations of infants (Ertel et al., 2011; Freed et al., 2012; Flykt et al., 2010; Haycraft et al., 2013; Holland et al., 2011; Sejourne et al., 2012).

Maternal efficacy seems to be the mediator between maternal depressive symptoms and child hospitalizations (Holland et al., 2011) and interventions for maternal depressive symptoms need immediate attention so as to address the risks of delayed

cognitive and language development, mental health problems, suboptimal physical growth, and other behavioral problems (Eriksen et al., 2011). For example, in 2000, >200,000 women aged between 18-44 years were diagnosed of depression and 7% of all hospitalization among young women were for depression (Wang et al., 2011). Negative perception of self (Swanson et al., 2012) during depressive situations may make a mother feel incapable of providing maternal feeding care for her infant and may prompt inappropriate infant feeding practices and this may result to controlling infant feeding practices (Haycraft et al., 2013).

Change in Society

In the United States in the last century, infant feeding practices experienced a drastic change from wet nursing to formula bottle and formula use (Stevens, Patrick and Pickler, 2009). Wet nursing began in 2000 BC until the 19th century when feeding bottle was introduced leading to the decline of wet nursing. As early as 2000 BC, breast feeding was considered a religious obligation and was not always possible due to lactation failure, and other barriers to the mothers (Stevens et al.). However, these trends have reversed slowly and breastfeeding prevalence has increased globally. Many epidemiologic studies have shown that breast feeding is the traditional method of infant feeding globally and provides great nutrient for infant's growth and development at early age (Dykes & Flacking, 2010; Murimi, Dodge, Pope and Erickson, 2010; Sheehan, Schmied and Barclay, 2013), and the last 2 centuries have seen dramatic turn in the United States.

Less than one third of infants born in the United States are exclusively breastfed for 6 months or more as recommended by the World Health Organization (WHO) and

American Academy of Pediatrics (Demirtus, Ergocmen and Taskin, 2011; Murimi, 2010; Kuzma, 2013). For example, an estimated 7.2% of mothers in Louisiana breastfeed their infants exclusively for 6 months, and more exclusive breastfeeding provide many positive health outcomes cognitive development, immune development which begins early in life (Murimi et al.). In a cross-sectional study conducted between 2007 and 2008 among 130 WIC participants, Murimi et al. revealed that about 51% of the women breastfed their infants for a mean of 15.7 ± 14.9 weeks, and more white mothers breastfed their infants compared to African American and Hispanic mothers or other races ($p<0.01$).

In 1999, the United States House of Representatives passed an appropriation bill (HR-2490) authorizing mothers of newborns to breastfeed their infants in federal properties, a way to encourage breast feeding in the society. Currently, about 24 states in the United States including the District of Columbia and Puerto Rico have laws in the books protecting breast feeding mothers in the workplace (Bai, Wunderlich and Weinstock, 2012). However, some mothers reported that the incentives offered by the government to encourage breastfeeding did not influence their decisions to breastfeed. Breastfeeding has increased, a reversal to demonstrate how physician-driven feeding practices and formula industries have taken over motherhood feeding decisions.

In 2004, R.H. Carmona, the U.S. Surgeon General sounded an alarm alerting parents about the looming epidemic surrounding children, and this epidemic coincides with the increased prevalence rates of rapid weight gain and childhood obesity in the last three decades (Ogden et al, 2012). The Institute of Medicine and Healthy People 2010, emphasized on the seriousness of this national problem but stated that urgent attention

was needed (Institute of Medicine (IOM), 2012). Childhood obesity is correlated to adulthood obesity (Rathnayake, Satchithananthan, Mahamithawa and Jayawardena, 2013; Zhang et al., 2003) and childhood obesity has multi-factorial causes that include genetics, socio-demographic, sedentary lifestyles, and excess dietary consumption (Jimenez-Cruz et al., 2010; IOM, 2012). The Centers for Disease Control and Prevention (2009), confirmed that dietary patterns and physical activity contributed the largest effect at the population level and on that premise, Michelle Obama in 2010 launched a campaign to eliminate childhood obesity within one generation. Effective nutrition and physical activity interventions make positive lifestyle changes to nutrition behavior on individual health status (Nutrition Care Process, 2010).

A report from the Institute of Medicine Committee on Childhood Obesity Prevention in Children and Youths contends that the United States society has changed dramatically in the last three decades and those changes coincided with rapid weight gains or childhood obesity among children (Goodell, Wakefield and Ferris, 2009; Min, Li, Li Wang, 2012). The committee blames the increase in weight to both parents working outside the home, longer working hours, and the school food environment. Secondly, the designs of our communities or built environment (Ding & Gebel, 2011; Li, Harmer, Cardinal, Bosworth & Johnson-Shelton, 2009) having direct effect on the choices and the amount children eat, and the access to physical activities contribute to the rising prevalence rates of childhood overweight and obesity in the society. For example, communities are filled with fast food restaurants (Li et al., 2009; Rundle et al., 2009) and no safe areas for play and exercise for children. This study stresses on communities need

to improve access to children's playgrounds where families can run, bike, and play (National Academies Press, 2009). Other studies showed that parental commitments to work increased children's television time and consumption of junk food and sedentary lifestyles (Tandon et al., 2012). Prior knowledge of the society and environment and children's eating behavior may be affected, and how all these affect maternal strategies would provide a necessary strategy in reducing childhood obesity.

Defining Infant Feeding Practices

The influence of infant feeding practices (Woo et al., 2012) on infant weight gain, and the health outcomes remain unresolved (Goodell et al., 2009) but in the first year of life, breastfeeding is the most accepted strategies for obesity prevention and many studies have documented the protective effect of breastfeeding (Demirtas et al., 2011; Disantis, Hodges and Fisher, 2013; Inoue, Binns, Otsuka, Jimba and Matsubara, 2012; Rossem et al., 2011) ,and her association to moderate reduction of later risk of overweight and obesity (Bartok and Ventura, 2009) . However, no efforts have been made to investigate the mechanism for the association since no causal association was concluded, and this was due to numerous health-related factors that influence maternal feeding practices (Krause, Lovelady, Peterson, Chowdhury and Ostbye, 2010). Krause et al (2010), in a retrospective follow-up study on weight retention, comparing breastfeeding, formula feeding , and mixed feeding at three months (n= 14330) or 6 months (n= 4922) postpartum, found an inverse relationship between breast milk vs formula milk on weight retention at 6 months postpartum in a sample of low-income women. The WHO, the American Academy of Pediatrics, and the Centers for Disease Control and Prevention

(Allcutt and Sweeney, 2010; Dai, Guan, Li, You and Lau, 2013; Koeber, Brice and Tombs, 2012) recommends global public health strategies that include an exclusive breastfeeding for the first 6 months of life (Cattaneo et al., 2011; Holbrook, White, Heyman, & Wojcicki, 2013) as an appropriate strategy for obesity prevention at early age which follows through adulthood.

Reviews of a large body of published studies on breastfeeding, highlighted the knowledge, attitude, practice, and policy on breastfeeding, but however, there are still inconsistent and conflicting findings more over among depressed and non-depressed African American and Hispanic women. Most of the inconsistency may be due to the complexity and contradiction stemming from study designs and differing terminologies applied to breastfeeding. In respect, researchers and policy makers failed to realize that the global term "breastfeeding" cannot describe the numerous behaviors associated to breastfeeding. Despite the foreseeable ambiguities, the differing categories attributed to breastfeeding, attempting to underscore the protective effect of breastfeeding on infant morbidity and mortality has been made (Holbrook et al., 2013; Murimi et al., 2010). Both consistent and acceptable definitions of breastfeeding are needed to ensure appropriate usage by policy makers and this may enable data comparison across countries, and to improve communication between programs (Noel-Weiss, Boersma and Kujawa-Myles, 2012). Infant feeding choices (Maman et al., 2012) prescribed by health care providers mostly during the high prevalence rates of HIV, and breastfeeding provides added reasons for consistent and standard definitions of infant feeding patterns (Oladokun, Brown and Osinusi, 2010). The discovery that HIV can be transmitted through breast

milk elucidated public health dilemma in countries where breastfeeding is culturally normal.

Infant Feeding Practices

Extensive review of the literature related to infant feeding practices, most in particular to maternal roles, knowledge, attitudes, and skills will be presented here. Right from uterine stage, mothers provide safe environments to their infant even after birth and decisions mothers make related to infant feeding include choices to breastfeed, to bottle feed, when to initiate solid foods, the amount and type of solid foods, juices and other non-milk substances, and the use of breast pump and bottles (Arden, 2009; Gage et al., 2012). Infant feeding decisions on breastfeeding (Gage et al.) provide both short- and long-term health benefits and balanced nutrients such as proteins, lipids, carbohydrates, minerals, vitamins, and trace elements that ensure growth and developments (Agostoni et al., 2009) .

Recent epidemiologic studies suggested that breastfeeding is the natural process (Feldens, Vitolo, Rauber, Cruz and Hilgert, 2012; Aksu, Kucuk and Duzgun, 2011; Bergmann et al., 2014; Williamson, Leeming, Lyttle and Johnson, 2011) and breast-milk provide immunologic protection against certain long-life illnesses, allergic diseases, sudden infant syndrome, asthma, obesity, and diabetes (Jones, Kogan, Singh, Dee and Grummer-Strawn, 2011; Olson, Horodynski, Brophy-Herb, and Iwanski, 2010; Stuebe, 2009;). The European Society of Pediatric Gastroenterology, Hepatology, Nutrition Committee on Nutrition (ESPGHAN), and The America Academy of Pediatrics (Agostoni et al , 2009; Holbrook et al. 2013) recognized breastfeeding as the natural

process and recommended that breast milk should be the most recommended feeding practice (Lee & Gould, 2009) for infants in the first 6 months of life. The Healthy People 2010 had an objective to achieve 75% breastfeeding initiative by the end of 2010 to improve infant nutrition and reduce morbidity and mortality (Stuebe and Schwarz, 2010), and most Southern States did not achieve the goal falling below 75% mark. There are racial and ethnic disparities in breast feeding initiation rates (Kolacek et al.), and amongst the 13.8% of mothers practicing exclusive breastfeeding, the number is less than 13.4% among the Hispanic or Latino population.

Although breastfeeding increased between 1965 and 1982 in the United States (Jones et al., 2011), a vast number of mothers were not exclusively feeding their infants for 6 months. Consistent with other studies, non-Hispanic Black women were less likely than non-Hispanic white women to initiate breastfeeding (CDC, 2006; Gibson-Davis & Brooks-Gunn, 2006; Grummer-Strawn and Mei, 2008). The decreased initiation of breastfeeding may likely be due to increased comfort with formula feeding among black women compared to non-blacks, and the impact of depressive symptoms among African American and Hispanic mothers. These findings are related to protein content differences between breast milk and formula milk (Koletzko et al., 2009). However, breast milk and formula milk have different protein contents and concentrations (Heinig, Nommsen, Peerson, Lonnerdal, & Dewey, 1993) which may explain the differences in growth patterns in infants among this population.

Other studies revealed that breastfed infants learn how to self-regulate minimizing high intake of calories (Brown & Lee, 2012). Other hypothesis explaining the protective

nature of breastfeeding and the risk of developing diseases may be that mother's formula feeding styles and use of bottle may encompass minimal control and significant un-response to infants cues and satiety, and is hypothesized to play major role in the development of overweight by impairing infant's appropriate response to the internal cues of hunger and satiation (DiSantis, Hodges, & Fisher, 2013). DiSantis et al. conducted a study to evaluate that breastfeeding is associated with child appetite regulation behaviors and growth, when compared to formula feeding. The findings showed that infants who were breastfed longer showed less restrictive behavior on infant food consumption due to the fact that maternal control over infant's feeding practices is associated to later development of childhood obesity (Rodgers et al., 2013). Numerous factors influence breast feeding initiation (Kimani-Murage et al., 2011), and this includes moral norms, age, education, culture, sexuality of the breast, self-esteem and maternal mental health relating to public breast feeding across all themes and social support (Dyson,, 2010).

Recent studies showed that socio-demographic, biomedical, psychosocial factors, maternal mental health (Sheehan et al., 2013) are associated with infant feeding decisions and are viewed based on sociocultural context, maternal characteristics, and infant factors. Qualitative studies identified the decision to breastfeeding as an individual choice and the intention predicts the initiation and duration, and this depends on mother's social circle and social support system (Sheehan et al., 2013). Infant feeding decision-making (Sheehan et al.) examined using behavioral theories such as theory of reasoned action (TRA), the theory of planned behavior (TPB) and the theory of maternal role attainment

(MRA) created a framework for understanding the infant feeding decision-making. Some researchers argued that the decision-making conceptual framework can assist in crafting theory-based intervention aimed at increasing the breastfeeding initiation and duration (Sheehan et al). The theory of reasoned behavior (TRB) suggested that performing a behavior depends on the magnitude of individual's behavioral intention (Sheehan et al.), and such intentions on breastfeeding involve attitudes and subjective norms or perception of other's attitude towards the behavior (Lawton, Ashley, Dawson, Waiblinger & Conner, 2012). Lawton et al. conducted a study employing the theory of planned behavior to predict breastfeeding intention and initiation among White British and South-Asian mothers living in Bradford and in their findings, they reported that strong intentions to breastfeeding led to higher rates of breastfeeding among the SA women and pointed out that intentions were due to emotions and moral beliefs. Previous studies emphasized on the breastfeeding knowledge, attitude, intentions and practices (Mbada et al., 2013), and indicated that the feeding practices constituted barriers to the benefits but contend that social support has been influential on breastfeeding decision.

Timing of introducing solid food (Kuo, Inkelas, Slusser, Maidenberg, &Halfon, 2011) during infancy presents important pediatric concerns due to the range of negative health outcomes (Arden, 2010). The American Pediatric Association and the WHO (Arden, 2010; Moorcroft, Marshall, and McCormick, 2011; Lin, Tzeng, Kao, Yang and Pan, 2011) recommend that solid foods should not be introduced until 4-6 months of age. Despite the universal acceptance of the recommendations, several studies argued on the relevance of the recommendations (Cattaneo et al. 2011). The European Society for

Pediatric Gastroenterology, Hepathology and Nutrition (ESPGHAN's) 2008 report recommended that infants start complimentary foods between 17-26 weeks of age (Moorcroft et al.) to prevent the negative health outcomes in life. Early introduction of solid foods may lead to overfeeding and poor nutritional outcomes (Kuo et al.), and is attributable to caregiver's perception that breastfeeding does not satisfy the infants' food needs and the hyped promotions by pharmaceutical companies increased marketing, and availability of infant formula (Matsuyama, Karama, Tanaka and Kaneko, 2013; Nor et al., 2012). Poor nutrition in infancy (Moorcroft et al., 2011), and childhood obesity may lead to long-term effect on adolescents and adult general health status, however, common sense tells us that infant's cannot substitute breastfeeding (Lin et al., 2011) for solid foods, and this cannot replace they nutrients in breast milk, and may put children at higher risk for malnutrition and gastrointestinal infections (Moorcroft et al., 2011). Research study by Seach, Dharmage, Lowe, and Dixon, (2010) found that delayed introduction of solid foods is associated with reduced odds of childhood obesity/overweight. Confounding variables like parental smoking, socioeconomic status, childcare and birth weight may help distort the results of the analysis. Recent study by Sariachvili et al. (2010) reported an association of delayed introduction of solid foods with incidence of eczema and allergic diseases in childhood. In a case-control study conducted by Sariachvili et al. with 1128 children participants from two cohort groups, the study showed that early exposure to solid foods is associated to reduced risk of eczema among infants mostly in children with allergic parents and indicated that the

findings were independent of parental factors like parental allergy, passive smoking or breastfeeding.

Inappropriate feeding practices like overfeeding of formula milk and early introduction of solid foods stem from maternal knowledge and skills accompanying infant feeding practices. Secondly, maternal attitudes and mental health related to food consumption and weight gain can influence maternal feeding practices. Poor knowledge of infant's nutritional requirements and maternal postpartum depression may lead to early introduction of solid foods contrary to the recommendations by American Academy of Pediatrics (Karp et al., 2010.). In addition, some research studies have shown that some mothers report that their infant's achieved major milestone earlier than expected just by being able to hold cup or spoon, and sitting in a chair (Brown and Lee, 2011). These findings may be a misnomer since they are not related to inappropriate feeding practices, and could help explain why many mothers see their attitudes as appropriate and introduce solid foods contrary to professional recommendations against early introduction of solid foods. Maternal lack of infant's feeding knowledge especially the nutritional contents, the recommended infant feeding practices, and infant's growth and development can influence maternal skills and abilities relevant to infant feeding practices. For appropriate feeding practices, mothers should be able to identify healthy food choices and be able to feed their children balanced and nutritious diet (Kimani-Murage et al., 2011). Nutritional guidance (Heinonen, Mannelin, Iskala, Sorsa & Juuso, 2009) based on the Recommended Daily Dietary Allowance (RDA) is needed during transition in early childhood and this is not related to inappropriate feeding practices but a point to show that many mothers lack

the skills to provide nutritious food and needed guidance (Heinonen et al., 2009; Katz, Njike, Rhee, Reingold, & Ayoob, 2010) for infant feeding practices.

The attitudes relating to infant feeding vary among mothers when it comes to what constitutes a healthy child and what is appropriate to feed a child. Maternal attitudes towards infant's feeding practices are influenced by many factors and this includes mothers' knowledge, mother's mental health, social support, and culture. Maternal social and family environment, mostly first time mothers can affect their attitudes related to how and what to feed their child. Although breastfeeding is universally accepted mode of infant feeding compared to formula feeding, many mothers look at themselves as incapable to breastfeed and thus question their ability to maintain balanced diet for themselves, which they viewed as important as breastfeeding (Inayati et al., 2012; Lindsay et al., 2009).

Research has shown that infant breastfeeding practice is an individual mother's responsibility (Larsen, Hall, and Aagaard, 2008) and even among those with full knowledge of breastfeeding practices, many mothers choose not to breast feed citing lack of support, the convenience of formula milk, the embarrassment of breastfeeding in the public, fear of pain, sore nipples and personal privacy (Andrew & Harvey, 2009; Bonia et al., 2013; Henderson, McMillan, Green, & Renfrew, 2010). In a qualitative study in Canada, Bonia and colleagues (2013) noted that women found breastfeeding as natural and traditional part of motherhood and this is been replaced with the concept that formula milk is as good as breast milk. The concept have been adopted by Australian women but their study revealed that mother's decision to formula milk is due to lack of social

support, convenience of formula milk, embarrassment of breastfeeding in the public and maternal mental health which was consistent with the previous study. Bonia and colleagues found that the above themes were the main determinants of mother's decision for formula milk and adoption of breastfeeding cessation.

Cultural influence is seen by many to be an important factor in the development of maternal attitudes related to infant feeding practices (Choudhry & Wallace, 2010; SmithBattle, 2008; Purdy & Flaskerud, 2010; Steinman et al., 2010; Tschann et al., 2013; Yotebieng, Chalachala, Labbok & Behets, 2013). Review of literature related to infant feeding practices, socioeconomic status (SES), and minority status are the main variables used as measures to identify mothers' cultural context. The literature review in an attempt to evaluate the cultural influences on infant feeding practices, centered primarily on the beliefs and practices of those of low SES and minorities (Dyson et al., 2010; Jimenez-Cruz et al., 2010; Lindsay et al., 2009). Among the minorities and low income populations, feeding practices such as adding cereal to infant's bottle and inappropriate formula preparation without following recommended guidelines, are shown in the literature to be due to cultural differences (Lindsay et al., 2009; Dyson et al., 2009). Such behavior stems from cultural beliefs that make mothers perceive that infant formula has insufficient nourishment for proper growth of their infants (Matsuyama et al., 2013). Using a focus group (Olson, Horodynski, Brophy-Herb and Iwanski, 2010) mothers reported that they learned their feeding practices from family members, health care professionals including primary care physicians, community health, and nutrition educators, and are unaware of the risk their feeding practices are to their infants due to

inconsistency related to varying personal, family, and environmental circumstances (Olson et al., 2010).

A Longitudinal cohort study conducted by Kroke, Strathmann and Gunther, (2006), found that many mothers underestimate their infant's weight but believe that bigger is healthier and better for infants (Baughcum, Chamberlin, Deeks, Powers and Whitaker, 2000; Jimenez-Cruz et al., 2010), and this may explain maternal overfeeding and misconception about infant feeding practices. Other studies showed that low-income and minority mothers do not trust or believe the CDC growth charts that define overweight, however, they believed that their infant's growth is predestined and attributable to parental genetic makeup and the act of divine will which they say is hard to limit, restructure, and change. Maternal decisions on when to introduce solid food and their choices of food for the infants appear to be due to convenience, and maternal food preferences rather than choice of appropriate nutritious food for the infants (Anzman, Rollins and Birch, 2010; Brown, Raynor and, Lee, 2011; Bentley, Gavin, Black, & Teti, 1999). A qualitative research study (Bonia et al.; 2013) found that perceived convenience about infant feeding practices allowed mothers more independence compared to breastfeeding, and many mothers refused to breastfeed their infants regardless of the amount of information they have on breast feeding.

Using the results from a qualitative study, Lakshman et al. (2011) developed a questionnaire (IFQ) to assess maternal attitudes and behaviors toward infant feeding practices. The scale was meant to assess maternal infant milk feeding practices, maternal decision making in infant feeding, the attitudes and beliefs related to infant feeding and

growth. The questionnaire was developed after literature reviews and qualitative study using semi-structured interview involving 38 parents (n=35 mothers). Three themes emerged on parent's decision making about volume and frequency of formula-milk feeding, instructions on formula-feeding, and infant's growth (Lakshman et al., 2011). A systematic review citing mistakes in formula preparation were common and parents added more powder than recommended relating to over concentration, and parents reported lack of information from healthcare providers. Further examination on maternal attitudes related to infant feeding (Kalinowski et al., 2012), noted that significant growth was based on SES status. Infants from lower SES were heavier at 3 months compared to those from higher SES and this may explain the rapid weight gain among minorities and low-income populations (Kalinowski et al., 2012). Other studies showed that mothers from low SES are less likely to breastfeed and if they breast feed, for only a short period. Breastfeeding according to research produce slower weight gain due to its low protein content, and produce hormones, enzymes, and growth factors that regulate energy intake, output and maternal control. These findings support the complex nature of maternal attitudes towards infant feeding and calls for further investigation into the factors that may influence future development of infant feeding practices.

The negative and health consequences related to infant feeding practices call for immediate attention due mainly to the complex factors that influences mothers and their families in their decisions and choices on how and what to feed their infants. The literature showed gaps in the understanding of developing appropriate infant feeding practices. What is known is based on the socio-demographic attributes and possible

outcomes relating to infant feeding practices. To implement appropriate intervention to promote infant feeding practices and bridge the gap to socioeconomic inequalities to obesity, and understand the appropriate infant feeding practices, we need to understand mothers on a personal level mostly their prior knowledge, attitudes, skills, mental health and behaviors relating to infant feeding practices. Maternal competence in infant feeding practices reflects maternal attainment role as a mother. Understanding factors that may lead to maternal role attainment may enable crafting interventions to promote appropriate eating habits for children and growth.

Maternal Role Attainment Theory (MRA)

This theoretical framework will help guide the operations of the conceptual framework guiding this study by identifying the relevant variables and their relationships in crafting the course of the study. The study focuses on the maternal role competency as the driving force of the study aimed at exploring her relationship with infant feeding practices. The conceptual framework of this theory focuses on the development and interaction process that occur between mother and child over time. During this process, the child bonds with the mother, achieving complete maternal care and joy to her role of motherhood. Previous research used the concept of maternal role attainment or maternal competence to evaluate the conceptual framework and conceptualized it as the operational concept. Reviews of the literature pertaining to the adolescent mothers and infant feeding practices guided the framing of the conceptual model (the adolescent infant care competence), and this is based on the theory of maternal role competence. This study will focus mainly on how maternal psychosocial factors (such as, maternal depression)

influence adolescent mother's perception of maternal role competence for infant feeding practices as related to maternal knowledge, attitudes, and skills and mother's sense of role competence and motherhood. It is hypothesized that competence for infant feeding practices influence actual infant feeding (Liu, Chen, Yeh & Hseih, 2011).

Maternal Role Competence

Many attempts have been made in the literature to identify the factors affecting maternal beliefs and feeding practices related to infant feeding. Scientists unfortunately lack the understanding of how these factors interact and influence parenting. The literature specifically relates the concept of maternal competence, evaluating factors that influence mother's personal feelings of competence and functions as mothers (Liu et al., 2011, Pridham et al., 2010, Tarkka, 2003, Lippe, Eilertsen, Hartmann and Killen , 2010, Secco, Ateah, Woodgate and Moffatt, 2002, Mercer, 2004). In fact, the literature is not sufficient enough for evaluating the relationship of these intrinsic feelings of maternal competence compared to the actual feelings of maternal practices. Basic understanding of this relationship may illicit an understanding of the complex factors that influence parenting as exemplified by infant feeding practices. Further advance in epidemiologic research would attempt to link maternal competence to realistic, measureable skills, attitudes, and knowledge related to parenting practices. The collaboration of such complex factors may highlight the complex development of maternal beliefs and practices which may elucidate potential areas for intervention for infant's feeding practices.

Maternal role competence involves cognitive and social process and is dependent on the cultural and family context (Liu et al., 2011), and this is influenced by mother-child characteristics, maternal mental health, self-esteem, and social support (Ercegovac, Ljubetic and Pericic, 2013; Tarkka, 2003). Mercer (2004) highlighted the theoretical framework of maternal role competence and attachment and was encouraged to explain the many factors that contribute to a woman's incorporation of a maternal role into her life. Mercer expanded Rubin's (1967) theory of maternal role attachment which focused on woman's achievement of maternal role identity, an ideal image of self as mother, perceived during pregnancy and postpartum. Mercer's work based on Rubin's initial work enhanced the need to identify the many factors that either individually or in combination attempts to work for or against maternal role attainment. Mercer's work extended the study period to about a year postpartum which enabled him to capture detailed picture of the role attainment process (Mercer).

In respect to maternal role attainment, Mercer (2004) defined it as "the process by which a woman attains competence in maternal role incorporating motherhood behaviors to self". Mercer (2004) argued that maternal role attainment advances in stages and looks at the infant as a partner. According to Mercer, Tarkka, (2003), the theory explained the four stages the mothers advances before the final goal of maternal role identity and this stages they named as follows: the anticipatory stage; the formal phase; the informal phase, and the personal maternal identity phase characterized by the woman's sense of attaining competence and attachment to the infant, satisfied and complacent with the role which commands comfort as identified (Ercegovac et al.; Liu et al., 2011; Mercer, 2004,

Tarkka, 2003). The anticipatory phase occurs prior to baby's birth when the mothers acquire knowledge about mothering expectations, with the formal phase beginning at birth. Mother's learning processes are based on help from professionals, friends, relatives, and family who provide advice and support during this stage. During the informal stage, mother's respond to infants characteristics and mother behaviors. This learning process by mothers according to Mercer (2004), Pridham et al.(2010), and Secco, (2002), occur for a period of 3 to 10 months , although with adolescent mother, this occurs within 6 to 10 months before proceeding to formal phase.

Mercer (2004) advanced the study and argued that basic understanding of the concept of MRA be replaced with "Becoming a mother" (BAM). A qualitative study assessing the concept of: "Becoming a mother" highlighted the mediating factors such as baby's behavior and mother's feelings of isolation and social support (Tarkka, 2003; Ercegovac et al., 2013). Mothers adapt their mothering behaviors based on feedback from family, friends and professionals. Mercer argued that MRA implies a static situation while BAM involves the fluctuation process that underlies mothering process (Mercer). Maternal competence and behaviors are aspects of maternal confidence (Liu et al, 2011, Ercegovac et al., (2013), and Tarkka (2003) which highlights the predictors of maternal role attainment and emphasized on the link between mother's self-concept, maternal mental health, attachments to the child, and infant health, and characteristics as they explain maternal competence. Factors associated with maternal role competence include infant care experience (Secco, 2002), pregnancy risk status (Mercer and Ferketich, 1995) positive psychosocial attributes and social support (McLaughlin and Harrison, 2006).

Literature on maternal behaviors related to maternal role attainment and becoming a mother with positive outcomes is exemplified when mothers' prepare for the infant, gains confidence or competence both in skills and knowledge that enables reading and understanding of infant's cues and behaviors (Pridham et al.,2010) , and able to provide nurturing environment that enhance growth and development. Young mother's experiencing depressive moods are likely to evidence tougher and less parenting behaviors (Knoche, Givens and Sheridan, 2007; Sheeber et al., 2012). Interventions that can eliminate maternal depressive mood are important and such interventions are necessary to identify the relevant support needed by mothers in their role competence. The effects of maternal depression on mother-infant interaction may be strong during this transition period (Pridham et al., 2001) when the infant and mother bonding is at the forming stage (Tarkka, 2003).

Maternal confidence and mother-infant interaction are not linked to maternal stress (Liu et al., 2011), and has no effect on the quality of infant's development and growth. However, maternal role attainment is affected by postpartum depression that occurs in about 10%-15% of child-bearing women (Eriksen et al., 2011; Flykt et al., 2010, Haycraft et al., 2013). Behavioral and intellectual difficulties have been linked to postpartum depression (Ertel et al., 2011).

Recent literature lacks research examining the link between postpartum depression and maternal role attainment, and depressive disorders are associated with infant's emotional and behavioral problems (Sheeber et al., 2012, Freed et al., 2012). Interventions focused to preparing women for childbirth, managing stress, anxiety and

depression and infant outcomes will moderate effects on parenting behaviors and experience (Sheeber et al., 2012; McManus, & Poehlmann, 2011, Holland et al., 2011), however many studies supported the occurrence of postpartum depression (Hartley et al., 2010; Wang et al., 2011).

Theoretical Foundations of Maternal Role Attachment and Competence

Much interest is centered on examining the maternal role attachment/competence (Holditch-Davis, Miles, Burchinal and Goldman, 2011) in shaping the growth and development of infant due in part to the maternal role attainment theory (see Rubin, 1967). Researchers like Rubin, Mercer (2004) and others developed a theory of maternal role attainment in nursing care to serve as a contextual framework of interaction for nontraditional mothers to develop maternal identity. This theory attempts to explain behaviors at differing stages of attainment; however the interaction approach explores how individual mothers respond and is responded to due to her learned behaviors (Tarkka, 2003, Liu et al., 2011).

The key assumption of this theory lies on the premise that interaction approach acknowledges that maternal behaviors mirror imaged her personal perceptions of her experiences and knowledge in the role and her infant's and others feedback to the role. However, maternal identity is a whole personality that can fluctuate with time (Mercer, 2004). Mercer's primary study viewed the infant as a partner who socially interacts with the mother right from birth, and this underscores the interactionist perspective that failed to see infants as social beings at birth, assuming that infant's nature is surrounded with their encounter. Further conceptualization of maternal role competence and attachment

coined mother-infant interaction are found throughout the literature (Koniak-Griffin, 1993, Secco, Ateah, Woodgate and Moffatt, 2002; Copeland and Harbaugh, 2005, Secco and Moffatt, 2003). Mercer (2004) and Rubin (1967) identified maternal role as social and cognitive process involving learning, skills and interaction. This suggests a bypass of the interaction and role theories but the Social Cognitive Theory (Bandura, 1977). Bandura's Social Cognitive Theory proposes that individual behavior is governed by three reciprocal factors: behavior, personal factors, and outside events. This theory explains that we play active role in our own development with added help from external events (Schiavo, 2007). The core assumption of this theory is that individual's self-beliefs are the predictor of one's thoughts, feeling and actions (Zimmerman, 1989). However, Bandura's theory was not central on Rubin's and Mercer's studies, but these studies cited it most in particular during the definition of role attainment process. Secco et al. (2002) in their pioneering nursing research study credited Bandura's social cognitive theory as the guiding concept for their research and acknowledged that Bandura's work is similar with the role theory. Secco et al. highlighted the impact of experience in role attainment. Incorporating Bandura's theory into the theoretical framework of maternal role attainment, clearly enabled peoples' understanding of the maternal role attainment not only as a process but as individual response triggered by self and the environment events (Schiavo, 2007).

Conceptual Definitions in the Literature of MRA and MRC

The literature exposes numerous conceptual definitions and this made comparisons across studies difficult. Theorizing on MRA, Rubin (1967) focused on

maternal identity which he described as maternal comfort in her role as a mother. Mercer (2004) expanded the definition of maternal competence and role attainment to include role acquisition which encompasses role competence and mothering role to make the identity established complete. Role competence is defined as maternal skills and interaction with the infant that enable infant's growth and development. Maternal role competence can be measured by others or self-based on her perception of competence in the role (Mercer and Ferketich, 1995, Ballenski and Cook, 1982) and Mercer's work on maternal identity and role attainment is similar to Rubin's conceptual framework. Nursing researchers followed the conceptual definition of Mercer (1981, 1986, 2004) focusing mainly on the maternal role competence or the like (Secco et al., 2002, Pridham et al., 2010; Liu et al., 2011; Flager, 1988) as maternal identity, presence, and competence (Holditch-Davis et al., 2011).

Numerous nursing researchers following Mercer (1981) and Rubin (1967) adapted similar constructs of maternal role competence focusing on personal assessment of women based on maternal confidence as mothers but different terminologies. Liu et al., (2011) defined role attainment like Mercer and however their conceptualization of maternal identity seemed as a distinct component of MRA which focused on the cognitive and interaction between mother and infant. The conceptual difference such as maternal identity and maternal role attainment (Mercer, 2004) are confusing as maternal identity focuses on individual self-identity while maternal role attainment focuses on mothering processes. As Mercer's MRC and Liu's MRA seem similar, Liu went above the subjective definition of MRC and evaluated the clinical relevance of MRA. In Secco

et al. (2002) definition of maternal role competence, Secco et al. incorporated maternal perceptions of her role competence with infant's responses to maternal actions in the context of care giver. Secco et al.'s conceptual definition is a mere refinement of Rubin's (1967), Mercer's (1985) initial work. Secco et al. defines maternal role competence as a challenge of attaining self-identity as well as infant care giver. Secco et al. highlighted that maternal perceptions of role competence are developed as the mother attained certain levels of competence that allowed for individual decision making about her infant care and her role as a mother.

Caregiving Role and Feeding Decisions

The concept of feeding espouses the metaphor for the maternal-infant relationship (Spegman and Houck, 2005) and centers around food that provides social experiences. The major role in transiting to motherhood or caregiver role as agent of change is learning infant feeding practices (Faith et al., 2013). Feeding is a process and a complex part of caregiving and nurturing process where the measure of infant's weight is the end point (Jansen et al., 2012). Maternal decisions on infant feeding practices centers on maternal mental health, baby's health, needs of other family members and living conditions (Sheehan et al., 2013). Olson et al. (2010) suggested that decisions and early introduction of solid food predicts the socioeconomic status and other cultural and moral beliefs and the introduction of solid food is viewed as overcoming milestone and maternal pride (Crocetti, Dudas, & Krugman, 2004). Crocetti et al. highlighted that early introduction of solid foods are the result of convenience, sign of infant maturity and an obsession for infant's weight gain. Canadian study revealed that early introduction of

solid foods offsets the perceptions that the baby is hungry and would sleep better during the night.

In a qualitative study by Sheehan et al. (2013) the authors highlighted that decisions on infant feeding practices are grounded in individual woman's experiences, beliefs, and cultural perceptions and the conceptual logic that says that good mothers' breastfeed their infants. Breastfeeding relates to maternal identity, a metaphor for motherhood (Sheehan et al., 2013; Stapleton, Fielder, & Kirkham, 2008) and support from relatives, friends, and caregivers act as conduit for breast feeding decision making process (Ekstrom, Wadstrom and Nissen, 2003; Schmied, Beake, Sheehan, McCourt, & Dykes, 2011), and the ultimate success aimed at contributing to weight loss. Social support from infant's father and most in particular his participation on breast feeding decisions, and support from professional caregiver enhances extended breast feeding duration, and explores a clear understanding of perceptions surrounding early breast feeding choice (Brown, Raynor, & Lee, 2011).

Studies conducted in Sweden revealed that pregnant women participated in classes aimed at increasing breast feeding knowledge, a formation of maternal network that may encourage social support that prolongs breast feeding duration (Schmied et al., 2011; Chabrol, Walburg, Teisedre, Armitage, & Santrisse, 2004), and poor social support may contribute as barriers to successful breast feeding process. Other studies showed that consistent to the above notion, health professional mostly midwives consider breast feeding education as essential and critical in understanding and reducing the misconceptions surrounding breast feeding. Balanced nutrition in infancy is the

foundation of good lifelong health (Lin, Tzeng, Kao, Yang, and& Pan, 2011), and surveys of infants in different countries showed significant differences in timing of introduction of complementary foods and other determinant factors.

The authors noted that in Germany for example, the initial complementary foods introduced are usually vegetables, potatoes, and meat mashed together. In a qualitative study (Lindsay et al., 2009) described Brazilian mothers child feeding practices and perceptions to be associated with infants' weight status and socioeconomic status (SES), cultural, and organizational factors. This study revealed that low-income mothers found that mother's child feeding practices and her perceived association to weight gain is related to material circumstances, social networks, and organizational factors such as government assistance Women, Infant Child assistant program (WIC), and maternal age.

Chabrol et al. (2004) in their qualitative study revealed that factors such as lower socio-economic status and race and ethnicity contribute to bottle feeding and early introduction of complementary foods. Most epidemiologic studies (Shaker, Scott, and Reid, 2004) focused on the association of maternal socio-demographic characteristic and breastfeeding rates. Maternal and paternal breastfeeding knowledge and attitudes have been explored in other studies, and these studies have shown to be predictive of the infant feeding decision and may be related to infant feeding behavior than demographic characteristics.

The findings related with the Theory of Reasoned Action (TRA) which stipulated that behavioral change is determined by individual intention to perform such behavior (Aylaz, Erci and Erten, 2011; Schiavo, 2007), and individual intention is influenced by

individual attitudes, subjective norms, perceived behavioral control (Pickett et al., 2012) geared towards performing the behavior including the surrounding pressure from environmental factors. Infant's weaning implies the first introduction of solid food, and epidemiologic studies showed significant health implications due to the introduction of inappropriate (Allcutt and Sweeney, 2010) solid foods, and this include eczema, asthma, allergy and obesity. In 2002, the WHO recommended that no solid food should be introduced prior to 6 months of age although no age was specified for formula feeding. Maternal influence on infant's diet (Crouch, O'Dea and Battisti, 2007) through nutrition knowledge, food availability and access, meal structure, and social practices shaped infant's food preferences for energy intake, eating patterns, emotional feeding and instrumental feeding. Control over feeding differed between cultures, SES status, and child's gender.

Research studies suggested that control over feeding impedes child's ability to self-regulate and other studies found no relationship (Webber, Hill, Cooke, Carnell and Wardle, 2010; Li, Fein and Grummer-Strawn, 2010) between infant feeding and self-regulation. Feeding is the metaphor for parenting (Morawska, Laws, Moretto, and Daniels, 2014), and critical to effective attachment and development of food preferences which relates to obesity risk. Parents and grandparents believed their best about a child, and attempted to control child behavior (Horodynski et al., 2007) which is exemplified when attempting to control child feeding practices during mealtime (Brown et al., 2011). Coercion, bribery, restriction, and instrumental feeding practices can be detrimental to the child's future feeding patterns, and this is viewed as controlling behaviors and paying no

attention to internal hunger and satiety cues (Gross, Mendelsohn, Fierman and Messito, 2011). Little is known about the mother-infant interaction during the transition from milk to solid foods among children. The 2003 National Health and Medical Research Council Infant Feeding Guidelines for Health Workers (Nutrition & Dietetics, 2010) reported that infants need solid foods at 6 month of age, and stated that breast milk contains all the nutritional requirements for infant growth prior to 6 months. As American Academy of Pediatrics (AAP) has noted that the period of transition which include some solid foods and breast and formula milk ends during adult eating when children eat family table foods and completely weaned from breast and bottle milk.

Early introduction of solid foods (Horodynski et al., 2007) increases the risk of developing auto-antibodies in infants and this is supported by a prospective study conducted by Ziegler et al. (2003). This study reported that both early and late introduction of cereal increased the risk of developing auto-antibodies, increased body fat, and BMI despite the family history. In other prospective, observational study involving 3,768 mother-infant dyads (Horodynski et al, 2007), infant feeding practices were associated with weight gain. The investigators employed multiple regression to examine how maternal pre-pregnant body mass (BMI) and infant feeding pattern relate to infant weight gain. Comparing with infants who were introduced to solid foods before 4 months, those infants gained more weight from that point to 1 year. The added weight due to early introduction of solid foods can move an infant from one percentile to another thus pushing the infant as being at risk of becoming overweight and or obese (Moorcroft et al., 2011) .

Ignoring the recommendations by AAP and WHO (Horodynski et al., 2007), relating to the timing of solid foods introduction, the common reason given based on caregiver's perception is that the infant is not satisfied with milk alone (Kabir et al., 2012) and does not sleep good at night. Early introduction of solid foods have important health implications for infants and mothers (Meehan and Roulette, 2013), and this is associated with infant diarrheal disease and mortality (Kuo, Inkelas, Slusser, Maidenberg and Halfon, 2011; Moorcroft et al., 2011). In a cross-sectional study of primary female caregivers (Crocetti et al., 2004), despite the knowledge of infant's feeding guidelines, the author's found that caregivers introduced solid foods prior to 4 months of age and stated that early exposure to solid foods induces antibody formation that causes future allergic disease and iron deficiency anemia.

Physical and Psychosocial Factors of Infant Feeding Practices

Breastfeeding is the recommended (Rossem et al., 2011; Inoue, Binus, Otsuka, Jimba and Matsubara, 2012) global best practice-based method of infant feeding practices and this practice provides the optimal way to feed an infant in the first 6 months of life (Disantis et al., 2013; Demirtas et al., 2011), and constitutes many health advantages for both mother and child (Horodynski et al., 2007; Stuebe, 2009). Despite the recommendations by the WHO and AAP, the rates of breastfeeding are far more low than 75% recommended (Stuebe and Schwarz, 2010) among developed nations. Effective intervention (Holbrook et al., 2013; Cattaneo et al., 2011) programs to prolong the breastfeeding duration is necessitated, and maternal age, education and social support play major role in the duration of breastfeeding and psychosocial factors such as intention

to breastfeed, self-efficacy and maternal confidence over breastfeeding which may contribute to the extended duration of breastfeeding.

In United Kingdom for example, breastfeeding rates are in line with the WHO recommendations of 75%, and about 76% of mothers initiate breastfeeding after birth (Bailey, 2007) and breastfeeding incidence is related to the age of mothers. Other studies have attempted to explain the short-duration of breast feeding. A study by Weimann, DuBois, and Berenson (1998) found that short duration of breastfeeding was due to financial status, family support and absence of breastfeeding role model. Other demographic variables related to short duration of breastfeeding include mothers' social class, the ethnic origin of the mother and cultural norms. Many studies (Dyson et al., 2010; Kimani-Murage et al., 2011) showed that attitudes predict maternal breastfeeding intentions, and this was supported by study conducted by Sheehan et al. (2013) which found significant correlation between attitudes and breast feeding duration. As Sheehan et al. (2013) highlighted other psychological variables such as self-esteem and self-efficacy with differing contextual framework. In a qualitative study, Bai, Middlestadt, Peng and Fly (2009) found that women placed high value on the emotional and health benefits of breastfeeding for 6 months relating it to the strong bond between mother-child and improved mother-child health. This supports previous studies that examined reasons associated with breastfeeding duration and returning to work or school which were shown to be the most stressors for breastfeeding among the mothers. Maternal return to work or school is the key factors influencing the duration of breastfeeding. Other studies Leung, Ho and Lam (2002) in China revealed that maternal smoking is related to breastfeeding

duration and maternal age, and education attainment were significant to breastfeeding initiation. Maternal smoking during pregnancy was strongly associated to failure of breastfeeding infants (Manios, Moschonis, Grammatikai, Anastasiaou and Liarigkovinos, 2010). This may be because smoking changes the taste of human milk similar to alcohol, garlic, and mint (Maloney, Hutchinson, Burns, Mattick, & Black, 2011), and makes human milk less palatable. Non-smoking mothers were twice as likely to breastfeed their infants (Lauria, Lamderti, & Grandolfo, 2012; Weiser et al., 2005).

Recent studies (Karp et al., 2010) suggested that infant weight changes may be associated to later obesity and poor health including diabetes. Many factors have been associated with maternal feeding practices, and two factors more commonly related to maternal feeding practices and infant's risk for obesity include parenting beliefs ,socio-demographic characteristics (Dyson et al., 2010), cultural norms, race, and ethnicity (Blissett & Bennett, 2013; Purdy & Flaskerud, 2010). Review of literature revealed major investigations focusing on breastfeeding initiation and duration but no investigation of the association between parenting beliefs and feeding practices relating to breastfeeding was done.

Parental Perception, Influence, and Styles

With the various trends (Synnott et al., 2007) associated with infant feeding practices, researchers have become aware of the ever-changing perceptions and needs of parents. Obesity has become more prevalent in children of all ages (Baughcum et al., 2000; Ogden et al., 2012), and has adverse physical, emotional, and social consequences. Previous studies showed that maternal perception of children's weight pointed to

considerable oversight of children's weight status related to misclassification or underestimation. However, obesity has multi-factorial etiology but data suggested that toddlers are at high risk of obesity due to overeating (Horodynski et al. 2011). In a qualitative study involving 813 mothers of Mexican decent in Baja California, Jimenez-Cruz et al. (2010) found that about 43% mothers underestimated their child's weight status, and this was more common among those of low socioeconomic status. This study concluded that low-income mothers from different areas in Mexico underestimated their infant's weight status and most mothers' perceived that natural and processed juices, sweetened drinks, and high fat snacks are healthy (Wardle, Carnell, & Cooke, 2005). The result of this study coincided with the study conducted in Cincinnati that revealed that obesity was more prevalent among mothers of low-education levels and heavier infants. Parent's underestimation of child's weight status was consistent with studies conducted by Cochran, Neal, Cottrell, and Ice, (2012). However, Tyer in his study reported that Mexican-Americans perceived heavy size infants as consistent with good health, and other studies investigating parental perceptions of child obesity found that parents were inconsistent in their perception about their children's overweight regardless of health professionals' advice or society perceptions (Eckstein et al., 2006; Cochran et al., 2012; Shirasawa et al., 2012).

In a pretest–posttest study, Perrin et al. (2010) conducted a study utilizing a Pediatrician Toolkit aimed at addressing parental perceptions of children's weight status (n=.115) of children aged 4–12 years, and found that parental perceptions of accurate infant weight status, diet and physical activity improved following the use of pediatrician

toolkit supporting weight status communication and counseling. In another study, Aljunaibi, Abdulle and Nagelkerke (2013) found that parents with poor perceptions of their child's weight status may ignore appropriate health messages and consistently underestimated the child's weight status. The literature clearly shows inaccurate parental perceptions of their child's weight status (Cochran et al., 2012), and a study of mostly Hispanic parents and low-income mothers of obese children of ages between 2 - 5 showed that 36% of parents did not perceive their obese child as overweight (Aljunaibi et al.) but saw it as evidence of good living.

Parents play major roles in influencing children's food intake and control what foods that are available, in what quantities, how it is prepared and how much consumed by the parents as role models (Wardle et al., 2005; Webber et al., 2010), and create the eating social environment by way of rules or strategies, and this influences children's eating (Zeinstra, Koeen, Van der Laan and Graaf, 2009). Literature on infant feeding practices supported the association between parental controlling feeding practices and child's body weight composition although these practices may be detrimental to child's eating behavior and weight status (Blissett and Farrow, 2007). In a study of 243 children aged 4-6 years old conducted by Wehrly, Bonilla, Perez and Liew (2014), this study revealed that low-income was associated with greater parental pressure to eat and higher child weight. Their findings concluded that there are higher rates of obesity and overweight among low-income and minority groups. Other studies have shown that parental eating restrictions and pressure to eat are the most parental feeding practices that influence child eating habits (Lauzon-Guillain, Musher-Eizenman, Leporc, Holub and

Charles, 2009) and weight status which are linked to child's eating behaviors characterized by responsiveness to external rather than internal cues of hunger and satiety (Webber et al., 2010; Blissett and Farrow, 2007). Controlling feeding practices have been hypothesized to have negative health consequences on children's weight trajectories disrupting self-regulation of food intake (Gross et al. 2011; Wardle et al., 2005). To determine whether controlling parental feeding practices are associated with children's adiposity and test the hypothesis that any association are due to maternal perception of child's weight. Webber et al. (2010) conducted a study involving 405 children ages 7–9 years old and found that higher child adiposity was associated with lower pressure to eat and higher restriction. Restriction appears to be due to maternal concerns about their child's becoming overweight instead of a cause of children's weight gain. Pressure to eat may be a more complex response influencing the desire to encourage consumption of healthy foods and ensuring adequate energy intake and appropriate weight gain. Such parental feeding practices may impede child's ability to self-regulate their food intake focusing them to external cues rather than their own hunger and satiety (Tschann et al., 2013). In a cross-sectional exploratory study conducted by Murashima, Hoerr, Hughes and Kaplowitz (2012), they collected data from 330 dyads of children aged 3-5 years and mothers participating in a program for low-income families in Michigan. The feeding practices employed by mothers were both overt and covert. The researcher found that more nutrient-dense foods were eaten by covert children while overt children were associated with lower weight status in preschoolers of low-income mothers. The study demonstrated controlling behaviors espoused by parent's leading to undesirable eating

behaviors by children and restrictive feeding practices may cause differential or unique contributions to child weigh status (Wehrly et al., 2014; Payne, Galloway and Webb, 2011). Longitudinal data suggests that controlling feeding practices may predict weight gain and feeding without responding to hunger and satiety cues may increase the risk of obesity (Blissett and Farrow, 2007; Gross et al., 2011).

Parental styles in the literature have been defined as an important factor influencing growing children's behavior (Phuphaibul, Wittayasooporn, & Choprapawon, 2012) and constitute overall parenting involving responsiveness versus non-responsiveness (development of child individuality and self-regulation) and demanding versus undemanding (supervision and discipline). Baumrind's initial work identified these parental styles as authoritative, authoritarian, and permissive (Phuphaibul et al., 2012; Bassett, Snyder, Rogers and Collins, 2013; Boles, Reiter-Purtill, & Zeller, 2013; Alizadeh, Talib, Abdullah, & Mansor, 2011). These categories exemplify parental control over children's behaviors and are functions of qualitative and quantitative differences over parental control over children. Children of permissive parents have shown researchers less control and no set rules and enforcement. Authoritarian and authoritative parent exercise high levels of control and set rigid rules and children tend to follow the due to fear of punishment (Jabeen, Anis-ul-Hague, & Riaz, 2013).

Parental feeding practices in the literature are the main focus in parental styles and child's temperament (Boles et al., 2013) and parents regulate children behaviors through parent-child interactions and relationship (Jabeen et al., 2013). The literature defines parenting practices as behaviors parents use to get children do some specific

skills such as control over eating. Parental feeding practices espouse restriction, monitoring, and pressure to eat and research has shown an association of these patterns of feeding to the development of obesity. Emotional feeding involves feeding in response to stress, instrumental feeding exemplifies feeding as a reward, feeding with excessive pressure constitutes pushy feeding, and restrictive feeding is feeding that reduces the intake of high-fat and high-calorie foods and these are correlated with development of childhood obesity. Recent research studies have shown that controlling feeding practices may at early stage modify child's eating behavior but raises problems by interfering with the child's ability to self-regulate eating-related behaviors (Hoerr et al., 2009; Wardle, Carnell, and Cook, 2005). Restrictive feeding practices by parents predict overeating and weight gain in children (Keller, Pietrobelli, Johnson and Faith, 2006) and restriction involves access to palatable, energy dense snacks and other studies have shown that restriction has counter-productive effect of increasing children's preferences for restricted foods (Faith and Kerns, 2005; Francis, Hofer and Birch, 2001). In a study conducted by Tovar et al., (2012) involving 383 mother-dyad enrolled in Live Well, a community-based, participatory, randomized controlled lifestyle intervention to prevent obesity or weight gain among immigrant mothers. The researchers revealed that most mothers report low demanding/high responsive feeding styles are associated with higher weight gain. The findings add to the growing literature suggesting that low demanding/high responsive feeding style may be a risk factor for childhood obesity. In another study involving 99 6-11 year old children, 60% of whom were overweight/ obese, Hennessy, Hughes, Goldberg, Hyatt, and Economos.(2010) found that a permissive-indulgent

feeding style significantly predicted high child BMI z-score. Other studies have identified permissive-indulgent feeding style related to significant increase in child's BMI z-score (Tovar et al., 2012; Hubbs-Tait, Dickin, Sigman-Grant, Jahns and Mobley, 2013).

Qualitative Studies in Feeding

There are few qualitative studies in the literature within the interest area. Phuphaibul et al., (2012) conducted a descriptive study of 4088 parents (82 fathers and 3413 mothers) and these parents were interviewed when their infants were 6 months old for background and childcare practices to identify parental styles. The findings revealed overprotection style during the first 6 months of life, followed by the reasoning style. Seldom were the controlling and neglectful styles an indication that parenting styles occur in random pattern during the first year of life. Also using a qualitative study, Tschann et al. (2013) conducted a qualitative study of 35 Latino parents in a focus groups and their study identified four parental feeding practice dimensions, positive involvement in child eating, pressure to eat, use of food to control behavior, and restriction of amount of food. The findings revealed good initial validity and reliability for the parental feeding practices which could be used to increase understanding of parental feeding practices, children's eating behaviors, and obesity among American Latinos at high risk for obesity.

Haga, Lynne, Slinning and Kraft (2011) conducted a qualitative study with 12 self-selected first time mothers aimed at gaining insight why some mothers find the transition to motherhood depressing and emotional while others feel content with the transition. The study produced two types of motherhood, which are referred to as "relaxed" and "controlled" mothers. This was a reflection of mother's perceptions and

need for mastery and their emotional experiences and this was centered on social support, managing breastfeeding with regard to well-being and depressive symptoms. The authors concluded that frequent consultations with midwifes, public health nurses during prenatal and postpartum periods was the central focus for prevention and this should be centered on the mothers expectations and needs which demands open discussion on how the partner would support each other during this critical period.

Roshita, Schubert and Whittaker (2012) conducted a qualitative study to explore the socioeconomic and cultural environments that may influence child-care practices in families of working and non-working mothers with children of differing nutritional status and types of caregivers in Depok, Jakarta Indonesia. The study revealed that mothers and caregivers need support and adequate resources to perform better child-care services regardless of the nutritional status and maternal employment status.

Matsuyama et al. (2013) conducted a qualitative study to explore perception and feeding practices of caregivers of children under 6 months old in Kwale, Kenya with their main focus on caregivers' knowledge, perceptions about health and nutritional problems of infants and their behaviors that affect feeding practices. In this exploratory study involving inductive approach, 32 mothers, mother-in-law, traditional healers were interviewed and 28 babies under 6 months were observed. The study suggested that mothers should be advised during prenatal and postnatal care about the importance of exclusive breast feeding in regards to their concerns about the health and nutritional status of their children.

Maternal Depression

Maternal postpartum depression is common amongst women (Mason et al., 2011) mostly first time mothers and other caregivers. The first week postpartum are critical periods for mother and child and women may present postpartum depressive symptoms and however it is unclear how breast feeding experience relates to postpartum depression (Watkins, Meltzer-Brody, Zolnoun and Stuebe, 2011).Studies have shown that depression is among the top disabling disorders worldwide and the leading cause of disease-related disability among young mothers (Wang et al., 2011) from diverse cultures. Literature has shown that about 13% of women (Dennis and McQueen, 2009) experience this disabling condition within 12 weeks postpartum and about 19.2% within the postpartum year. In the United States, maternal depression is occurring at alarming rates making maternal depression a public health concern (Freed et al., 2012). Epidemiologic studies have shown that about 17% women meet the diagnostic criteria for major depression in their life time. Studies conducted in the United States revealed that depression is more prevalent in women than men (Freed et al.). Among economic disadvantaged women in the United States, the rate of depression prevalence among women is double compared to the general population of women. The WHO contends that depression accounts for more disability worldwide compared to other diseases (Hurley, Surkan and Black, 2012). Epidemiologic studies estimated that maternal depression among young mothers with children range from 17% to 19% (Freed et al.) however about 9.4% and 12.7% develop depression during pregnancy and about 21.9% may develop postpartum depression.

The negative consequences of maternal depression on parenting have been documented (Haycraft and Blissett, 2013) and maternal depression is associated with disruption and disorganization in maternal-child interactions resulting to hostility, coercion, withdrawal and lower maternal self-esteem (Haycraft and Blissett, 2013). Mothers play important role in determining healthy lifestyles and an agent of change for child's healthy weight (Lampard et al., 2014). Many parenting practices during infancy has been the central focus in child weight development, including breastfeeding, early introduction of solid foods, and parental feeding practices and some studies have indicated that postnatal depression may be associated with maternal obesity (Milgrom et al., 2012) a self-perpetuating cycle of mood change, inactivity, and high calorie intake as shown in a large number of those with health problems. Studies from developed and developing countries (Ertel et al., 2012), reveals that maternal depression may affect parenting as related to feeding practices. In developing countries where food scarcity is common, maternal depression impairs maternal ability to provide adequate nutrition to the child resulting to underweight but in developed countries surrounded with obesogenic environments, maternal depression translates to reliance on quick and easiest food options which encompasses fat dense foods resulting to overweight (Ertel et al.).

Although breastfeeding (Galler, Harrison, Ramsey, Chawla and Taylor, 2006; Gagliardi, Petrozzi and Rusconi, 2010) has been recognized as the optimal method for infant's feeding for the first 6 months of life, ample numbers of mothers worldwide do no breastfeed (WHO, 2000, AAPP, 1997). Mothers play an important role in determining infant's healthy lifestyles and central agent for change for child's healthy weight

(Lampard et al., 2014) and many of the maternal practices during infancy have been implicated in infant's weight development such as breastfeeding, early introduction of solid foods, physical activity parenting, screen-related parenting, and parental feeding practices. However, we know less about how depression affects parenting and possible child development but depression compromise a mother's ability to provide appropriate care and evidence-base practice suggests that depression can interfere with parenting leading to poor social development, and problems with physical, psychological and mental health in children (Vericker et al., 2010). Several studies have examined maternal depressive symptoms experienced by mothers after delivery as potential risk factors for non-initiation or continuance of breast feeding (Gagliardi et al., 2010). To achieve optimal (Tashakori et al., 2012) health for infants, WHO recommended exclusive breast feeding for the first six months of life and exclusive breast feeding increases oxytocin secretion and induction of maternal-fetal attachment and bonding (Tashakori et al.). In a study conducted by Thome, Alder, and Ramel, (2006) showed that depressive symptoms were related to lower levels of exclusive breastfeeding. In addition, Abou-Saleh, Ghubash, Karim, Krymski, and Bhai, (1998) found that breastfeeding mothers show lower levels of PPD symptoms, although their sample size was small. Most studies on maternal practice have reported the odds of breastfeeding cessation (Field, 2010) for mothers experiencing postpartum depression and these studies indicates that mothers with high postpartum depression score are more likely to discontinue breastfeeding at 4-16 weeks postpartum and were giving infants complementary foods and this may have led to undesirable feeding practices leading to the difficulties noted in infants' of depressed

mothers (Field, 2010). In a study conducted by Dennis and McQueen (2009), mothers reported being unsatisfied with breastfeeding and lower levels of breastfeeding self-efficacy and this exemplified the feeding difficulties noted in infants of depressed mothers (Field, 2010). Gagliardi et al. (2010), while recognizing the importance of breastfeeding show that postpartum depression may increase the risk of poor feeding practices and discovered some methodical issues in the published studies and concluded that the results were inconsistent and call for future investigation. Many studies relating to the determinants of breastfeeding centered on the assessment of socioeconomic and demographic factors (Galler et al., 2006) and medical histories. In an observational study conducted by Haycraft et al. (2013) on a 58 mother-child dyads attempting to examine the associations between maternal use of controlling feeding practices with self-reported maternal symptoms of maternal depression found that higher levels of depressive symptoms were related to higher levels of verbal and physical pressure to eat, incentives to eat and higher levels of maternal talks about food during meal time and maternal depression was not linked to restrictive type of infant feeding.

Summary

Literature review supports that nutrition during infancy is of great importance for growth and development of a child and also showed many examples of research available regarding maternal feeding practices more in particular mothers' decisions to breastfeed or formula feed and the introduction of complementary or solid foods. There is lack of research investigating how the psychosocial factors of maternal feeding practices affect infant weight gain and Social cognitive theory and Social Learning theory of Bandura

(1997) can be used to explain and predict people's behavior relative to the environments. The basic premise of this theory provides a framework for understanding the continuous interaction between people and the environment with each influencing the other. Bandura (1997) argued that self-efficacy is the central belief that promotes behavioral change. Social support, depressive symptoms, maternal health status, attitudes, and behavior are embodied in the physical and psychosocial factors that influence maternal feeding practices. Bronfenbrenner (1993) socio-ecological theory is related to social cognitive theory, as health behaviors and attitudes revolve around an ecologic system where the organism and the environment is in continuous interaction. The socioecological theory integrates the perception of social exchange, disease occurrences, benefits, social support, social capital and other mediating variables to determine the reaction to infant health. The ecological theory focuses on the concept that all organisms and population live, interact, and die. Maternal feeding practices exemplifies this concept and maternal role competence theory focuses on the bonding and interaction of the infant with the mother. Attainment of motherhood role brings joy to both mother and child and enhances the growth and development of the child. Maternal attitudes towards infant feeding and appropriate knowledge are influenced by culture, social status, experience, and exposure to relevant education (Blissett and Bennett, 2013; Purdy and Flaskerud, 2010).

Mothers with depressive symptoms owe their infant's the responsibility of proper care in helping them develop good nutritional habits that lasts throughout live. Social cognitive based on the theory of Planned Behavior predicts that differences in maternal feeding intentions and responsiveness to infant's needs are related to the mental state of

the mother. In appropriate attitudes and moral norms were the stronger predictors of intentions. Intentions and affective attitudes were the predictors of maternal feeding practices as a result of emotions and beliefs about infant feeding (Lawton et al., 2012).

Conclusively, depressed mothers (Ertel et al., 2011) showed that incidence of stressful life events such as divorce, poverty, and events related to economic hardship and that family disruption and economic hardship were the independent risk factors for children's outcomes which extend to adulthood. Thus children of depressed mothers are more likely to be exposed to many adversities related to disorganized mother-child interactions and adverse behavioral and health outcomes throughout life course (Ertel et al., 2011) and fewer numbers of blacks and Hispanic depressed mothers receive services. Ertel and colleagues in their study found that Hispanic and black mothers were more likely to suffer from depression compared to non-Hispanic white mothers. In the United States, about 13% of all children are exposed to maternal depression (Kersten-Alvarez et al., 2012) in their infancy and this exposure places infants at increased risk for factors such as mother-infant interactions, insecure mother-infant attachment, cessation of breastfeeding, and early introduction of solid foods and all these can impact child's growth and development. Studies show that later development may suggest that maternal postpartum depression (PPD) may have a long-lasting effect on infant's development (Kersten-Alvarez et al., 2012). Adequate understanding of infants development entails understanding of infant's growth and development based on the ecological contexts (Bronfenbrenner, 1979) which shows that children do not grow in isolation but rather participate in multiple interacting systems that affect growth (Bronfenbrenner, 1977) and

such factors include child's temperament, ability, interest, environmental features like parental characteristics, family circumstances, neighborhood characteristics and their interactions (Knoche et al., 2007).

Chapter 3: Research Design and Methods

Introduction

In this chapter, relevant methodology to investigate whether there is an association with postpartum depression (PPD) in African American and Hispanic women, their infant feeding practices (breastfeeding vs formula feeding), and resultant infant weight gain at 1-year of age will be presented. This chapter will describe and explain the methodology used in this study and the research methods that informed this choice. This study was a quantitative approach utilizing secondary data obtained from Infant Feeding Practices Study 11 collected between May and December 2005 from pregnant women in their third trimester (Fein et al., 2008).The methodology will be presented as follows: (1) research questions and hypotheses, (2) research study design, (3) description of the research sample and setting, (4) data collection measures, and (5) data analysis procedures.

Research Questions and Hypotheses

Chapter 1 introduced the subject matter of this dissertation project, which was to investigate the possible association of maternal postpartum depression, infant feeding practices (breastfeeding vs. formula feeding), and infant weight gain at 1-year of age in African American and Hispanic women. The focus of this study is particularly significant as it is centered on the determinant factors that may lead to childhood obesity among African American and Hispanic children. The study aimed at discovering whether maternal postpartum depression affected infant feeding practices and whether that was

associated with excessive infant weight gain among African American and Hispanic populations.

This study will also investigate whether there is a difference in infant weight gain between infants of African American and Hispanic women aged 18 to 25 in relation to postpartum depression and infant feeding practices. Maternal body mass index (BMI), sex of infant, household income, age of mother at child birth, and mother's level of education will be further investigated as covariates for potential confounding and interaction effect on the outcome variable (infant weight gain).

The following four research questions and related hypotheses will guide this study:

RQ1: Is there a relationship between postpartum depression, infant feeding practices (breastfeeding vs formula feeding) and infant weight gain among African American and Hispanic mothers?

$H_0$1: There is no relationship between postpartum depression, infant feeding practices (breastfeeding vs formula feeding) and infant weight gain among African American and Hispanic mothers.

H_a1: There is a relationship between postpartum depression, infant feeding practices (breastfeeding vs formula feeding) and infant weight gain among African American and Hispanic mothers.

RQ2: Is there a difference in infant feeding practices (breastfeeding vs formula feeding) between African American and Hispanic mothers with PPD and those without PPD

$H_0$2: There is no difference in infant feeding practices (breastfeeding vs formula feeding) between Africa American and Hispanic mothers with PPD and those without PPD.

H_a2: There is a difference in infant feeding practices (breastfeeding vs formula feeding) between Africa American and Hispanic mothers with PPD and those without PPD.

RQ3: Is there a difference in weight gain over 1-year between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed?

$H_0$3: There is no difference in weight gain over 1-year between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed.

H_a3: There is a difference in weight gain over 1-year between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed.

RQ4: Is there a difference in weight gain over 1-year between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed, after adjusting for maternal body mass index, household income, mothers age, mother's education level, and sex of the infant?

$H_0$4: There is no difference in weight gain over 1-year between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed, after adjusting for maternal body mass index, household income, mothers age, mother's education level, and sex of the infant.

H_a3: There is a difference in weight gain over 1-year between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed, after adjusting for maternal body mass index, household income, mothers age, mother's education level, and sex of the infant.

Research Design

This study took a quantitative approach utilizing secondary data from IFPS II to assess the relationship of postpartum depressive symptoms in African American and Hispanic women, infant feeding practices, and infant weight gain during the first year of life. The IFPS II (CDC, 2009), a longitudinal study involving mothers in their third trimester through the first year of life of the infants, was conducted by the US Food and Drug Administration (FDA) in collaboration with Centers for Disease Control and Prevention (CDC), Department of Health and Human Services, National Institute of Child Health and Human Development, Office of Dietary Supplements, National Cancer Institute of Health, and the Maternal and Child Health Bureau, Department of Agriculture between May and December 2005 (Gaffney et al., 2014). In this cross-sectional study, about 4,000 pregnant women across the nation participated over the course of 15 months and the sample was selected from a national consumer opinion panel consisting of 500,000 households across United States. The study was designed to obtain information pertaining to infant feeding practices in their first year of life, information on infant and maternal health status, factors affecting infant feeding practices, and maternal diet.

Sample and Setting

The overall setting of this study was national and the sample consisted of depressed and non-depressed women in their third trimester and their infants through their first year of life. Postnatal questionnaires were mailed monthly when the infants were 2 months old through 7 months of age and every 7 weeks until the child is 12 months of age. An estimated 2,250 women continued with the study until Year 1 of their infant's life. The sample frame for this study came from the nationally distributed consumer opinion panel of > 500,000 women in the United States. Questionnaires were mailed consistently over a period of 18 months. In a prenatal survey, about 4,889 women, African Americans (n = 298) and Hispanics (n = 334) participated. Using the G*Power analysis to determine the appropriate sample size, the analysis showed that a total sample (N = 176) is appropriate. Comparing the groups, (n=88 each group), a total of about 176 participants may provide the needed effect size of 80% with 95% confidence interval. Based on the survey numbers, this study had an adequate sample size to power the study. Approval for the study was obtained from the Walden University Institutional Review Board prior to obtaining data from the CDC. This research will therefore be based on secondary data obtained from CDC.

The rationale for using secondary data in research is that they are easily accessible and available at little or no cost to the researcher compared to primary data (Thomas & Heck, 2001). Secondary data analysis reduces the impact of time constraints, economic constraints, and psychological constraints experienced by the primary investigators (Burstein, 1984). The advantage of using secondary data sources over primary data is

largely based on the fact that the data already exist and therefore the time spent on the study is reduced considerably than the time spent on studies that use primary data collection. In addition, cost of the project is also reduced.

Secondary data analysis does have certain limitations. One common limitation is that such data would have been primarily collected to answer specific questions and may not be in formats that best suit subsequent users. Potential disadvantages are therefore centered on the fact that data selection, quality, and methods of collection were not under the control of the researcher. Secondary data may be embedded with errors due to poorly designed questionnaire, interviewer bias, systematic error in measurement, or inadequate sample size. Such data may have been collected from a sample that may not adequately be representative of the population of interest to researchers other than the primary investigator. Validity of secondary data is therefore usually a concern for researchers.

The concept of precision and accuracy is complementary to the concept of random error and validity. Generally poor data quality could result from two areas: (a) data collection errors which could arise from poor data collection instrument design or administration such as ambiguous or wrongly framed survey questions, data collected from a sample not representative of the study population, interviewer/interviewee bias; or (b) errors in the dataset that reflect incorrect data entry or lack of entry of original information.

The IFPS II data used for this research was obtained from CDC. Many of the validity concern above were expected to be minimal given the organizational capacity of CDC and other collaborating agencies that were involved in IFPS II. Confidentiality was

ensured in this study and all data was coded before receipt from the CDC. IFPS II data incurred minimal ethical concerns in this study as the CDC documented a rigorous approval process in collecting the data.

The IFPS II data has been validated and quality verified by other studies (Gaffney et al., 2014; Fein et al., 2014; Li, Scanlon, May, Rose and Birch, 2014). Fein et al. attempted to describe the methods used in the IFPS II in their study of infant feeding care practices during the first year of life. There have also been over 20 other publications based on the IFPS II data set (CDC, 2010).

The instrument of data collection for Postpartum Depression (one of the key independent variables in this study) is the Edinburgh Postnatal Depression Scale. This screening tool had been widely used in mental health profession. Its validity was established by Cox, Holden & Sagovsky (1987).

Inclusion criteria for participation in the IFPS II study were (a) women in their third trimester, (b) mothers and infants without medical problems that would affect feeding, and (c) infants born within 35 weeks gestation, weighs 5 pounds or more, not a twin and spent no time in the intensive care greater than 3 days women 18-24 years old.

Study exclusion criteria included (a) infants undergoing serious long-term health problems that may affect infant feeding practices, (b) mothers living in a zip code where postal delivery is not delivered, (c) women and infants who failed the screening process by a physician or pediatrician, (d) women who were unable to provide informed consent, and infants with less than 30 weeks gestational age. Several factors contributed to the development of exclusion criteria. Only infants with gestational age > 35 weeks and

weighs greater than 5lbs were included because of multi problems associated with neonate feeding such as breast and formula suckling. Only mothers who provide informed consent were allowed due to ethical concerns. Infant birth age limit (birth at greater than 35 weeks gestational age) were set to allow full understanding and complete analysis of infant feeding patterns by including such infants mature enough to latch a mother's breast or formula bottle. The exclusion of infants with health problems was necessary to control for confounding factors that may arose from these infants and their effects to the study. For example, all infants who required specialized feeding methods and foods were excluded. The basic assumption is that mothers of these infants may have different beliefs and behaviors and as a result, they were excluded. Such difference in beliefs and behavior had been documented. Infant birth is known to trigger certain behaviors, among mothers, aimed at enhancing survival, growth, providing care and suitable environment during stress (Feldman and Eidelman, 2007). According to Bronfenbrenner (1977) social support impacts the psychological wellbeing, and behavior of mother based on the concept surrounding the importance of ecological variables to familial functioning (Crnic, Greenberg, Ragozin, Robnson and Basham, 1983). Different race/ethnicity has different beliefs and behaviors towards preterm babies most in particular in relation to infant feeding practices which are viewed differently by different ethnic groups. Of great importance is the unrealistic disorganization of mother-child interaction and the concerns of postpartum depression and anxiety. Women not belonging to a national consumer opinion panel were excluded due to inconsistent response to the survey questionnaires and helped minimize non-response. Birth weight (Yu et al., 2011)

is used as indicator of conditions the fetus experience in utero and there is research evidence demonstrating the association of birth weight and childhood and adult obesity. Lower birth weight has been associated to greater central obesity measured by the waist-hip ratio and increased risk for cardiovascular disease, diabetes, and hypertension. Similarly, higher birth weight is associated with increased risk of obesity from infancy to early adulthood (Yu et al., 2011).

Independent and Dependent Variables

Infant Feeding Practices (breast feeding vs formula feeding) and postpartum depression were the Independent variables and Infant weight gain over 1-year is the Dependent Variable. Two infant feeding practices were assessed and these are breastfeeding and formula feeding at 2 months post-partum.. Breast feeding at 2 months was computed as average proportion of breast milk to the total milk consumed by the infant on a daily basis based on maternal self-report in IFPS11 survey. Gaffney et al. (2014) contends that less breastfeeding at early infancy constitutes a major risk factor for weight gain later in life.

The practice of formula milk in the IFPS II survey item at 2-months was assessed with the following questions “How often does your drink all his or her bottle of formula?” and “In the past 7 days, about how many ounces of formula did your baby drink at each feeding?” Maternal body mass index (BMI), Household income and Level of Education will be further investigated as covariates for potential confounding effect on the outcome variable (Infant weight gain). The relationship between the dependent and independent variables will be analyzed in partition using race/ethnicity.

Infant Weight Gain at 1 Year of Age

IFPS II survey provided questions to determine infant weight gain. For example, participants' were asked "How much did your baby weigh during his/her last doctor's office visit?" The main assumption in this study is that regular office visits for well-child visits regularly scheduled for the first six months after birth provides reliable data about child weight measure. Maternal self-reported weight at last well-child visits minus the birth weight amounts to infant's weight gain (Gaffney et al., 2014). Weight gain will be categorized as normal, overweight and obese. Infants growth chart help pediatricians to keep track of child's progress and there is a wide variation in the height and weight of normal children. Growth charts came from information obtained from measuring and weighing thousands of children and national average for weight and height for each age and sex were established and plotted forming a curve line and thus the 50th percentile curve. For instance, in a sample of 1000 boys or girls, 500 would be above the curve and 500 below the curve. Babies grow at different rates and follow certain pattern based on their age. Healthy full-term babies weigh an average of between 5 pound 8 ounces and 8 pounds 13 ounces. Kids weighing slightly less or more are healthy. In some cases, smaller baby mostly premature is at a greater risk for certain health problems and infants born larger than average are at greater risk for low blood sugar mostly when mothers had gestational diabetes. At 4 to 7 months, infants double their birth weight according to Kids Health Normal range at this point is 10 and 18 pounds with a monthly increment of about 1.25 pounds monthly for the next 3 to 4 months. Based on this trend one can assess whether the infant is gaining weight as required or more than required based on age.

Postpartum Depression

Previously, a10-item Edinburgh Postpartum Depression Scale (EDPS) was incorporated in the IFPS II data study at 2-months postpartum survey, (Gaffney et al, 2014). Postpartum depression was measured from the information obtained from the mothers themselves through self-report based on their feeling in the past seven days. Scores from EDPS range from 0 to 30 and the higher scores suggests higher risk of postpartum depression lower scores signify lower risk of postpartum depression. A cut off of 10 was embedded in the scale to screen for minor depression in primary settings (Gaffney et al., 2014). In this study, mothers with EDPS reading of greater than 10 will be considered depressed and those with EDPS reading equal to or less than 10 will be considered not depressed. This cutoff score has been used recently in community-based population studies to screen for minor depressive symptoms (Hansua, Scholle, Haskett, Spadaro and Wisner, 2008; Mayberry, Horowitz and Declercq, 2007). However, there had also been studies about where 13 were used as cut off (Watson et al 2011). This study however considers minor depression significant to be included given its overall implication if found to be associated significantly with infant weight gain.

Infant Feeding Practice

Two infant feeding practices were assessed and these are breastfeeding and formula feeding starting at 2 months postpartum. Gaffney et al. (2014) contends that less breastfeeding at early infancy constitutes a major risk factor for weight gain later in life. The practice of formula milk in the IFPS II survey item at 2-months was assessed with the following questions; How' often does your child drink all his or her bottle of

formula?, and In the past 7 days, about how many ounces of formula did your baby drink at each feeding?

Breast feeding at 2 months was computed as average proportion of breast milk to the total milk consumed by the infant on a daily basis based on maternal self-report in IFPS11 survey.

The data for this variable was collected by IFPS II in three levels originally: low, defined as <20% of milk feeding being breast milk; medium defined as between 20% and 80% of milk feedings being breast milk; and high, defined as >80% of milk feeding being breast milk.

In this study, infant feeding practice will be defined as a categorical dichotomous variable where: 20% or less of breast milk feeding will be categorized as formula feeding and >20% of milk feeding and infants feed only breast milk exclusively will be categorized as breastfeeding.

Covariates

Covariates are the variables which effects on the dependent variables without interest of the researcher and are not controlled by the researcher although they have effects on the dependent variable. To control for potential confounding variable effect, four maternal and infant characteristics were assessed for their contributions to the outcome variable. These include: sex of infant, Mothers BMI, age of mother at child birth, mothers level of education (high school, some college, and bachelor's degree or more) and household income based on 2006 poverty guidelines as published by the US Census Bureau (2009).

Data Analysis Procedures

Comparative descriptive statistics, categorized by Race/Ethnicity (Hispanic and African American mothers) were conducted and reported for infant feeding practices, Postpartum Depression, and infant weight gain at 2, 6, and 12 months. An Independent t-test and Pearson chi square analysis were performed to assess whether there is any significant associations among postpartum depression, infant feeding and weight gain at 2 and 6 months of age. ANOVA was conducted to compare group differences (depressed and nondepressed). Multiple linear regression (utilizing postpartum depression and infant feeding practices as categorical dichotomous predictors) were performed to estimate the effect, of depression and feeding practices on infant weight gain at 1-year. Possible interaction and cofounding effects were investigated using; mother's level of education, household income as a percentage of poverty threshold, mothers BMI, mother's age, and sex of infant as covariates. Linearity, normality and homoscedasticity assumptions imposed by these statistical procedures were also evaluated. Further, multiple analysis of covariance (MANCOVA) will be employed to control for the effects of supplementary continuous independent variables (covariates) and help determine whether a difference exist.

RQ1: Is there a relationship between postpartum depression, infant feeding practices (breastfeeding vs formula feeding) and infant weight gain among African American and Hispanic mothers?

Null Hypothesis: There is no relationship between postpartum depression, infant feeding practices (breastfeeding vs formula feeding) and infant weight gain among African American and Hispanic mothers.

Alternate Hypothesis: There is a relationship between postpartum depression, infant feeding practices (breastfeeding vs formula feeding) and infant weight gain among African American and Hispanic mothers.

Pearson chi square analysis of association employing will be conducted to determine if there is statistical significant association among postpartum depression, infant feeding practices, and infant weight gain among African American and Hispanic mothers. These tests will help answer the research question number 1.

RQ2: Is there a difference in infant feeding practices (breastfeeding vs formula feeding) between African American and Hispanic mothers with PPD and those without PPD

Null Hypothesis: There is no difference in infant feeding practices (breastfeeding vs formula feeding) between Africa American and Hispanic mothers with PPD and those without PPD.

Alternative Hypothesis: There is a difference in infant feeding practices (breastfeeding vs formula feeding) between Africa American and Hispanic mothers with PPD and those without PPD. In order to answer research question number 2, Analysis of variance (ANOVA) was used to analyze group differences at 2 months of child birth.

RQ3: Is there a difference in weight gain over 1-year between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed?

Null Hypothesis: There is no difference in weight gain over 1-year between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed.

Alternate Hypothesis: There is a difference in weight gain over 1-year between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed.

A repeated measure ANOVA at 2, and 6 months utilizing an 8 x 3 (months 2, 6, and 12) design will be used to address this research question.

RQ4: Is there a difference in weight gain over 1-year between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed, after adjusting for maternal body mass index, household income, mothers age, mother's education level and sex of the infant?

Null Hypothesis: there is no difference in weight gain over 1-year between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed, after adjusting for maternal body mass index, household income, mothers age, mother's education level and sex of the infant?

Alternative Hypothesis: there is a difference in weight gain over 1-year between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed, after adjusting for maternal body mass index, household income, mothers age, mother's education level and sex of the infant?

Multiple analysis of covariance (MANCOVA) (8 x 3 design) will be used to control for the effects of supplementary continuous independent variables—covariates and this will

help determine if a difference exist. Covariates are the variables which effects on the dependent variable without interest to the researcher and such variable are not controlled by the researcher and however, these variables have effects on the dependent variable. Possible interaction and cofounding effects were investigated using; mother's level of education, household income as a percentage of poverty threshold, mothers BMI, mother's age, and sex of /infant as covariates.

Protecting Human Subjects and Ethical Considerations

This study ensured high level of confidentiality. The data obtained from CDC were coded to preserve the identity of the participants. The IFPS II maintains a high level of confidentiality by encoding all data before release to prospective researchers. Finally, informed consent was obtained by the primary researcher prior to the codification and release of the data.

Missing Data

Post-analysis will be conducted in cases of missing data to ensure that do not differ systematically from the data used in the analysis. Appropriate imputation technique will be utilized and the above research questions reanalyzed where necessary to verify that outcome do not differ significantly as a result of excluded observations with missing data.

Storage of Research Data

Considering my research data, only data needed for my research will be stored and safe guarded for 5-7 years using an online file sharing services like Dropbox and Humyo that allows keeping an online copy of your files which can be accessed from any

computer with an internet connection. The storage system synchronizes versions of your files between different device (e.g., your laptop, desktop and the online space) and allows sharing of files with other users. Online storage can also be useful as a remote back-up solution. Individual identification and password and encryption electronic signatures or watermarking will be implemented for protecting and keeping track of authorship and changes made to the data files. Duplicate hard and soft copies will be created in case of disaster and regularly back up for (both on and offsite) files.

Summary

This research was conducted using quantitative data obtained from Infant Feeding Practices Study 11. Quantitative data occur in univariate, bivariate and multivariate levels. Univariate statistics were employed to describe the data characteristics. Hypothesis of research question 1 was addressed using independent t- test and Pearson's Chi Square analysis of association was performed to assess whether there is any significant associations among postpartum depression, infant feeding and weight gain among these populations. Also, repeated measure ANOVA at 2, 6, and 12 months with 8x3 design was performed to investigate whether any difference in infant weight exist. To address research question 2, analysis of variance (ANOVA) was conducted to compare group differences while repeated measure ANOVA at 2, 6, and 12 months of child birth was employed to provide answer to research question 3. Research question 4 was addressed with multiple analysis of covariance (MANCOVA) to control for the effects of supplementary continuous independent variables—covariates and this will help determine

if a difference exist. Finally, quantitative analysis was enhanced by the use of SPSS (13th edition) software, Minitab (version 17) and Microsoft Excel.

Chapter 4: Findings

Introduction

This chapter describes the study sample and the results of the statistical analysis performed to answer the research questions and test hypotheses. Bivariate analysis, in the form of Pearson chi square test of independence is conducted comparing the frequencies of feeding practices (breast-feeding vs. formula-feeding) and infant weight gain (normal weight vs. overweight) among African American and Hispanic mothers. Binary logistic regression analysis will address question number two given that the outcome variable is a dichotomous categorical variable. The (ANOVA) was used to compare the difference in mean weight gain between African American and Hispanic mothers with or without postpartum depression who formula feed and those who breast feed. The mean weight gain as determined by a permutation of three factors (race, feeding practice and postpartum depression), each were compared at two levels using the "General Linear Model" submenu within ANOVA in Minitab. An exploratory multivariate analysis of the data is also presented in the form of analysis of covariance (ANCOVA) to control for the effects of supplementary continuous independent variables, covariates that will help determine if a difference exist.

Sample Characteristics

Between May and December 2005, approximately 4,000 pregnant women across the United States participated in infant feeding practices study over a course of 15 months and the sample was selected from a consumer opinion panel consisting of 500,000

households.. The IFPS II data included 300 African-American and 335 Hispanic participants (Watkins et al., 2011).

The IFPS II, a longitudinal study involving mothers in their third trimester through first year of life of the infants, was conducted by the US Food and Drug Administration (FDA) in collaboration with the Centers of Disease Control and Prevention (CDC), Department of Health and Human Services, National Institute of Child Health and Human Development, Office of Dietary Supplements, and National Cancer Institute of Health, and the Maternal and Child Health Bureau, Department of Agriculture (Gaffney et al., 2014). The study was designed to obtain information pertaining to infant feeding practices in their first year of life, information on infant and maternal health status, factors affecting infant feeding practices and maternal diet. The basic characteristic of this data as related to this study is the high prevalence of missing data relevant to the variables of interest (See Table 1 below).

Table 1

Number and Percentage of Available and Missing Data on all variable (n = 635)

Variable	Number of Available data (%)		Number of Missing (%)	
	African American	Hispanic	African American	Hispanic
Infant Average Weight (4-7th Month)	210(70)			214(63.88)
Normal Weight	29(9.67)	56(16.72)		
Overweight Weight	61(20.33)	65(19.40)		
Depression (measured by EPDS Scale)			198(66)	186(55.52)
Depressed (EPDS > 10)	22(7.33)	45(13.43)		
Not Depressed (EPDS < = 10)	80(26.67)	104(31.04)		
Infant Feeding			210(70)	195(58.21)
Breast fed (> 50% breast milk)	62(20.67)	110(32.84)		
Formula fed (< 50% breast milk)	28(9.33)	30(8.96)		
Maternal BMI			9(3)	8(2.39)
Under Weight (<19.8)	26(8.67)	43(12.84)		
Healthy Weight (19.8to 26)	114(38)	146(43.58)		
Overweight (>26 to 29)	51(17)	48(14.31)		
Obese (>29)	100(33.33)	90(26.87)		
Mothers' Level of Education			58(19.33)	42(12.54)
No College Education	72(24)	88(26.27)		

1-3 years of College	118(39.33)	144(42.99)		
Bachelor's Degree or more	52(17.33)	61(18.21)		
Mothers' Age			1(0.00)	1(0.00)
Mothers' aged 18-24 years	150(50)	129(38.51)		
Mothers' aged 25-34 years	120(40)	168(0.15)		
Mothers' aged 35 or older	29(9.67)	37(11.04)		
Household income (% of poverty level)			None	None
Poor (< 185%)	182(60.67)	186(55.52)		
Median income (185 to 349%)	81(27)	92(27.46)		
High income (> 349%)	37(12.33)	57(17.01)		
Infant age before solid			251(183.67)	104(31.04)
Greater than 4 months	41(13.67)	71(21.19)		
Less than4 months	8(2.67)	9(2.69)		

(table continues)

Variable	Number of Available data (%)		Number of Missing (%)	
	African American	Hispanic	African American	Hispanic
Feeding used to induce sleep (Bottle-to-Bed)			178(59.33)	168(50.15)
Never	50(16.67)	88(26.27)		
Occasionally	19(6.33)	25(7.46)		
Often	53(17.67)	54(16.12)		
Infant fussy?			179(59.67)	168(50.15)
Yes	23(7.67)	32(9.55)		
No	98(32.67)	135(40.30)		

Mothers' employment Status			80(26.67)	63(18.81)
Employed full time	80(26.67)	93(27.76)		
Temporary unemployed	37(12.33)	34(10.15)		
Self Employed	10(3.33)	14(4.18)		
Employed part time	22(7.33)	26(7.76)		
Retired and not employed	None	2(0.60)		
Full time home-maker	38(12.67)	84(25.07)		
Disabled, Student etc and not employed	33(11)	19(5.67)		

Note. If computed average weight + margin of 1.25lb is greater than twice the infant birth weight, the infant was classified as overweight. Otherwise, the infant was classified as having normal weight.

Analysis of Missing Data

The ten variables of interest—infant weight, mother's EDPS score, percentage of breast milk the infant was fed, maternal BMI, feeding to put infant to sleep (i.e. bottle to bed), maternal employment status, family poverty level, maternal age, infant fussiness, and maternal level of education—were analyzed to determine whether there is a pattern among survey respondents with missing values.

Missing data are usually classified into three major types: missing completely at random (MCAR), missing at random (MAR) and missing not at random (MNAR). Out of these three groups, data missing not at random (MNAR) possess the greatest challenge. When values are not missing at random, it suggests that the survey respondents did not respond to certain questions for certain reasons. Inferences drawn from the analysis of

data sets where values are not missing at random has the potential of yielding misleading results (Rubin, 1996; Schafer, 1997; Horton and Lipsitz, 2001; Barnard and Meng, 1999).

A multiple imputation statistical procedure is generally accepted as the best way to address missing data. The procedure replaces missing values with values considered most appropriate from several averages of available data values. Multiple imputation works best when missing values fall with the MCAR or MAR category (Rubin, 1996; Schafer, 1997; Horton and Lipsitz, 2001; Barnard and Meng, 1999).

The secondary data used in conducting this research coded missing data in eight ways:

Q = respondent did not return questionnaire

N = respondent was supposed to answer question but did not

S =respondent gave a conflicting response

F = fathers demographic information not available

"." = missing without any designated reason

99 respondent did not know (e.g., age of other household members)

88 = not specified for verbatim data (e.g., main question answered but follow up Specific was not)

999 = used for inconsistent coding (e.g., "0" servings for infant feeding).

All variables of interest with missing values, irrespective of reason for missing as outlined above were analyzed to determine missing type.

The analysis indicates that 9 of 10 variables of interest listed above are missing at least one datum. The population of study included 635 survey respondents (cases) made up of 300 African American and 335 Hispanic mother/ infant dyads. Missing data analysis indicated that 513 (about 81%) out 635 survey participants did not respond to at least one survey question. This means that only 122 participants (19%) answered all questions included in the questionnaire regarding the 10 listed variables of interest (Figure 1).

Overall, approximately 66% of the data points required for the analysis were missing due to one of the eight reasons for missing data listed above. This is an unusually high percentage of missing values compared to what is conventionally acceptable. Generally 5% or less missed is considered acceptable provided data is MCAR or MAR. Beyond this, power and reliability is affected especially if data is MNAR, which is the case here (Graham, 2008 in Stuart, 2010 ; Little and Rubin, 2002) In addition, the three major variables of interest (infant weight, post-partum depression, and whether the infant was fed breast milk or formula milk) are missing over 50% available data points (see Table above).

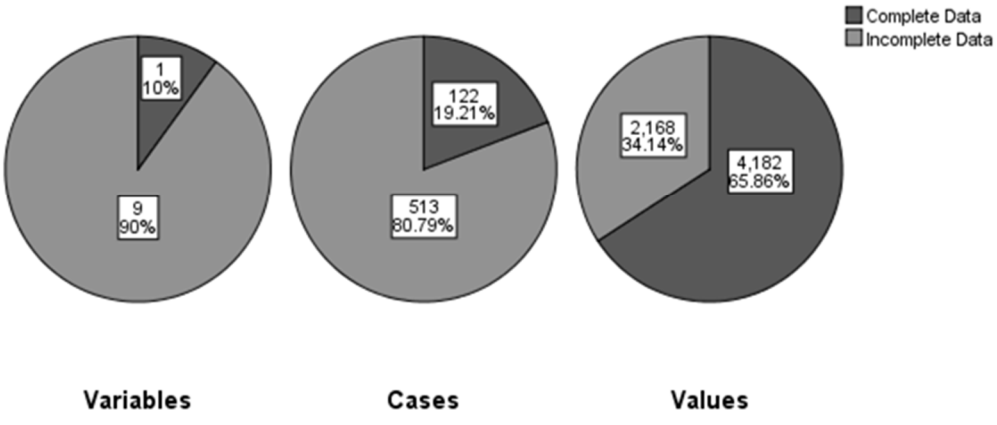

Figure 1. Overall summary of missing variables, cases, and values.

Table 2

Descriptive Summary of Missing Values

	Missing				
Variables	*N*	Percent	Valid *N*	Mean	Std. deviation
Infant weight	424	66.8%	211	16.3763	2.72690
% breast milk	405	63.8%	230	71.0994	28.07552
EPDS score	384	60.5%	251		
Infant fussiness	347	54.6%	288		
Bottle to bed	346	54.5%	289		
Employment status	143	22.5%	492		
Level of education	100	15.7%	535		
Mothers BMI	17	2.7%	618	27.1599	7.42513
Mothers age	2	0.3%	633	26.42	5.913

Figure 2 indicates that there is a pattern to missing data. A cluster of colored patches on the bottom right and a cluster of non-colored patched to the left indicate contiguous missingness or monotonicity. Many of the missing data are associated with infant weight (avWeight), EPDS score, percentages breast milk infant was fed (avPctbm), whether infant was reported as being fussy, and how often the infant was put to bed with feeding. Apart from suggesting that data are likely not missing at random (NMAR),

Figure 2, also suggest that a partial monotone approach of multiple imputation will be appropriate for replacing the missing data.

In summary, the analysis of missing values indicate that there is a chance that the outcome of the data analysis based on the chosen population of study will be biased and that multiple imputation may not effectively correct the resulting effect.. In attempt to mitigate the problem posed by missing values, a conservative statistical estimate will be reported all through the analysis.

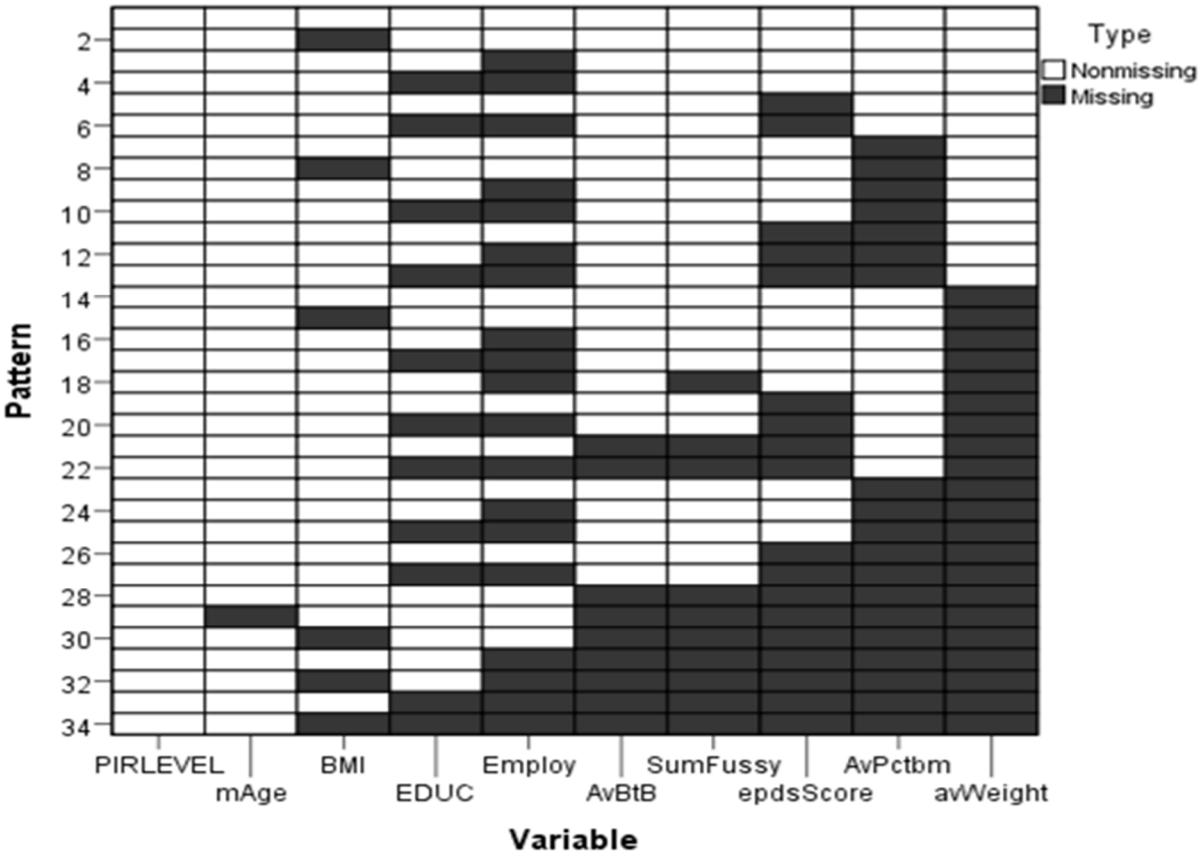

Figure 2. Missing value patterns.

Omitted Variable Bias

Infant age before solid food was introduced: One of the four clinical practice guidelines concerning infant feeding behavior is that solid food should not be introduced earlier than age 4–6 months (Clayton, Li Perrine, & Scanlon, 2012). Previous research indicated that this variable has a statistical significant effect in determining infant weight gain (Gaffney et al, 2014). This variable was however not included due to poor response from the study population (Response rate was 7.27% for African American and 12.60% for Hispanics (See Table 12 in Appendix B.)

Multiple Imputation

SSPS was used to perform multiple imputations based on the research questions. In all cases, generate a fixed random seed set at SPSS default value. We set number of iteration to 5 and select the automatic option to enable the system auto decide appropriate imputation method between the monotone and Markov Chain Monte Carlo Method of multiple imputation. The Monotone method works best when missing data is contiguous while Markov Chain Monte Carlo Method works best when data is missing arbitrary (Schafer 1997, pp. 147–148). In this research missing data were both arbitrary and contiguous among most variables. This implies that no one of the method alone would have been appropriate here. Choosing the automatic option enables SPSS to use both method where appropriate to perform data imputation.

Outcome of Analysis Based on the Research Questions

Research Question 1

Is there a relationship between infant feeding practices (breastfeeding vs. formula feeding) and infant weight gain (normal weight vs. overweight) among African American and Hispanic mothers? (See table *2 for number and percentage of survey participant by race)

Table 3

Descriptive of infant weight and infant feeding practice (Breast milk Vs. Formula Milk) by race (African American, n=300 and Hispanic (n=335)

Variable	Number of participants (%)		Mean (SD)	Mean (SD)
	African American	Hispanic	African American	Hispanic
Infant feeding				
Breast fed (> 50% breast milk)	62(20.67)	110(32.84)		
Formula fed (< 50% breast milk)	28(9.33)	30(8.96)		
Infant average weight (4-7th month)**				
Normal weight	29(9.67)	56(16.72)	14.37(2.31)	14.88(2.39)
Overweight weight	61(19.40)	65(19.40)	17.20(2.04)	17.79(2.61)

*African American

** If computed average weight + margin of 1.25lb is greater than twice the infant birth weight, the infant was classified as overweight. Otherwise, the infant was classified as having normal weight.

A chi-square test of independence was conducted comparing the frequencies of feeding practices (breast-feeding vs. formula-feeding) and infant weight gain (normal weight vs. overweight) among African American and Hispanic mothers. The analysis indicates that there is an association between infant weight gain and feeding practices.

Irrespective of race, infants who were breast fed were more likely to have normal

or healthy weight (89.1%) than infants who were formula fed (10.9%). These differences were found to be significant ($X^2_{(1)}$=10.461, P= 0.01) with moderate effect size (*Phi* = 0.275). Due to large percentage of missing data (See tables 7 and 10 in Appendix B), multiple imputation was used to increase sample size and the analysis repeated. Similar results as above were obtained (see table *B below).

Table 4

Association Between Infant Weight Gain (normal weight vs. overweight)† and Feeding Practice (breast feeding vs. formula feeding)‡ at 7 Months Postpartum.

Count	Complete Case Analysis (n=155)	Multiple Imputation (n=286)
Breast Fed (Normal Weight)	57 (89.1%)	103 (87.8%)
Formula Fed (Normal Weight)	7 (10.9%)	14 (12.2%)
Breast Fed (Overweight)	59 (64.8%)	108 (63.6%)
Formula Fed (Overweight)	32(35.2%)	62 (36.4%)
Statistic	Complete Case Analysis (n=155)	Multiple Imputation (n=286)
Pearson Chi-Square (df)	11.712(1)**	17.894(1)***
Continuity Correction (df)	10.461(1)**	16.749(1)***
Phi	0.275	0.250

† Infant weight gain normal weight Vs. Overweight was determined based on the accepted convention that infants double birth weight at 4 to 7 months (Kids Health).
‡ Infants whose feeding constitutes 50% or more breast milk 7months post partum were classified as breast fed. Those who received less than 50% milk 7months post partum were classified as formula fed.
*$p < 0.05$ **$p < 0.01$ ***$p < 0.001$

Research Question 2

Is there a difference in infant feeding practices (breastfeeding vs. formula feeding) between African American and Hispanic mothers with PPD and those without PPD? (See table 5 below for descriptive of PPD by race.

Table 5.

Descriptive of Postpartum Depression (measured by Edinburg Postpartum Depression Scale-EDPS) by race (African American, n=300 and Hispanics, n=335.

	African American	Hispanic
Infant Feeding		
Breast fed (>50% breast milk)	62(20.67)	110(32.84)
Formula fed (< 50% breast milk)	28(9.33)	30(8.96)
Depression (measured by EPDS Scale)		
Depressed (EPDS >10)	22(7.33)	45(13.43)
Not Depressed (EPDS < = 10)	80(26.67)	104(31.04)

Binary Logistic regression in SPSS was used to address this research question. The overall test of model coefficient of complete cases (n=192, missing = 443) was not statistically significant ($x^2 = 4.842$, df = 2, *p*-value=0.089). The result of the overall test after multiple

imputation (n=289) remained insignificant (on average $x^2 = 4.031$, df = 2, *p*-value=0.133). However Hosmer and Lemeshow test indicated that the model may have some utility (x^2=2.104, *df*=2, *p*-value = 0.349). The usefulness was indicated to be very low by Negelkerke rescalled R-Square (0.037). Interpreted loosely*[1] the Negelkerke rescalled R-Square (0.037) implies that only about 4% of the variation in infants feeding habit is accounted for by the combined factors of Race and mothers psychological state (measured by PPD classification). The observed vs. predicted frequencies of Feeding Habit (Breast milk vs. Formula milk) indicates that with or without the explanatory variables (PPD and Race), the interpretative effect of the model remained more or less the same (at 75%) and only increasing very slightly after multiple imputation (75.1%) – see Table 3

However of the two factors of Race and PPD, Race does seem to have more effect. Pre-analysis using Pearson correlation coefficient indicated low negative correlation between Infant Feeding Practices and Race (-0.109) but even quite lower negative correlation between Infant Feeding Practices and Mothers Psychological State as measured by PPD (-0.033). Also, controlling for the effect of PPD, the odds that an infant was feed formula milk decreased by about half for infants of Hispanic mothers compared to those of African American mothers (*Wald's-*χ^2*(df)* = 4.642(1), *p*-value =0.031, *Beta*=-7.32, *odd's ratio*= 0.481). This latter result however proved to be

[1] The word loosely was used here because the test statistic (Negelkerke rescalled R-Square = 0.037) does not have the same interpretation as coefficient of determination (R^2) in regression analysis. It is however considered as a crude approximation of R^2

unstable after multiple imputation (*p*-value =0.225, *Beta*=-0.443, *odd's ratio*= 0.642))- see **Table C and D** below for a summary of these results.

Table 6

The Observed and Predicted Frequencies of Feeding Habit (Breast milk Vs. Formula milk) by Logistic Regression of Complete Case Analysis (n=192) with the cutoff of 0.50

		Complete case analysis (*n* = 192) Feeding Habit			Multiple imputation (***n*** = 289) Feeding habit		
Observed		*Breast fed*	*Formula fed*	*% Correct*	*Breast fed*	*Formula fed*	*% Correct*
Feeding Habit	*Breast Fed*	144	0	100	218	0	100
	Formula Fed	48	0	.0	71	0	.0
Overall Percentage				75‡			75.1‡

‡The overall percentage of the interpretative effect of the model remained the same for both Null model (without any explanatory variables) and the Complete model (with Race and PPD as explanatory variable)

Table D

SPSS Binary Logistic Regression Analysis of Feeding Habit (Breast milk Vs. Formula milk) as dependent variable against Race (African American/Hispanic) and mothers psychological state (Depressed Vs. Not Depressed based on EPDS – Survey) as independent variables.

Overall Model Evaluation

Test	Complete Case Analysis (n=192)	Multiple Imputation (n=289)
Likelihood ratio test –x^2(*df*)	4.842 (2)	4.031 (2)
Hosmer_Lemeshow Goodness –of-fit test - x^2(*df*)	2.104(2)	
Nagelkerke(Max rescaled) R-Squared	0.037	0.021

Variables in the Equation

	Complete Case Analysis (n=192)			Multiple Imputation (n=289)	
Predictor	*β*	*Wald's*χ^2*(df)*	e^{β} *(Odds Ratio)*	*B*	e^{β} *(Odds Ratio)*
EPDS-Scale	-0.198	0.289(1)	0.821	-0.080	0.923

Race	-0.732	4.642(1)*	0.481	-0.443	0.642
Constant	1.133	1.054(1)	3.104	0.159	1.173

*$p < 0.05$ **$p < 0.01$ ***$p < 0.001$

Research Question 3

Is there a difference in infant weight gain at 7th month after birth between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed?

A multiple ANOVA was used to evaluate differences in mean infant weight gain based on the effect of three factors each at two levels: Race (African American, Hispanic), Infant feeding practice (breast milk, formula milk), and Mothers psychological state (mothers with PPD vs. mothers without PPD).

Only the main effect of Infant feeding practice (breast milk, formula milk) was found to be significant at alpha level 0.05. It yielded an F-ratio of F (1,134) = 4.036, p = 0.047. The result indicated that irrespective of race, infants who were formula fed tend to have higher weight (17.7± 2.9 lbs and 16.8 ± 2.6lbs, for Hispanics and African Americans respectively) compared to infants who were breast fed (16.5 ± 3.0 lbs and 16.3 ± 3.1 lbs for Hispanics and African Americans respectively- See figures 1 in Appendix C). The main effect of Race was not significant F (1,134) = 1.259, p = 0.264, nor the main effect of PPD F (1,134) = 0.976, p = 0.325. Full factorial interactions of Infant feeding practice, Race and PPD were not significant at alpha level 0.05 (see table 13 in appendix B for details). The analysis conducted in this section was repeated after

multiple imputations. The results did not change in any significant way (See Table *4 below)

Table 7 Analysis of variance (ANOVA) assessing the effect of Race, Post-Partum Depression and Infant feeding options (breast feeding vs. formula feeding) on infant weight gain.

Complete Case Analysis (n=142)*						
Source	Type III Sum of Squares	df	Mean Squares	F	Sig	Partial Eta Squared
Race	11.032	1	11.032	1.259	0.264	0.009
Breast milk Vs. Formula milk (PCTBM)	35.354	1	35.354	4.036	0.047	0.029
Depressed Vs. Not Depressed (EPDS)	8.551	1	8.551	.976	.325	0.007
Race * PCTBM	0.116	1	0.116	0.013	0.909	0.000
Race * EPDS	0.944	1	0.944	0.108	0.743	0.001
PCTBM * EPDS	14.576	1	14.576	1.664	0.199	0.012
Race * PCTBM * EPDS	12.614	1	12.614	1.440	0.232	0.011
Error	1173.773	134	8.760			
Total	40363.606	142				

Multiple imputation (n=298)**						
Source	Type III Sum of Squares	df	Mean Squares	F	Sig	Partial Eta Squared
Race	10.609	1	10.609	1.412	0.236	0.005
Breast milk Vs. Formula milk (PCTBM)	51.766	1	51.766	6.891	0.009	0.023
Depressed Vs. Not Depressed (EPDS)	3.776	1	3.776	0.503	0.479	0.002
Race * PCTBM	3.794	1	3.794	0.505	0.478	0.002
Race * EPDS	0.074	1	0.074	0.010	0.921	0.000
PCTBM * EPDS	6.797	1	6.797	0.905	0.342	0.003
Race * PCTBM * EPDS	0.001	1	0.001	0.000	0.992	0.000

Error	2178.473	290	7.512
Total	81687.593	298	

**R-squared* =0.052 (*Adjusted R-Squared* = 0.002)
***R-squared* =0.032 (*Adjusted R-Squared* = 0.009)

Residual analysis indicated that basic assumptions of Analysis of Variance were satisfied (Levene's Test of Equality of error variance yielded F (7,134) = 1.260, p = 0.275, See figures 2-5 in Appendix C for graphical analysis of residuals disaggregated by race).

Research Question 4

Is there a difference in weight gain at 7th month after birth between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed, after adjusting for mothers BMI, mothers level of education, mothers age, family Socio-economic status, mother's employment status, infant fussiness, using feeding to put baby to sleep and Infant age before solid food was introduced?

In order to assess the effect of Race, Post-Partum Depression (PPD) and Infant feeding practice (breast feeding vs. formula feeding) on infant weight gain, controlling for the listed covariates, a full factorial Analysis of Covariance (ANCOVA) was conducted. The result indicated a significant effect of maternal BMI [F (1,107) =8.982, p=0.003], Mothers Level of Education [F (1,107) =4.029, p=0.047], and Bottle-to-Bed [F (1,107) =4.188, p=0.043], on Infant Weight gain after controlling for Race, PPD, Infant feeding practice (breast feeding vs. formula feeding), mothers age, family Socio-

economic status, mother's employment status, and infant fussiness. The result also indicated that the main effect and interactions of the main predictor variables were not significant at alpha level 0.05.

However, after multiple imputation, the result changed quite reasonably. The following were now found to have significant effect on infant weight gain: Infant feeding practice (Breast milk vs. Formula milk) [F (1,620) =4.042, p=0.045], Post-partum depression (Depressed vs. Not depressed) [F (1,620) =2.731, p=0.099], maternal BMI [F (1,620) =16.423, p=0.000], Mothers Level of Education [F (1,620) =7.760, p=0.006], Bottle-to-Bed [F (1,620) =17.612, p=0.000], Maternal employment [F (1,620) =4.701, p=0.0.031], Infant fussiness [F (1,620) =11.415, p=0.001], and the interaction between Race, Post-partum depression and Infant feeding practice (Breast milk vs. Formula milk) [F (1,620) =3.675, p=0.056], See Table E below.

Table 8 ANCOVA assessing the effect of Race, Post-Partum Depression and Infant feeding options (breast feeding vs. formula feeding) on infant weight gain, controlling for maternal BMI, Level of education, Age, Poverty Level, Employment status, Infant fussiness, Bottle to Bed.

Complete Case Analysis (n=122)*						
Source	Type III Sum of Squares	df	Mean Squares	F	Sig	Partial Eta Squared
Race	2.955	1	2.955	0.429	0.514	0.004
Breast milk Vs. Formula milk (PCTBM)	0.262	1	0.262	0.038	0.846	0.000
Depressed Vs. Not Depressed (EPDS)	19.085	1	19.085	2.769	0.099	0.025
Maternal BMI	61.915	1	61.915	8.982	0.003	0.077
Mothers Level of Education	27.776	1	27.776	4.029	0.047	0.036
Bottle to Bed	28.872	1	28.872	4.188	0.043	0.038
Error	737.579	107	6.893			
Total	34649.394	122				

Multiple imputation (n=635)**						
Source	Type III Sum of Squares	df	Mean Squares	F	Sig	Partial Eta Squared
Race	3.439	1	3.439	0.441	0.507	0.001
Breast milk Vs. Formula milk (PCTBM)	31.558	1	31.558	4.042	0.045	0.006
Depressed Vs. Not Depressed (EPDS)	21.325	1	21.325	2.731	0.099	0.004
Maternal BMI	128.221	1	128.221	16.423	0.000	0.026
Mothers Level of Education	60.590	1	60.590	7.760	0.006	0.012
Bottle to Bed	137.504	1	137.504	17.612	0.000	0.028
Employment Status	36.704	1	36.704	4.701	0.031	0.008
Infant Fussiness	89.122	1	89.122	11.415	0.001	0.018
Race * PCTBM * EPDS	28.693	1	28.693	3.675	0.056	0.006
Error	4840.679	620	7.808			

Total	182865.730	635

**R-squared* =0.173 (*Adjusted R-Squared* = 0.065
***R-squared* =0.117 (*Adjusted R-Squared* = 0.097) *Note-Only key results were included here, see Appendix B table 14 for full result including interaction terms.*

In order to isolate and better define specific relationships between infant weight gain and main predictor variables, multiple regression analysis was subsequently conducted, including covariates that the analysis of covariance above showed to have significant effect. Analysis indicated that infants of mothers' who has bachelor's degree or more on average weigh about 1.71 pounds less than infants of mothers without any college education. This difference was found to be significant at 95% confidence level (β=-1.70863, SE=0.73668, p=0.0223). Infants of mothers' who had 1-3 years of college were found to weigh, on average, 1.01 pounds less than infants of mothers without any college education. This difference was however found not significant at 95% confidence level (β=-1.01375, SE=0.68328, p=0.1409, CI = -2.36842, 0.34091).

Though statistically insignificant, the multiple regression analysis also indicated as follows:

1. Infants who were often put to bed with feeding bottle (i.e., bottle-to-bed), weight 0.99 pounds more than infants who were never sleep induced by feeding (β=0.99477, SE=0.58452, p=0.0917, CI= -0.16410, 2.15364).
2. Infants of Obese mothers' weigh 0.86 pounds, on average, more than infants of mothers with normal weight (β=0.85545, SE=0.61148, p=0.1647, CI= -0.35688, 2.06777).

3. Infants of underweight mothers' weigh 1.78 pounds, on average, less than infants of mothers with normal weight (β=-1.78022, SD=0.95374, p=0.0646, CI= -3.67012 – 0.10968).

See Table *F for more details. All basic assumption associated with Multiple Linear regression was satisfied (See figures 8,9 and 10 in Appendix C).

Table 9 Multiple regression of Infant Average Weight against Race, feeding practice (breast milk vs. formula milk), PPD, Mothers BMI, Level of Education and Bottle-to-Bed (n=122)

Predictor	*β (SE)*	P-Value	95% CI
Race	-0.30949(0.54636)	0.5723	(-0.77372, 1.39270)
Breast milk Vs. Formula milk	-0.65503(0.63524)	0.3048	(-1.91446, 0.60440)
Depressed Vs. Not Depressed	0.31630(0.58246)	0.5882	(-0.83849,1.47109)
Mothers' BMI*			
Under Weight	-1.75277(0.98168)	0.0770	(-3.69903, 0.19350)
Overweight	-0.18465(0.83474)	0.8254	(-1.83960, 1.47031)
Obese	0.85545(0.61148)	0.1647	(-0.35688, 2.06777)
Bottle to Bed†			
Occasionally	-0.25588(0.67133)	0.7039	(-1.58685, 1.07509)
Often	0.99477(0.58452)	0.0917	(-0.16410, 2.15364)
Mothers' Level of Education‡			
1-3 years of College	-1.01375(0.68328)	0.1409	(-2.36842, 0.34091)
Bachelor's Degree or more	-1.70863(0.73668)	0.0223	(-3.16916, -0.24809)

Mothers' employment status			
Employed full time	-0.24743(0.66420)	0.7102	(-1.56426,1.06941)
Self employed	-1.91062(1.15339)	0.1006	(-4.19733,0.37609)
Employed part-time	-0.24718(0.86980)	0.7768	(-1.97164,1.47727)
Temporary Unemployed	-0.80114(0.76930)	0.3001	(-2.32634,0.72406)
Infant fussiness	0.56705(0.56366)	0.3167	(-0.55047,1.68456)

**Mothers' BMI was referenced to mothers with Healthy weight (19.8 – 26).*
†Bottle-to-Bed was *referenced to mothers who do not use feeding as a means to induce infant to sleep.*
‡*Mothers' level of education was referenced to mothers without any college education.*

In summary, the analysis based on question 1 had the null hypothesis rejected and Chi square test of independence indicating that, without regard to race, infants who were breast fed were more likely to have normal or healthy weight compared to those who were formula fed. Analyzing our second question, it showed that the null hypothesis could not be rejected which implies that infant mothers' race and psychological state (depressed or not depressed) do not really matter in a significant way in determining differences in feeding habit adopted by parents. The findings from this research question add to our understanding of the relationship between postpartum depression and infant feeding practices.

Furthermore, the result of the analysis of variance (ANOVA) showed that infant weight differed statistically significantly due to the effect of feeding practices (breast milk and formula milk) adopted by parents. The effect of race (African American and Hispanic) and maternal psychological state (mothers with PPD vs mothers without PPD)

was found to be statistically insignificant. The findings based on question 3, add to the body of evidence available to inform practice when caring for mothers and infants in the first few months postpartum and the high levels of depressive symptoms found in this study.

Finally, analysis based on question 4 revealed that the null hypothesis was rejected indicating significant effect of only maternal BMI, maternal educational level, Bottle-to-Bed on infant weight gain after controlling for Race, PPD, infant feeding practices (breast feeding vs formula feeding), maternal age, family SES, maternal employment status, and infant fussiness. Further analysis indicated that infants of mothers' with college education were found to weigh less on average than infants of mothers without any college education.

Chapter 5: Main Findings of the Analysis

Introduction

This chapter presents an overview of the problems, the purpose of the study, the summary, and discussion of the major findings of this dissertation project as they relate to the current literature. Childhood overweight and obesity are public health problems that require more attention in our communities. Various health risks that affect children during infancy have been associated with higher infant body mass index and increased odds of childhood obesity. One of the areas of interest in finding a solution to this problem is examining the mental states of African-American and Hispanic mothers, who are affected by PPD and determining if their infant feeding practices (breastfeeding vs. formula feeding) influence obesity or overweight in children. The purpose of this study was to assess whether PPD, race/ethnicity, and infant feeding practices are related to excessive infant weight gain.

Data Set

The data set required for the evaluation of the respective research questions was the IFPS II data set (Gaffney et al., 2014). The IFPS II sample was based on a nationally distributed consumer opinion survey and the results provided valuable data on infant feeding due to the frequency of its questionnaires and wide coverage of various salient issues. Several researchers have utilized the IFPS II data on various studies. Gaffney, Kitsantas, Brito & Swamidoss (2014) employed this data set to examine postpartum depression (PPD) as a potential risk factor for maternal departure from infant feeding guidelines and subsequent excessive infant weight gain. The findings indicated that using

logistical models after controlling for demographic factors, mothers with PPD were 1.57 times (95% confidence interval (CI): 1.16, 2.13) more likely to breastfeed at low intensity and 1.77 times (95% CI: 1.16, 2.68) more likely to add cereal to infant formula. Although PPD tends to be associated with the early introduction to solid foods (odds ratio: 1.42; 95% CI: 1.07, 1.89), the relationship was not significant after controlling for potential confounders. A small but significantly greater average weight gain at 6 months was observed among infants of mothers with PPD (10.15 lb. SD = 2.32 vs 9.85lb SD = 2.32). In addition, research by Li, Fein and Grummer-Strawn (2008) found that infants who were breastfed more intensively during early infancy (6 months) were less likely to have excess weight gain during late infancy (12months). This study utilized the IFPS II data set. Their findings revealed that infants fed with low breastfeeding intensity (20% of milk being breast milk) and medium breastfeeding intensity (20%-80%) in the first half of infancy were at least 2 times more likely to have excess weight during the second half of infancy than those breastfed at high intensity (80% and higher). In addition, this study further suggested that infants who emptied bottles in early infancy were 60% more likely than those who rarely emptied bottles to have excess weight during late infancy. Finally, the study indicated that the mother's encouragement of bottle emptying was negatively associated with the infant's risk for excess weight during the second half of infancy.

Infant weight gain was computed based on the accepted convention that infants double their birth weight between 4 to 7 months postpartum. Estimates used here were the average weight at 5th and 6th month. Though data were not actually available for the 7th month, excluding the 4th and the 7th months infant weight ensured that expected

weight was neither underestimated nor overestimated. However, the implication of taking average weight of the 5th and the 6th month was that in cases where data were only available for one of the two months, the study may have underestimated expected weight if the available data was only that of the 5th month. To compensate for such tendency to underestimate, 1.25 pounds was added to all computed expected average infant weight. Research indicates that 1.25 pounds is the expected normal monthly weight gain for a healthy child (Cravioto, Birch, De Licardie and Rosales, 1967). An attempt to identify an ideal weight for a 7-month-old infant means identifying the desirable range, and according to KidsHealth, babies come in different shapes and sizes. The important point is that they follow the same pattern of growth and that during the first six months of life, an infant gains about 1.5 to 2 pounds per month. After 6 months, average weight gain slows to 1 to 1.25 pounds per month. A point of concern in the study was that babies may have weight fluctuations. A slight decrease or increase throughout the year is usually is normal, but a significant change can indicate a problem. Kids health indicated that it could be a problem if a baby is gaining weight without increase in height. Note that the addition of 1.25 pounds in any case will not lead to overestimation since the estimate used 5th and 6th months data but was supposed to include the infant's weight between 4th and 7th months. On average, it is therefore expected that the estimate of infant weight gain remained conservative and did not overestimate nor under estimate expected infant weight at 7th month postpartum.

Another matter of consideration here is that the classification of infant weight ought to include those who were underweight and obese (as expected in four classes of

BMI – underweight, healthy weight, overweight and obese). However in this study infants who weigh less than twice their birth weight at month 7 was simply classified as healthy (this subsumes the underweight and healthy weight categories) while infants who weigh more than twice their birthweight at Month 7 was classified as overweight (this subsumes the overweight and obese categories). Defining infant weight as a described above enables the researcher to increase sample size without violating the core objective of the study which is concerned mainly with infants overweight and variables related to same. Defining infant weight is justifiable based on the fact that only healthy and non-preterm infants were included in the study. In addition, determining infant weight classification at 7^{th} month post-partum has two advantages: (a) it ensures that the classification of infant weight is based on accepted convention in this field of study, (b) it also improved study validity since infant weight up to the 6^{th} month is obtained officially from infants' hospital records during parents' post-natal wellness visits. Infant weight reported after the 6 months were solely that of the parents and thus have higher tendency of being incorrectly measured.

The classification of feeding practice (breast fed vs formula feed) based on percentage of breast milk infant was fed was also done conservatively. The researcher did not only restrict this computation to values reported up to the 7^{th} month, infants classified as having been breastfeed must also have been fed 50% or more breast milk on average between birth and the seventh month . This compares favorably with classifications used in prior research (low < 20% of milk feeding is breast milk, medium where breast milk feeding is between 20% and 80% and high where more than 80% of milk feeding is

breast milk) (Gaffney et al., 2014). Previous studies (Piwoz, Kanashiro, De Romana, Black and Brown, 1996; Dewey, Heinig, Nommsen, Peerson, and Lonnerdal, 1993; Dewey, Heinig, and Nommsen-Rivers, 1995) explained the possible mechanisms for why breastfeeding provided healthy infant weight and the properties of breast milk and the metabolic programming associated to infant feeding mode. Consistent to other studies, Ong et al. (2006), in this study revealed that among formula fed infants, dietary energy intake at 4 months tend to predict weight gain and obesity and there were no significant association with breast feeding. This may reduce the risk of being overweight and the addition hormones such as Leptin and adiponectin found in breast milk but not in formula milk may help regulate appetite and energy metabolism while adiponectin may cause weight loss (Li, Fein and Grummer-Strawn, 2008).

Research Outcome

Research Question 1

Is there a relationship between infant feeding practices (breastfeeding vs. formula feeding) and infant weight gain (normal weight vs. overweight) among African American and Hispanic mothers?

Data analysis Included a Pearson Chi-square Test of Independence and demonstrated that, without regards to race, infants who were breast fed were more likely to have normal or healthy weight (89.1%, n=57) than infants who were formula fed (10.9%, n=7). These differences were found to be significant ($X^2_{(1)}$=10.461, P= 0.01) though with low effect size (Phi = 0.275). These results remained stable across analysis based on list-wise deletion of incomplete cases based on increased sample size through

multiple imputations. Analysis with imputed data showed that infants who were breastfed were more likely to have healthy weight (87.8%, n=103) compared to infants who were formula fed (12.2%, n=14). These differences remained significant ($X^2_{(1)}$=16.749 $P<$ 0.001) though with low effect size (*Phi* = 0.275).

In cognizance of a large percentage of missing values, the reported chi-square statistics and p-value above were the conservative Yates Continuity Correction values. Infant weight gain and percentage of breast milk infants were required to be fed before being classified as having been breast fed were also computed conservatively. In conclusion, this study demonstrated a significant difference between breast feeding and formula feeding. Consistent with previous studies, breastfeeding seems to have small but protective effect against obesity in children (Arenz, Ruckerl, Koletzko & von Kries, 2004; Dewey, Heining, Nommsen, Peerson, & Lonnerdal, 1993). In the study performed by Mihrshahi, Battistutta, Magarey, & Daniel (2011), the findings from their study supported the contention that there was an association between formula feeding, feeding to schedule and weight gain in the first months of life. After controlling for the covariates (gender, maternal age, education and smoking during pregnancy and birth weight), only formula feeding (OR =1.72(95%CI 1001-2.94), p=0.047 and feeding to schedule (OR= 2.29 (95%CI 1.14-4.61), p=0.020) were significant to infant weight gain.

Findings from this research supports the body of research that breastfeeding may offer a protective mechanism against later childhood obesity (Gillman et al., 2008; Dewey, 2003). A meta-analysis of nine international studies published between 1999 and 2003 found a dose-dependent effect of breast-feeding in reducing latter childhood

obesity, after adjusting for potential confounding factors (Arnez et al., 2004). Consistent with Hawley, Johnson, Nuusolia, & McGarvey, (2012), whose study found that formula feeding were significant and formula fed boys were more likely to be obese at 15 months (38.6) than breastfed boys (23.4%), $X^2 = 8.4$, $p<0.01$, odds ratio =2.05, 95% confidence interval (1.04-4.05).

Research Question 2

Is there a difference in infant feeding practices (breastfeeding vs. formula feeding) between African American and Hispanic mothers with PPD and those without PPD?

Data analysis using a Binary Logistic Regression indicated no difference in infant feeding practices (breastfeeding vs. formula feeding) between African American and Hispanic mothers with PPD and those without PPD. This implies that infant mothers' Race and Psychological state (depressed or not depressed) were not a significant influencer with regards to feeding habits adopted by these mothers.

The overall test of model coefficient of complete cases (n=192, missing = 443) was not statistically significant ($x^2 = 4.842$, df = 2, *p*-value=0.089). The result of the overall test after multiple imputation (n=289) remained insignificant (on average $x^2 = 4.031$, df = 2, *p*-value=0.133). The observed vs. predicted frequencies of Feeding Habit (Breast milk vs. Formula milk) indicates that with or without the explanatory variables (PPD and Race), the interpretative effect of the model remained more or less the same (at 75%) and only increasing very slightly after multiple imputation (75.1%)

The findings from this research question add to our understanding of the relationship between postpartum depression and infant feeding practices. In contrast to

the previous studies (Fein et al., 2008; Sacco et al., 2007), our sample included a homogeneous group of mothers predominantly African American and Hispanics whose infants were full term and in good health. Our study indicated no relationship between depression, race, and feeding practices. Gaffney et al., 2014, in their logistic model adjusted for socio-demographic factors revealed that mothers with postpartum depression were 1.57 times (95% confidence interval (CI): 1.16, 2.13) more likely to breastfeed at low intensity and 1.77 times (95% CI: 1.16, 2.68) more likely to add cereal to infant formula. Although PPD was associated with the early introduction to solid foods (odds ratio: 1.42; 95% CI: 1.07, 1.89), this relationship was not significant after adjusting for potential confounders. However, a small but significant average weight gain at 6 months was observed among infants of mothers with PPD (10.15 lb, SD=2.32 vs 9.85, SD =2.32). The differences in their result from our result may be due to the percentages of missing data experienced in our data.

Also after using multiple imputation to increase the size of data (from 192 to 289) this result became statistically insignificant even though the odds ratio remained unchanged. However, Gaffney et al (2014) revealed in their study that mothers with PPD were 1.57 times (95% confidence interval (CI): 1.16, 2.68) more likely to breastfeed at low intensity compared to those without PPD. Gaffney et al. (2014), in their study used older white women who were moderately employed, with higher education and higher income. Some maternal characteristics like as pre-pregnancy BMI, postpartum smoking, perception of fussiness as a problem. Our findings are consistent with the Life Course Health Development model suggesting that many risk factors arising during the critical

moments of early life has the potential to interact over time causing a range of long-term health problems (Gaffney et al., 2014; Halfon et al., 2005). There remains a gap in the literature regarding PPD and race on infant feeding practices. Therefore, there are needs for further investigation on the possible association of these variables.

Research Question 3

Is there a difference in infant weight gain at the 7th month following birth between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed?

A multiple ANOVA was used to evaluate differences in mean infant weight gain based on the effect of three factors each at two levels: Race (African American, Hispanic), Infant feeding practice (breast milk, formula milk), and Mothers psychological state (mothers with PPD vs. mothers without PPD). Only the main effect of Infant feeding practice (breast milk, formula milk) was found to be significant at alpha level 0.05. It yielded an F-ratio of F (1,134) = 4.036, p = 0.047. The result indicated that regardless of being Hispanic or African American, infants who were formula fed tend to have higher weight (17.7± 2.9 lbs and 16.8 ± 2.6lbs, for Hispanics and African Americans respectively) compared to infants who were breast fed (16.5 ± 3.0 lbs and 16.3 ± 3.1 lbs for Hispanics and African Americans) respectively. The main effect of Race was not significant F (1,134) = 1.259, p = 0.264, nor the main effect of PPD F (1,134) = 0.976, p = 0.325. Full factorial interactions of Infant feeding practice, Race and PPD were not significant at alpha level 0.05.The analysis conducted in this section was repeated after multiple imputations and results were not significantly different.

Consistent with other studies (Stettler et al., 2004; Gibbs and Forste, 2013; Mihrshahi, Battistutta, Magarey, and Daniels, 2011; Hawley, Johnson, Nu'usolia, and McGarvey, 2012), infants that were fed formula for the first six months were about 2.5 times more likely to be obese at 24 months of age compared to infants who were breast fed. Therefore, in formula fed infants weight gain during infancy may be the precursor for the development of obesity years later.

Research Question 4

Is there a difference in weight gain at 7th month after birth between infants of African American and Hispanic mothers with or without PPD who formula feed and those who breastfeed, after adjusting for mother's BMI, mother's level of education, mother's age, family Socio-economic status, mother's employment status, infant fussiness, whether feeding was used to put the baby to sleep, and infant age before solid food was introduced?

In order to assess the effect of Race, Post-Partum Depression (PPD) and Infant feeding practice (breast feeding vs. formula feeding) on infant weight gain, controlling for the listed covariates, a full factorial Analysis of Covariance (ANCOVA) was conducted. The complete case analysis result indicated a significant effect of maternal BMI [F (1,107) =8.982, p=0.003], Mothers Level of Education [F (1,107) =4.029, p=0.047], and Bottle-to-Bed [F (1,107) =4.188, p=0.043], on Infant Weight gain after controlling for Race, PPD, Infant feeding practice (breast feeding vs. formula feeding), mothers age, family Socio-economic status, mother's employment status, and infant

fussiness. The result also indicated that the main effect and interactions of the main predictor variables were not significant at alpha level 0.05.

However, after multiple imputations, the result changed quite reasonably. The following were now found to have significant effect on infant weight gain: Infant feeding practice (Breast milk vs. Formula milk) [F (1,620) =4.042, p=0.045], Post-partum depression (Depressed vs. Not depressed) [F (1,620) =2.731, p=0.099], maternal BMI [F (1,620) =16.423, p=0.000], Mothers Level of Education [F (1,620) =7.760, p=0.006], Bottle-to-Bed [F (1,620) =17.612, p=0.000], Maternal employment [F (1,620) =4.701, p=0.0.031], Infant fussiness [F (1,620) =11.415, p=0.001], and the interaction between Race, Post-partum depression and Infant feeding practice (Breast milk vs. Formula milk) [F (1,620) =3.675, p=0.056],

Further analysis showed that, infants of mothers' with college education were found to weigh less on average than infants of mothers without any college education. Infants of mothers with bachelor's degree or more on average weigh about 1.69 pounds less than infants of mothers without any college education (β=-1.69081, SD=0.71812, p = 0.0203).

Though the result could not be concretely proven not to have occurred by chance, it was also found that increased infant weight gain is associated with increased maternal BMI. Infants of overweight and obese mothers', on average, weight 0.17 and 0.82 pounds more than infants of mothers with healthy weight (β=0.16826, SD=0.83682, p=0.8410, CI= -1.48997 – 1.82648) for overweight mothers and (β=0.82034, SD=0.60224, p=0.1759, CI= -0.37304 – 2.01373) for obese mothers. Consistent with previous study

(Gibbs and Forste, 2013) infants fed formula for the first 6 weeks were about 2.5 times more likely to be obese at 24 months of age relative to infants predominantly fed breast milk. The early introduction of solid foods (< 4 months) and putting the child to bed with a bottle and maternal BMI also increased the likelihood of obesity or weight gain. Our study showed that maternal BMI, level of education and bottle-to-bed had statistical significant effect on weight gain. Consistent with other study (Frederick, Williams, Sales, Martin, & Killien, 2008), maternal BMI was independently and positively associated with infant weight (β =44.7, p = 0.001) after adjusting for confounders, in a quadratic model.

Two things should however be noted here: (a) the analysis was underpowered due to low sample size (n=122). Power analysis indicated that a sample size of 289 observations would have been required to achieve 85% power for moderate effect size of 0.25. Multiple-imputation could not be implemented here due to very large percentage of missing data (81%). (b) There is expected effect of omitted variable bias due to exclusion of one of the covariates- Infant age before solid food was introduced. Previous research indicated that this variable has a significant effect in determining infant weight gain (Gaffney et al., 2014). Infant age before solid food was introduced but was not included in this study due to very poor response from the study population (The response rate was 7.27% for African American and 12.60% for Hispanics.)

Strengths and Limitations of the Project

This study has many strengths and to the researcher's knowledge, the main strength is that this is the first study to asses possible early predictors of childhood obesity by evaluating the relationship between maternal postpartum depressions, infants

feeding practices and infant weight gain over 7 months of age among African America and Hispanic populations, Other strengths include the quality of data set used, the frequent testing of survey questions, the detail of the data about infants' feeding patterns, the inclusion of questions that address most topic areas likely to affect feeding and the large sample size. The IFPS II, collected detail information on breastfeeding from birth to 12 months of life. In the analysis, we were able to use multiple covariates that may confound the association between infant feeding practices, postpartum depression and infant weight gain.

However, this study has many limitations. Although the data was from a longitudinal study with a well distributed sample throughout the United States, the sample was not representative of the US population. A random sample of pregnant women from all race and ethnicity would have been more representative than a sample drawn from a self-selected consumer panel, choosing women at their third trimester of pregnancy. Third, African American and Hispanic mothers were underrepresented in the study population, and our results may not be representative of the entire population. Finally, there was a very high incidence of missing data mostly among the study populations relative to the relevant variables of interest. Therefore, results of these analyses were sometimes unstable and could be viewed as biased due to the high rate of missing data. However, there is a need of further investigations of these variables utilizing a different data set with less missing data.

Another limitation is that infants' weight measurement and infant feeding practices were self-reported, reporting errors may occur mostly if the mother were absent

when the weight was measured. The reporting error may bias the result towards the null value. Furthermore, since the primary researcher failed to obtain the mother's base-line depression status, this study was unable to assess comparatively the effect of depression as a result of pregnancy vs. chronic case of depressed mother. For example, the IFPS II data collection failed to capture the prevalence rates of less serious but more common disorders like infant gastroesophageal reflux that may influence on finding as it pertains to solid food initiation (Moorcroft, Marshall, & McCormick, 2011).

Implications for Research

This study utilizing the IFPS II data set gave information regarding infant feeding practices and led to the following recommendations for future research. First, future assessment of race and infant feeding practices is needed since such result if substantiated may have significance in designing pre- and post-natal educational programs. However, the results from this study cannot substantiate this significance due to high incidence of missing data (69.8%). Future research is warranted to expand on this study by conducting a prospective study of African American and Hispanic women and their feeding practices over-time is likely to answer these questions. In addition, future studies is warranted with population-based representation of African American and Hispanic infants (Ogden et al., 2010) with greater generalizability to the full spectrum of maternal-infant dyads in the United States.

Conclusions

This study evaluated maternal postpartum depression and infant feeding practices with infant weight at 7 months. In the sample with African American and Hispanic

women, it found that, regardless of race, infants who were breastfed were more likely to have normal healthy weight (89.1%) than infants who were formula fed (10.9%). In addition, race or psychological state (depressed or non-depressed) does not determine the particular feeding practices a mother uses. These findings add to our understanding of the relationship between postpartum depression, race, and infant feeding practices. Finally, our study showed only partial significance with maternal BMI and insignificance with other socio-demographic factors, Maternal BMI level in our study may provide predictive of weight-for –age at 7 months.

Other maternal factors such as pre-pregnancy BMI, level of education, employment status, Bottle-to-bed presented a significant association with infant weight gain. These findings were consistent with previous research that found these maternal characteristics to be associated with infant weight gain (Baker, Michaelsen, Rasmussen and Sorensen, 2004; Baughcum et al., 2000; Melar-Quinoez, Lucia & Kaiser, 2004). With respect to the relationships among the variables of interest, our study found that race and PPD had no relationship with infant weight gain. This finding provides support for a trajectory of events occurring when there are mothers with PPD raising infants. First, both research and clinical practice agree with the findings showing that depressed mother are more likely to formula feed their infants early in life (Dennis and McQueen, 2009). Transitioning to bottle feeding may result to changing dynamics on the number of stressors associated to breast feeding. Although research about the effects of PPD on weight gain is not available, clinical experience and common sense would tell us that to

adopt any particular feeding method believing that it helps infants sleep longer at night is a matter of individual choice.

My study findings was aligned with the life course health development model, which suggests that the potential risk factors occurring during critical time of early infancy may interact with each other and accumulating over a time period may result to long-term health consequences (Halfon and Hochstein, 2002; Halfon et al., 2005). Any attempts to interrupt this trajectory that began with the maternal depressive symptoms and maternal-child dyad may be essential, not only for maternal-child health but may help modify early life risk factors for childhood obesity. The infant weight gain found in this study, although small, was statistically significant. Taveras et al. (2009), found that the potential importance of incremental changes at early time in the life cycle to be underscored by the findings of the Project Viva study (n=559) in which similarly small increments predicted increased risk of obesity at 3 years of age.

In consideration to my findings, some important limitations need to be taken into account. Although IFPS II was a national study providing large data set and resources about infant feeding practices, minority representation in the sample was low (635). This consideration is very important mostly when studying early life predictors of childhood obesity simply due to the fact that the highest rates are found among African Americans and Hispanics (Ogden et al., 2012). Secondly, the survey approach used in the study resulted to self-reported data, which may lead to some inaccuracies as a result of higher rates of missing data.

Despite the limitations, our study has some strength's. To my knowledge this is the first study of early childhood predictors of childhood obesity that used a large national data set to investigate the relationships between PPD, infant feeding practices, and infant weight gain among minorities, African Americans and Hispanic population. Further research is needed to replicate and extend these findings using population-based samples that could be generalized to the full spectrum of maternal-infant dyads in the United States. Findings from this study add to the body of evidence available to inform practice mostly when caring for mothers and infant just few months after delivery. The rate of depressive symptoms found in my study at 2 months and other current studies supports practice guidelines that calls for early PPD assessment during well-baby visits.

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Appendix A: Variable Description

Dependent variable:

Infant weight gain: Literature indicates that healthy full-term babies weigh an average of between 5 pound 8 ounces and 8 pounds 13 ounces. Kids weighing slightly less or more are healthy. At 4 to 7 months, infants double their birth weight according to Kids Health. Normal range at this point is 10 and 18 pounds with a monthly increment of about 1.25 pounds monthly for the next 3 to 4 months. Based on this trend one can assess whether the infant is gaining weight as required or more than required based on age.

In this study, data was available for birth weight and infant weights in 3,5,7,9 and 12 months. The average of reported infant weight in month 5 and 7 was used to determine infant weight classification. If the computed average weight + margin of 1.25lb is greater than twice the infant birth weight, the infant was classified as overweight. Otherwise, the infant was classified as having normal weight. For infants who have no data in either month 5 or month 7 was included as missing data. When data was reported for only one of the two months, it was used directly as the average weight for the infant. The added margin of 1.25lb help to avoid underestimating in instances when the only reported data came from the 5^{th} month. Survey usually report previous month data so the data for the 5th and 7^{th} month reported the weight of the infant measured at 4^{th} and 6^{th} month respectively. Given that infants are expected to double their weight within the range of 4 to 7 months, the 1.25lb margin will also help to avoid under estimation since its addition ensures that every observation with reported 6^{th} month weight get to be

computed as 7th month and those with only 5th month weight get computed as 6th month weight. This overall brings a balance thus avoiding under or overestimation. At month 5 and 7, infants who's computed average weight plus margin of 1.25lb were more than twice their birth weight, were considered overweight. An infant who's computed average weight less margin of 1.25lb were more than twice their birth weight, were considered underweight. However this study included such infants to the category classified as having normal weight for the following reasons. All preterm babies and babies born with complications were excluded from the study. All infants in the study were therefore considered healthy. This supported by literature as stated in the first paragraph of this item description.

Independent variable:

Infant Feeding Practices (breast feeding vs formula feeding): Average of reported percentage breast milk baby was feed over survey period (12months). 50% was chosen as cutoff. Babies who were fed 50% or more breast milk were classified as breastfed. Those who had less than 50% breast milk were classified as formula fed.

Postpartum depression: a10-item Edinburgh Postpartum Depression Scale (EDPS) was incorporated in the IFPS II data study at 2-months postpartum survey. In this study, mothers with EDPS reading of greater than 10 will be considered depressed and those with EDPS reading equal to or less than 10 will be considered not depressed.

Covariates:

1. Mother's BMI: Mother's body mass index (BMI) is known to be a strong predictor of child BMI (Z Pei et al). Generally BMI is calculated by dividing

weight by the square of height (in inches) and multiplying the result by 703. Mother's Pregnancy body mass index was used. It is categorized as follows < 19.8-

a. underweight; 19.8 to 26-normal; > 26 to 29-overweight; and > 29-obese.This covariate was included in the analysis as a categorical dichotomous variable. In this instance, mothers classified as underweight and those classified as having normal weight were both categorized as having normal weight. This is justifiable since the inclusion criteria for the data collection ensured that only healthy mothers were included in the survey. Those classified as overweight and those classified as Obese were both categorized as overweight. This could be justified on the grounds that the interest of this study considers overweight and obesity as being on the same side of effect analysis.

2. Mother's level of education: Mother's level of education has been found to influence parenting food practices (Carine A. Vereecken et al). Mother's level of education is also considered to be associated with mother's understanding of best infant feeding practices and its implementation. Here this variable was classified into three categories as follows: (1) No College-those who had some years of grade school and those who graduated from high school but has no years of undergraduate studies, (2) 1-3 years in college – those with 1-3years of college

and did not earn a bachelor's degree. (3) Bachelors or more – for college graduates and those with post graduate degrees.

3. Mother's age: Older mothers who may have had a child before this study is considered to have better infant nurturing experience and may differ in their feeding practices when compared with young mothers who may be having their first baby at
    a. The time of this study. This covariate was classified into three: (1) Young mothers –
4. to 24yrs, (2) Mothers aged 25 to 34, and (3) Mothers aged 35yrs or more.
5. Socio-economic status: Household poverty level play a role in feeding practices adopted by mothers as a malnourished mother may not be able to breast feed infants often or afford richer formula milk as mothers with better socio-economic background. This variable was included as percentage of poverty level using 2006 federal poverty guideline. Less than 185% was classified as poor, 185 to 349% as median income and more than 349% was classified as high income.
6. Infant age before solid food was introduced: One of the four clinical practice guidelines concerning infant feeding behavior is that solid food should not be introduced earlier than age 4–6 months. Infant age at solid food introduction was included as a dichotomous variable-solid food was introduced before 4^{th} month postpartum or otherwise.
7. Bottle to bed: using feeding to put baby to sleep is a known child care practice among mothers. This practice is a violation of one of the clinical practice

guideline for infant feeding behavior and could contribute to excessive weight gain in infant. Response here was coded as follows: 1-At most bedtimes, including naps, 2-At most night bedtimes, but not naps, 3- At most naps, but not night, 4 - Only occasionally at bedtimes, including naps, 5: Never. For the purposes of analysis, this variable was reclassified as follows using average of responses from birth to the 7th month. The classification is as follows: (1) average response greater than or equal to "1" but less than or equal to "3" was classified as "often", (2) average response greater than "3"

a. but less than or equal to "4" was classified as "often", (3) average response greater than "4" but less than or equal to "5" was classified as "Never"

8. Mother's report of whether she perceived infant fussiness to be a problem at 2 months of age (yes/no – 0 for no and 1 for yes). Some mothers react to infant fussiness by feeding baby. Excessive feeding could lead to infant gaining excess weight. While not welcomed, fussiness in a positive way, could also mean physical activity for the baby and could lead to extirpation of calories. There is therefore need to control for this variable. For the purpose of analysis and given that we are looking at weight gain by the 7th month, this variable was classified into two as follows: (1) Infant is fuzzy (if the mother responded yes up to 3 or more times in the first 7 month postpartum- that is 50% or more of the time since the 7th month survey collected 6th month data), and (2) Infant is not fuzzy (if the

mother responded yes less than 4 times in the first 7 month postpartum. Note that data was not collected for the 7th month. There is there was no survey data returned in the 8th month for all variables in the original data set.

9. Mother's employment status: full-time employment status has been found to be negatively correlated with breastfeeding initiation and duration. This variable was classified as follows: 1- Works for someone else full time, 2- Temporarily unemployed, 3- Self-employed, 4 - Works for someone else part time only, 5- Retired and not employed, 6- Disabled, student, and not employed, 7- Full time homemaker. This variable was reclassified as follows: Unemployed (2,5 and 6), Employed full time (1), self-employed (3), employed part-time (4) and fulltime homemaker (7)

Missing data: In the source data, missing data was coded in eight ways:

Q = respondent did not return questionnaire

N= respondent was supposed to answer question but did not

S=respondent gave a conflicting response

F= fathers demographic information not available

"." = Missing without any designated reason.

99 = respondent do not know (eg. Age of other household members)

88 = not specified for verbatim data (eg main question answered but follow up specific was not)

999= used for in consistent coding (eg. "0" servings for babies feeding).

Note: In conducting the analysis for this study, all cases of missing data were set as missing.

Appendix B: List of Tables

1. Number and percentages of survey participants by race.
2. Number and percentage of mothers who use feeding to put baby to sleep (Bottle to bed) by race.
3. Mother's level of education by race
4. Mother's employment status by race
5. Mother's depression status by race based on Edinburgh Post-Partum Depression Scale.
6. Number and percentage of infants classified as fussy or not fussy by race.
7. Infants' weight status by race classified as having normal weight or overweight by 7th month after birth.
8. Mother's age group by race classified into three categories.
9. Mother's BMI by race
10. Number and percentage of infants by race classified as having been breastfed or formula fed by 7th month after birth.
11. Household income as a percentage of federal poverty level by race.

Number and percentages of survey participants by race.

Race	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1: White	3863	78.80	3863	78.80
2: Black	300	6.12	4163	84.92
3: Hispanic	335	6.83	4498	91.76
4: Asian/Pacific Islander	136	2.77	4634	94.53
5: Other	120	2.45	4754	96.98
N: No specific Answer or missing	148	3.02	4902	100.00

Number and percentage of mothers by race (including missing data) who use feeding to put baby to sleep (Bottle to bed) classification as follows: (1) average response greater than or equal to "1" but less than or equal to "3" was classified as "often", (2) average response greater than "3" but less than or equal to "4" was classified as "often", (3) average response greater than "4" but less than or equal to "5" was classified as "Never

Bottle to bed as feeding practice			
Bottle_to_bed	**Race**		
Frequency Percent	**African American**	**Hispanic**	**Total**
Missing data	178 28.03	168 26.46	346 54.49
Never	50 7.87	88 13.86	138 21.73
Occasionally	19 2.99	25 3.94	44 6.93
Often	53 8.35	54 8.50	107 16.85
Total	300 47.24	335 52.76	635 100.00

Mother's level of education by race (including missing data) classified into three categories as follows: (1) No College-those who had some years of grade school and those who graduated from high school but has no years of undergraduate studies. (2) 1-3 years in college – those with 1-3years of college and did not earn a bachelor's degree. (3) Bachelors or more – for college graduates and those with post graduate degrees.

Mother's Level of Education			
Level_of_Educ	**Race**		
Frequency **Percent**	**African American**	**Hispanic**	**Total**
Missing Data	58 9.13	42 6.61	100 15.75
1-3 years in college	118 18.58	144 22.68	262 41.26
Bachelor's degree or more	52 8.19	61 9.61	113 17.80
No college education	72 11.34	88 13.86	160 25.20
Total	300 47.24	335 52.76	635 100.00

Mother's employment status by race classified as follows: 1- Works for someone else full time, 2- Temporarily unemployed, 3- Self-employed, 4 - Works for someone else part time only, 5- Retired and not employed, 6- Disabled, student, and not employed, 7- Full time homemaker.

Mother's employment status			
Employment Status	**Race**		
Frequency **Percent**	**African American**	**Hispanic**	**Total**
Disabled, student etc and not employed	33 5.20	19 2.99	52 8.19
Missing Data	80 12.60	63 9.92	143 22.52
Retired and not employed	0 0.00	2 0.31	2 0.31
Self-employed	10 1.57	14 2.20	24 3.78
Temporarily unemployed	37 5.83	34 5.35	71 11.18
employed full time	80 12.60	93 14.65	173 27.24
employed part-time	22 3.46	26 4.09	48 7.56
full time homemaker	38 5.98	84 13.23	122 19.21
Total	300 47.24	335 52.76	635 100.00

Mother's depression status by race (including missing data) classified as being depressed or not depressed post-partum, based on Edinburgh Post-Partum Depression Scale.

Mother's depression status post-partum			
EDPS class	**Race**		
Frequency **Percent**	**African American**	**Hispanic**	**Total**
Missing Data	198 31.18	186 29.29	384 60.47
Depressed	22 3.46	45 7.09	67 10.55
Not depressed	80 12.60	104 16.38	184 28.98
Total	300 47.24	335 52.76	635 100.00

Number and percentage of infants classified as fussy or not fussy by race (including missing data). The classification was as follows: (1) Infant is fuzzy (if the mother responded yes up to 3 or more times in the first 7 month postpartum- that is 50% or more of the time since the 7th month survey collected 6th month data), and (2) Infant is not fuzzy (if the mother responded yes less than 4 times in the first 7 month postpartum.

Table of fussiness by Race			
Fussiness	**Race**		
Frequency **Percent**	**African American**	**Hispanic**	**Total**
Missing Data	179 28.19	168 26.46	347 54.65
Infant is fussy	23 3.62	32 5.04	55 8.66
Infant is not fussy	98 15.43	135 21.26	233 36.69
Total	300 47.24	335 52.76	635 100.00

Infants' weight status by race classified as having normal weight or overweight by 7th month after birth.

Infant weight status			
Weight Status	**Race**		
Frequency **Percent**	**African American**	**Hispanic**	**Total**
Missing Data	210 33.07	214 33.70	424 66.77
Normal Weight	29 4.57	56 8.82	85 13.39
Overweight	61 9.61	65 10.24	126 19.84
Total	300 47.24	335 52.76	635 100.00

Mother's age group by race classified into three categories as follows: (1) mothers aged 18-25, (2) mothers aged 25-34 and (3) mothers aged 35 and above.

Mother's Age			
Age_group	**Race**		
Frequency **Percent**	**African American**	**Hispanic**	**Total**
Missing data	1 0.16	1 0.16	2 0.31
mothers >34 yrs	29 4.57	37 5.83	66 10.39
mothers aged 18-24	150 23.62	129 20.31	279 43.94
mothers aged 25-34	120 18.90	168 26.46	288 45.35
Total	300 47.24	335 52.76	635 100.00

Appendix C: List of Figures

1. Interaction plot of effect of feeding practice (1=Breast fed, 2=Formula fed) and Race (2=African American, 3= Hispanic) on infant weight gain.

2. Normal probability plot of residuals of the Analysis of Variance comparing mean differences in infant weight gain based on the effect of three factors each at two levels: Race (African American, Hispanic), Infant feeding practice (breast milk, formula milk), and Mothers psychological state (mothers with PPD vs. mothers without PPD).

3. Histogram of residuals of the Analysis of Variance comparing mean differences in infant weight gain based on the effect of three factors each at two levels: Race (African American, Hispanic), Infant feeding practice (breast milk, formula milk), and Mothers psychological state (mothers with PPD vs. mothers without PPD).

4. Boxplot of residuals of the Analysis of Variance comparing mean differences in infant weight gain based on the effect of three factors each at two levels: Race (African American, Hispanic), Infant feeding practice (breast milk, formula milk), and Mothers psychological state (mothers with PPD vs. mothers without PPD).

5. Scatter plot of residuals against fitted values from the Analysis of Variance comparing mean differences in infant weight gain based on the effect of three factors each at two levels: Race (African American, Hispanic), Infant feeding practice (breast milk, formula milk), and Mothers psychological state (mothers with PPD vs. mothers without PPD).

6. Power Analysis – ANOVA

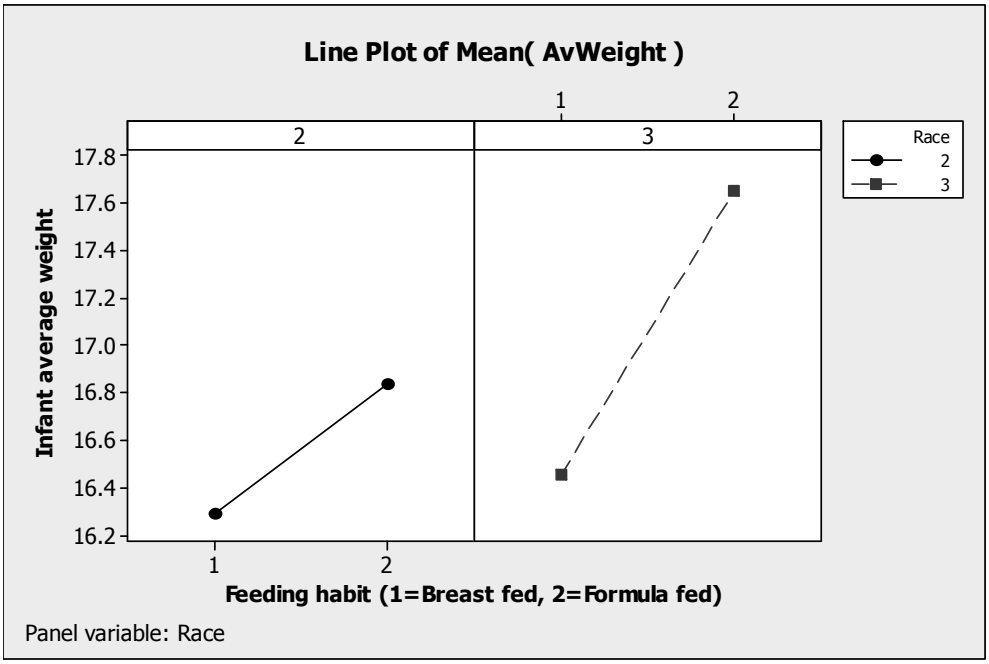
7. Power Analysis – ANCOVA

8. Probability plot of residuals for multiple regression of Infant Average Weight against Mothers BMI, Level of Education and Bottle-to-Bed

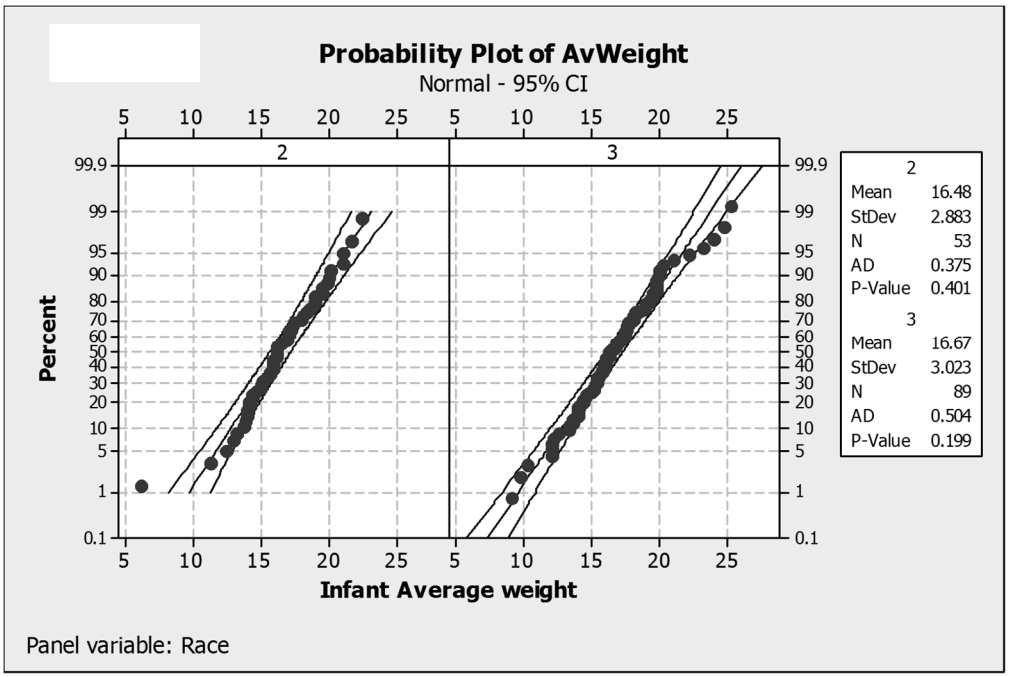
9. Box plot of residuals by race for multiple regression of Infant Average Weight against Race, feeding practice (breast milk vs. formula milk), PPD, Mothers BMI, Level of Education and Bottle-to-Bed

10. Scatter matrix of main variables of interest-Average infant weight gain (AvWeight), Race (African American/Hispanic), feeding practice (percentage breast milk –avpctbm) and PPD Score (epdsScore).

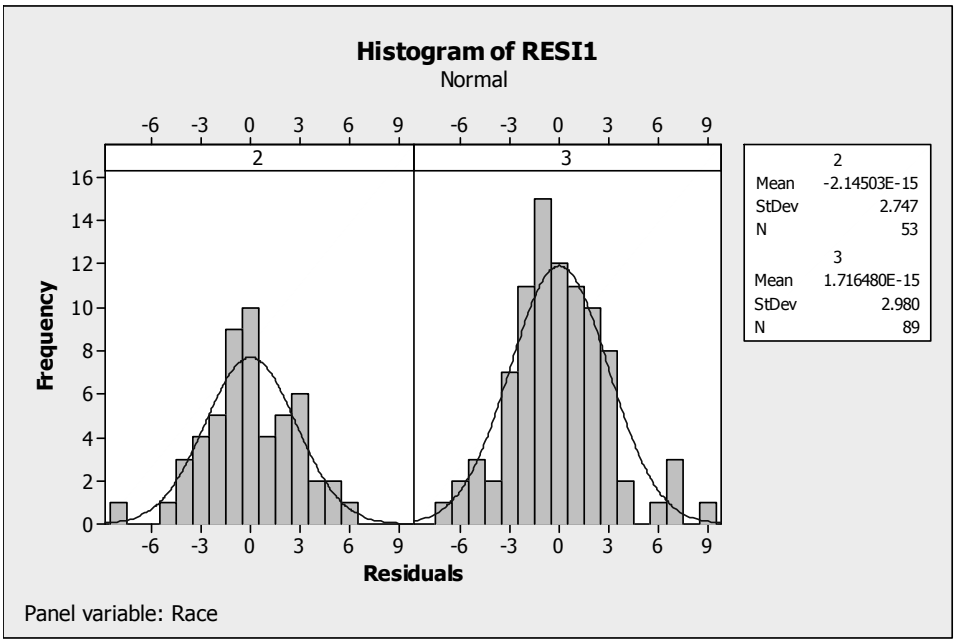
Interaction plot of effect of feeding practice (1=Breast fed, 2=Formula fed) and Race (2=African American, 3= Hispanic) on infant weight gain.



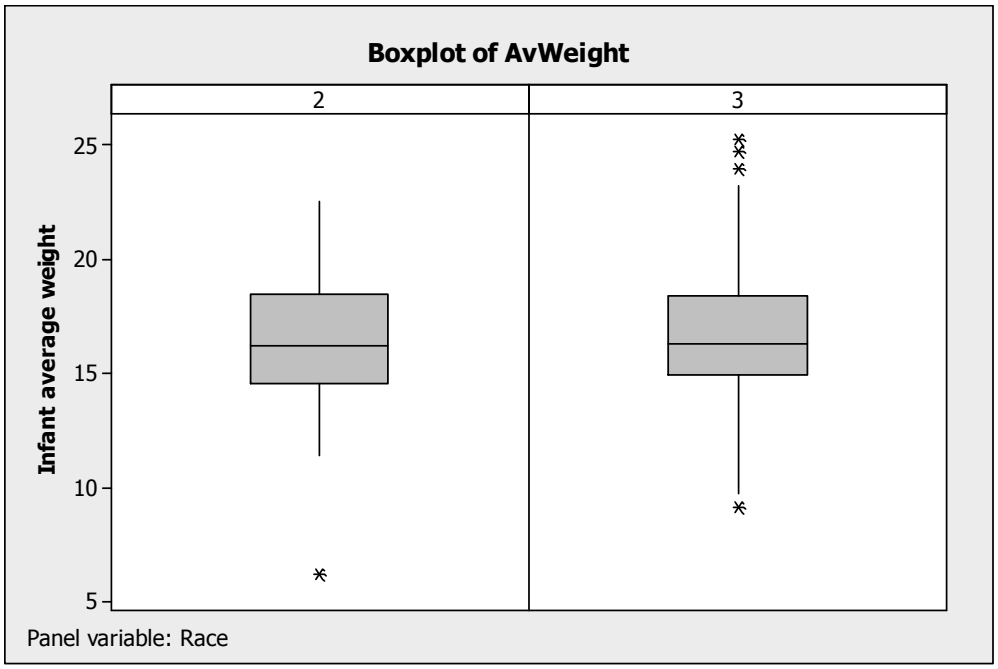
Normal probability plot of residuals of the Analysis of Variance comparing mean differences in infant weight gain based on the effect of three factors each at two levels: Race (African American, Hispanic), Infant feeding practice (breast milk, formula milk), and Mothers psychological state (mothers with PPD vs. mothers without PPD).



Histogram of residuals of the Analysis of Variance comparing mean differences in infant weight gain based on the effect of three factors each at two levels: Race (African American, Hispanic), Infant feeding practice (breast milk, formula milk), and Mothers psychological state (mothers with PPD vs. mothers without PPD

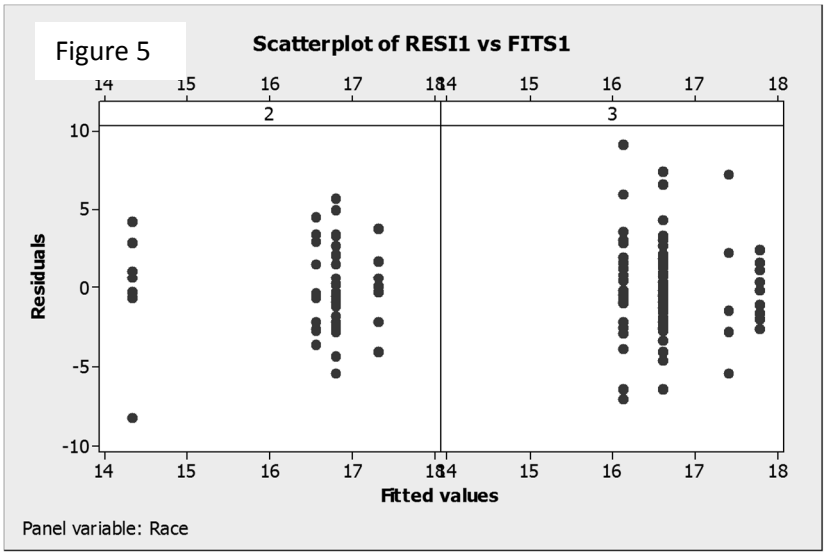


Boxplot of residuals of the Analysis of Variance comparing mean differences in infant weight gain based on the effect of three factors each at two levels: Race (African American, Hispanic), Infant feeding practice (breast milk, formula milk), and Mothers psychological state (mothers with PPD vs. mothers without PPD).

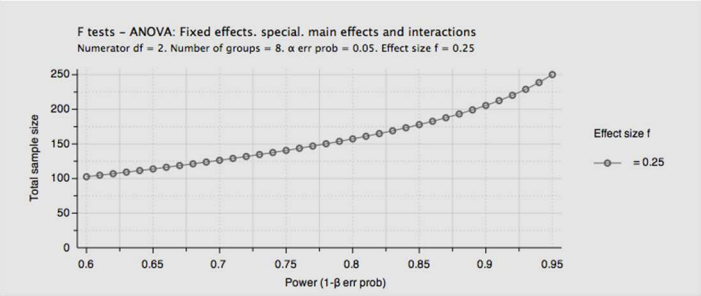


Scatter plot of residuals against fitted values from the Analysis of Variance comparing mean differences in infant weight gain based on the effect of three factors each at two levels: Race (African American, Hispanic), Infant feeding practice (breast milk, formula milk), and Mothers psychological state (mothers with PPD vs. mothers without PPD).

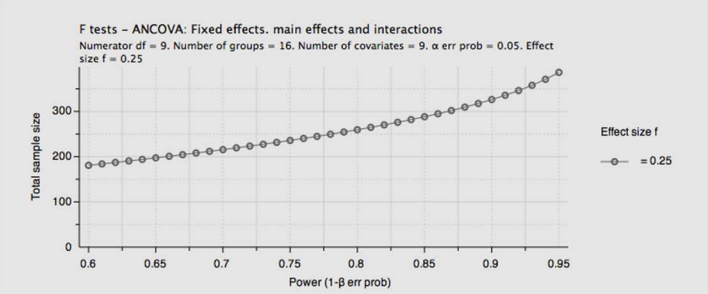
Figure 5



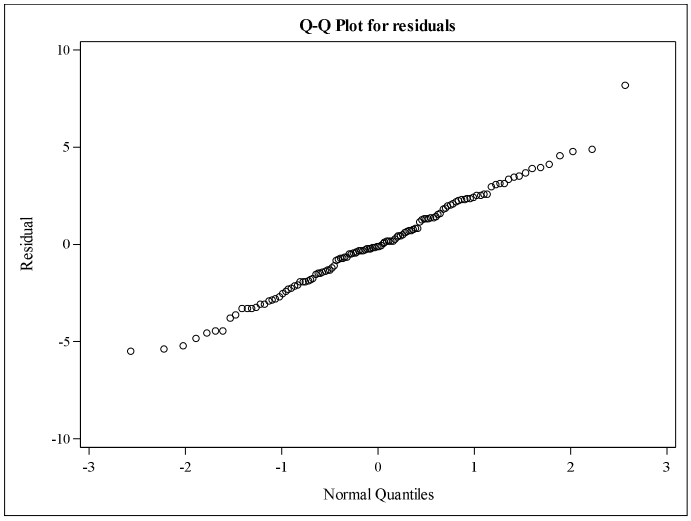
Power Analysis - ANOVA



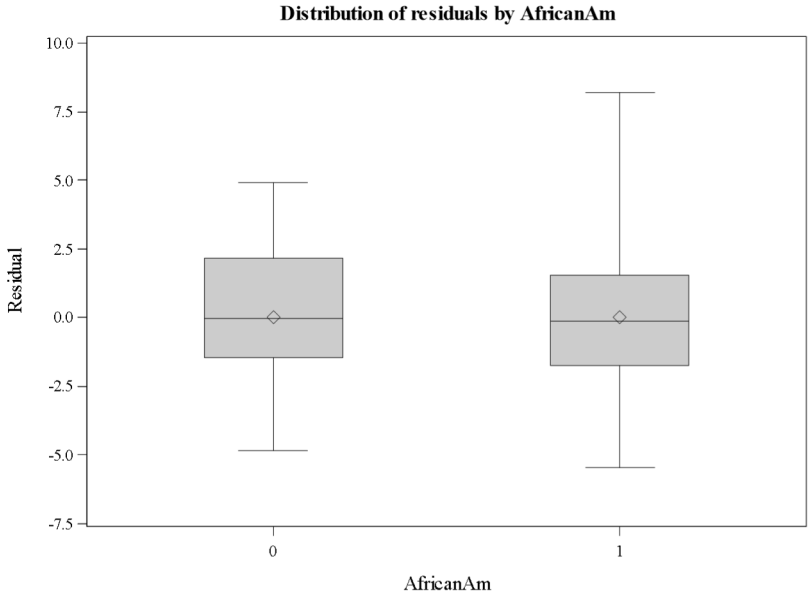
Power Analysis - ANCOVA



8. Probability plot of residuals for multiple regression of Infant Average Weight against Race, feeding practice (breast milk vs. formula milk), PPD, Mothers BMI, Level of Education and Bottle-to-Bed



9. Box plot of residuals by race for multiple regression of Infant Average Weight against Race, feeding practice (breast milk vs. formula milk), PPD, Mothers BMI, Level of Education and Bottle-to-Bed



10. Scatter matrix of main variables of interest-Average infant weight gain (AvWeight), Race (African American/Hispanic), feeding practice (percentage breast milk –avpctbm) and PPD Score (epdsScore).