EXPLORING THE RELATIONSHIPS BETWEEN MOTHERS' USE OF FOOD TO SOOTHE, FEEDING TYPE AND MODE, MATERNAL FEEDING STYLE, INFANT BEHAVIOR, AND INFANT WEIGHT-RELATED OUTCOMES DURING EARLY INFANCY

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COMMITTEE MEMBERSHIP

TITLE: Exploring the Relationships Between Mothers' Use of Food to Soothe, Feeding Type and Mode, Maternal Feeding Style, Infant Behavior, and Infant Weight-Related Outcomes During Early Infancy

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ABSTRACT

Exploring the Relationships Between Mothers' Use of Food to Soothe, Feeding Type and Mode, Maternal Feeding Style, Infant Behavior, and Infant Weight-Related Outcomes During Early Infancy

Megan Kathleen Hupp

Rapid infant weight gain (RWG) in the first six months postpartum is a strong predictor for obesity during childhood and adolescence. Although biological factors can influence infant weight gain trajectories, the modifiable factor of parent feeding practices can also have an influence. The use of food to soothe (FTS), or the act of feeding a child when he/she is upset for reasons other than hunger, has been associated with unhealthy eating behaviors and less-favorable weight outcomes in children and older infants. However, limited studies have explored the use of FTS during early infancy before the introduction of solids foods. The present study was a secondary analysis of mothers who completed previous infant feeding studies ($n = 134$) and was aimed at exploring whether maternal-reported use of FTS was associated with greater infant weight gain during the first six months postpartum and whether feeding type (exclusive breastfeeding versus exclusive formula-feeding versus mixed feeding) or bottle-feeding intensity (percent of daily feedings from a bottle) moderated this association. Both maternal-reported and observational measures of maternal and infant characteristics and their associations with the use of FTS were also explored. Individual correlations as well as multiple and logistic regressions were used to assess whether FTS predicted change in weight-for-age, weight-for-length, and/or RWG from birth to study entry. One-way ANOVA tests were used to assess the differences in use of FTS by feeding type and/or bottle-feeding intensity. Individual correlations and multiple regressions were used to assess whether maternal feeding style and/or infant temperament, clarity of cues, and/or eating behavior predicted the use of FTS. The mean age for infants was 14.8 weeks ($SD = 7.1$, range = 1.7 - 31.0 weeks). The results showed that the use of FTS had a significant negative association with percent of daily feedings from a bottle ($r = -0.20$, $p = 0.021$), and a significantly higher association among mothers who reported mixed feeding ($M = 2.87$, $SD = 0.20$) versus exclusive formula feeding ($M = 2.20$, $SD = 0.20$). Greater pressuring feeding, greater infant negativity, and lower infant surgency were all significant predictors for the use of FTS ($p < 0.05$). FTS was not significantly associated with infant weight gain during the first 6 months postpartum. Neither feeding type or bottle-feeding intensity moderated the relationship between the use of FTS and infant weight gain. Future studies would benefit from recruiting a more diverse sample population, including measures of FTS that have been validated on infants younger than 3 months, and following the infants at more frequent time points from birth to 6 months postpartum.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter I

INTRODUCTION

1.1 Statement of the Problem

Rapid infant weight gain during the first year postpartum, particularly the first 6 months, is a strong predictor for obesity and related health morbidities during childhood and adolescence (Dennison et al, 2006; Ekelund et al, 2006 & 2007; Lanigan and Singhal, 2009; Taveras et al, 2011; Young et al, 2012; Zheng et al, 2018). Although the mechanisms for this relationship are not fully understood, rapid weight gain during early infancy as compared to later infancy or early childhood has demonstrated a stronger association with later obesity (Ekelund et al, 2007; Taveras et al, 2011; Zheng et al, 2018). Early infancy is a period of extensive development where the infant's physiology and metabolism are sensitive to external factors (Pray, 2015). Subsequently, obesity prevention efforts have started to focus on early infancy as an opportune window for intervention (Lanigan and Singhal, 2009; Paul et al, 2009; Paul et al, 2011; Savage et al, 2016; Young et al, 2012).

Although biological factors, such as low infant birth weight, are predictive of rapid weight gain (Ashworth et al, 1997; Eickman et al, 2006; Goncalves et al, 2014; Zheng et al, 2018), studies have also shown that infant weight trajectories are influenced by parental feeding practices (Appleton, et al 2018; Birch and Doub, 2014; Gillman, 2010; Karaolis-Danckert et al, 2007; Heinig et al, 1993; Li et al, 2012; Paul et al, 2009). An infant is reliant on his or her parents to decide the type of feeding (breast milk versus formula), the mode of feeding (directly from the breast versus from a bottle), and the style of feeding (e.g., responsive versus controlling). Infant feeding research has highlighted that healthy feeding practices are those that are contingent upon the infant's feeding cues and thus optimize the infant's ability to self-regulate intake (Disantis et al, 2011; Perez-Escamilla et al, 2017).

Randomized control trials have shown that responsive feeding is associated with lower risk for rapid weight gain during early infancy (Paul et al, 2011; Paul et al, 2014; Savage et al, 2016). Responsive feeding is the act of being in-tune with the infant's hunger and satiation cues and then responding to these cues in an appropriate manner that is contingent upon the infant's needs (Perez-Escamilla et al, 2017). A key component of responsive feeding is only feeding the infant when he or she expresses signs of hunger, and then stopping the feeding when the infant expresses signs of satiation.

The use of food to soothe (FTS) is a feeding practice that has recently gained attention in the literature and has been linked to unhealthy eating behaviors and weight outcomes (Blisset et al, 2010; Braden et al, 2014; Jansen et al, 2019; Sleddens et al, 2013; Stifter and Moding, 2015; Stifter et al, 2011). FTS is the act of feeding a child when he/she is upset for reasons other than hunger. Although studies suggest that humans have an innate response to be soothed by food (Gray et al, 2002; Macht and Simons, 2011; Smith et al, 1990), other studies have shown that this practice is associated with unfavorable outcomes, particularly during childhood. Among children, parents' use of FTS is associated with children's tendencies toward emotional eating (Braden et al, 2014), eating in the absence of hunger (Blisset et al, 2010), and increased overall consumption of unhealthy snacks (Sleddens et al, 2013), all of which are eating behaviors that are associated with obesity during childhood (Braet and Vanstrien, 1997).

Few studies have focused on the use of FTS during infancy, but these studies have shown that the use of FTS is a relatively common practice (Jansen et al, 2019) and is associated with less favorable weight outcomes. Two studies have shown that the use of FTS is associated with greater infant weight status (Stifter et al, 2011) and greater increase in infant weight-for-length z-score from 6- to 18-months (Stifter and Moding, 2015). Additionally, more frequent use of FTS at 6 months was associated with overweight status at 6 years of age (Jansen et al, 2019).

Due to the strong link between rapid infant weight gain during the first 6 months postpartum and later obesity, further research is needed to better understand the association between the use of FTS and infant weight gain during the first 6 months. One of the main limitations of previous FTS studies is that the sample populations combined younger infants (≤ 4 months) with older infants (5 -12 months). This combination complicated the findings and made it difficult to isolate the association of FTS and weight gain during early infancy. Additionally, within these previous samples, some infants were introduced to solid foods and some were not. Once solid foods have been introduced, the food composition plays an additional role in the relationship between FTS and weight gain because more palatable, high-energy foods are typically used to soothe (Sherry et al, 2004). Unfortunately, none of the previous FTS studies collected data on infant diet composition, and this could have been a confounding variable. Specifically isolating the sample population to younger infants that have not yet been introduced to solid foods would allow for a clearer understanding of the association between the use of FTS and infant weight outcomes during early infancy.

Previous studies have also not explored whether feeding type (breast milk versus formula) or feeding mode (breast- versus bottle-feeding) moderates the association of FTS and infant weight outcomes. Rametta et al (2015) and Stifter and Moding (2015) showed that the use of FTS is more common among breastfeeding mothers compared to formula-feeding mothers. However, neither study looked at the different infant weight outcomes among these two groups, nor did they further categorize the groups by level of bottle-feeding. In general, formula-fed and bottle-fed infants (regardless of whether the content in the bottle is formula or breast milk) have demonstrated faster weight gain trajectories than exclusively breastfed infants (Heinig et al, 1993; Li et al, 2012). The content of the formula (Appleton et al, 2018) and the caregiver-led nature of bottle-feeding (Ventura and Terndrup, 2016) can both affect the amount of energy that the infant consumes. Therefore, it seems plausible that, for infants who are predominantly bottle-fed, there might be a stronger association between frequent use of FTS and greater weight gain during early infancy. Exploration of this association would aid in the development and tailoring of obesity prevention efforts focused on infant feeding practices.

In order to tailor these infant feeding interventions, there still needs to be a better understanding of the maternal and infant characteristics that are more closely linked to the use of FTS. A mother's decision to use certain feeding practices, including FTS, is usually based on multiple factors. Previous studies have shown conflicting results predicting the use of FTS by maternal education (Rametta et al, 2015; Saxton et al, 2009), family income (Evans et al, 2011), and/or maternal BMI (Stifter and Moding, 2015). However, few studies have explored the association of FTS with maternal feeding style (e.g. responsive and pressuring). Additionally, fewer or no studies have explored the association of FTS with infant characteristics, such as infant temperament, clarity of feeding cues, and eating behavior.

Although the use of responsive feeding has frequently been associated with healthier infant outcomes, this practice has also been associated with the use of FTS (Stifter et al, 2011; Stifter and Moding, 2015). Therefore, a better understanding of the relationship between these two feeding practices is warranted. Previous FTS studies used self-reported measures of responsive feeding and these measures might have been biased and not shown the full picture of how the mother is responding to her infant's cues. These mothers might believe they are being sensitive and attuned to their baby's distress, but they might not have the right strategies to appropriately respond to their infant's needs. Therefore, more objective measures of responsive feeding are needed in order to better understand the relationship of this practice and the use of FTS.

Additionally, few studies have explored the infant characteristics that are more closely associated with the use of FTS. The associations of infant negative and surgent temperaments with the use of FTS have both been studied (Stifter et al, 2011; Stifter and Moding, 2018), however, little to no studies have examined the association between the use of FTS and infant clarity of cues or infant eating behavior. If the infant cannot clearly express their hunger needs, the infant's mother might not know if the infant is hungry or crying for other reasons. Therefore, it is plausible that the mother might be more likely to feed her infant at the first sign of distress. Additionally, an infant's enjoyment of food or their inability to recognize their own satiety levels might also influence the mother's choice to use FTS for infant distress.

With repeated evidence showing the importance of healthy growth trajectories during the first 6 months postpartum (Dennison et al, 2006; Ekelund et al, 2006 & 2007; Lanigan and Singhal, 2009; Taveras et al, 2011; Young et al, 2012; Zheng et al, 2018), and other studies suggesting that the use of FTS is associated with unhealthy outcomes (Blisset et al, 2010; Braden et al, 2014; Jansen et al, 2019; Sleddens et al, 2013; Stifter and Moding, 2015; Stifter et al, 2011), there needs to be a better understanding of the relationship between the use of FTS and infant weight gain during the first 6 months. Additionally, in order to tailor obesity prevention programs targeted at infants, there also needs to be a better understanding of the maternal and infant characteristics that are more closely associated with the use of FTS. To this end, the following secondary analysis aims to assess the association between the use of FTS and infant weight gain, maternal feeding style, and certain infant characteristics. This research is an initial step toward identifying targets for infant feeding interventions aimed at preventing unhealthy feeding practices for infants under 6 months. These interventions, in turn, will ideally help mothers better connect with their infants, ensure healthier infant weight gain trajectories, and ultimately help prevent obesity and other morbidities later in the infants' lives.

1.2 Statement of Purpose and Research Hypotheses

The purpose of this study was to explore the association of the use of FTS and infant weight outcomes in the first 6 months postpartum and whether feeding type (any breastfeeding, exclusive formula-feeding, or mixed feeding) and/or feeding mode (percentage of daily feedings from bottles) moderates this relationship. Additionally, maternal and infant characteristics associated with the use of FTS were explored (See

Figure 1.1 for a conceptual model and map of the hypotheses). We hypothesized the following:

1. With respect to infant weight gain from birth to study entry, greater use of FTS will be associated with higher conditional weight-for-length (WLZ) and weight-for-age (WAZ) z-scores, as well as rapid weight gain (RWG).
2. With respect to feeding type and mode, mothers that predominantly breastfeed will have a higher average score for the use of FTS compared to mothers that predominantly bottle-feed.
    a. The association of weight gain with the use of FTS will be moderated by the mode of feeding, with predominately bottle-fed babies seeing greater changes in WLZ and WAZ with increased use of FTS and predominantly breast-fed babies seeing little to no changes with increased use of FTS.
3. With respect to maternal correlates of use of FTS, greater use of FTS will be associated with greater maternal-reported responsive and pressuring feeding styles, and lower observed scores for maternal sensitivity to infant cues and maternal responsiveness to infant distress.
4. With respect to infant correlates of use of FTS, greater use of FTS will be associated with lower observed scores for clarity of cues and responsiveness to caregiver, greater maternal-reported negative temperament, enjoyment of food and food responsiveness, and lower maternal-reported surgent temperament and satiety responsiveness.

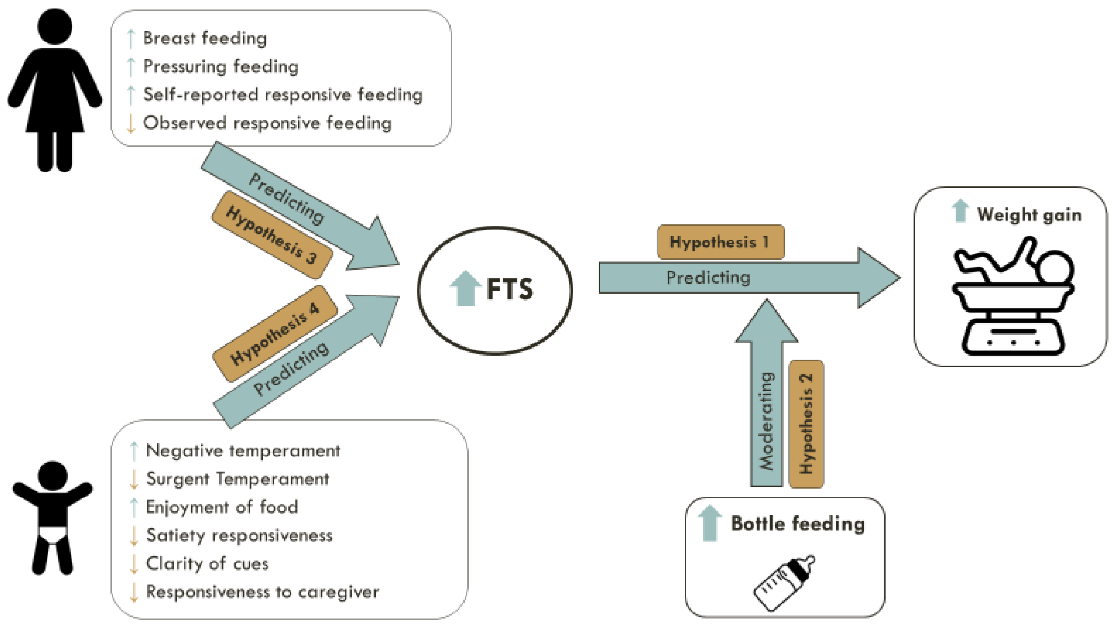

Figure 1.1

Conceptual Model and Map for Study Hypotheses

1.3 Delimitations

The study was delimited to the following parameters:

1. This is a secondary analysis and the data were originally collected for prior hypotheses and analyses. Therefore, the original study designs were not specifically intended for the outcomes of this study.
2. Only participants living within the area of Philadelphia, PA or San Luis Obispo, CA were recruited for this study.
3. Only English-speaking mothers between the ages of 18 and 40 were eligible for the study.

1.4 Assumptions

The study is based on the following assumptions:

1. It is assumed that the observed feeding interaction between mother and infant was representative of a typical interaction between mother and infant.
2. It is assumed that all participating mothers answered truthfully in their questionnaires.
3. It is assumed that the participating mothers interpreted the definition of FTS in a similar manner.

1.5 Limitations

The study is limited by the following factors:

1. Only one feeding interaction between the mother and infant was coded, and this interaction occurred in a lab setting which might not have been representative of a typical feeding.
2. The measurement for FTS was self-reported and some mothers might have had different interpretations for the definition of FTS.
3. The measurement for FTS had not been previously validated on infants younger than 3 months.
4. One of the four studies included in this secondary analysis had mothers who reported significantly different sociodemographics than the other three studies.
5. The measurements for infant temperament and eating behavior were self-reported by the mother and might have been subject to bias.

1.6 Definition of Terms

Analgesic: reliever of pain, typically referring to a pain-relieving drug

Body Mass Index (BMI): a weight-to-height ratio, calculated using a person's mass in kilograms and height in centimeters (BMI = weight [kg]/height [m]2) and is used to identify the status of a person's weight (e.g. underweight, normal weight, overweight, or obese)

Bottle Feeding Intensity: the percent of daily feedings given from a bottle

BMI Percentile: BMI as compared to others with the same age & sex and is typically used to standardize the BMI measurement for children and infants

BMI z-score: BMI expressed as certain standard deviations from the average BMI for a specific age & sex and is also used to standardize the BMI measurement for children and infants

Child Obesity: characterized as a BMI that is at or above the 95th percentile for age and sex

Child Overweight: characterized as a BMI that is at or above the 85th percentile for age and sex

Confounder: a variable that might be affecting both the exposure variable and the outcome variable, thus leading to a spurious association between the exposure and the outcome

Eating Behavior: the style in which the infant or child initiates or terminates eating

Emotional Eating: the act of eating to regulate emotions as opposed to alleviating hunger

Fat Mass: the portion of the body that is composed of adipose or fat tissue

Feeding Mode: feeding the infant from the breast or from the bottle

Feeding Practices: a broad term that encompasses different methods of feeding (e.g. feeding type, feeding mode, and/or feeding style)

Feeding Style: parenting style, or clustering of parenting strategies, that is specific to infant feeding

Feeding Type: the use of breast milk or formula to feed an infant

Food Responsiveness: the infant's desire to eat based on external cues (e.g. the presence of milk)

Food to Soothe (FTS): the act of feeding a child when he/she is upset for reasons other than hunger

Infant Cues: the motor movements and/or sounds that the infant uses to communicate his or her needs to their caregiver

Infant Feeding Cues: infant cues that demonstrate their hunger or satiety

Latch: the act of the infant's mouth clasping onto the nipple of the breast in order to initiate the breastfeeding

Less-hydrolyzed Protein: certain formulas contain hydrolyzed protein which is protein that has been broken down to its components (e.g. amino acids and peptides) and less-hydrolyzed protein typically has not been broken down

Maternal Responsiveness to Distress: the mother's ability to respond to her infant's distress (e.g. fussiness, whining, or crying) in a timely manner and to use different methods to soothe her infant's distress (e.g. shushing, re-positioning, etc.)

Maternal Sensitivity to Cues: the mother's ability to accurately interpret her infant's cues and appropriately respond to these cues in a timely manner

Milk Stimulation: the process of initiating milk flow

Milk Transfer: the exchange of milk from the nipple to the infant's mouth

NCAFS: Nursing Child Assessment Parent-Child Interaction Feeding Scale, developed in the 1970s by Dr. Barnard and colleagues, objectively assesses and measures the feeding interaction between parent and child

Negative Temperament: infant behavior characterized by infant demonstration of sadness, distress to limitations, fear, and poor soothability

Neurotransmitters: chemical messenger that sends signals to different organs in the body via nerve fibers

Non-Nutritive Sucking (NNS): occurs when the infant's mouth is using sucking motions, but there is no milk provided from the nipple

Nutritive Sucking (NS): occurs when the infant is using sucking motions and is actively receiving milk from the nipple

Oral Sucrose Solution: a sugary liquid of different concentrations which has been used in clinical settings as an analgesic for infant pain during minimally-painful procedures

Parenting Style: clustering of parenting strategies that are characterized by the dimensions of parent responsiveness and demandingness

Plasticity: easily malleable or flexible

Postpartum: following childbirth

Pressuring Feeding: characterized by attempting to feed a child in the absence of hunger cues

Protein: a macronutrient composed of long chains of amino acids

Rapid Infant Weight Gain (RWG): characterized by a change in weight-for-age z-score that is greater than 0.67

Reactivity: the extent to which the infant responds to different stimuli

Responsive Feeding: the act of being in-tune with the infant's hunger and satiation cues and then responding to these cues in an appropriate manner that is contingent upon the infant's needs

Satiety/Satiation: the feeling of fullness after consuming energy

Satiety Responsiveness: the infant's ability to recognize their fullness and self-regulate their intake of milk

Secondary Analysis: the analysis of data that has already been collected from a previous study

Self-Efficacy: the belief that one can achieve what they set out to achieve

Self-Regulation: the infant's ability to modulate his or her own behavioral or emotional responses to these stimuli

Surgent Temperament: infant behavior characterized by demonstration of high-intensity pleasure, approach, vocal reactivity, smiling/laughter, and low cuddliness

Temperament: behavioral differences in infant reactivity and self-regulation

Weight-for-age percentile or z-score (WAZ): a measurement of the infant's weight that is standardized by age and sex, based on the World Health Organization (WHO)

Weight-for-length percentile or z-score (WLZ): a measurement of the infant's weight as compared to their length and is standardized by age and sex, based on the World Health Organization (WHO)

CHAPTER II

LITERATURE REVIEW

2.1 Rapid Infant Weight Gain and Later Obesity

Rapid infant weight gain (RWG), or a change in weight-for-age z-score that is greater than 0.67, is a strong predictor for later obesity during childhood and adolescence (Baird et al, 2005; Lanigan and Singhal, 2009; Young et al, 2012; Zheng et al, 2018). A recent meta-analysis showed that RWG in the first 2 years postpartum was associated with a significantly increased risk for later overweight/obesity during childhood and adulthood (pooled OR = 3.66, 95% CI: 2.59-5.17) (Zheng et al, 2018). This same study also highlighted that these odds were higher if the RWG occurred during the first year postpartum versus the first 2 years.

Multiple studies have emphasized that RWG during the infant's first year after birth, specifically the first 6 months, is especially predictive for later risk of being overweight or obese (Dennison et al, 2006; Ekelund et al, 2006; Lanigan et al, 2009; Young et al, 2012). A longitudinal study with 606 infants showed that RWG in the first 6 months was associated with a significantly increased risk of childhood overweight at 4 years (OR 1.4, 95% CI: 1.3-1.6) even when adjusting for birth weight, breastfeeding history, and ethnicity (Dennison et al, 2006). Another longitudinal study of 248 infants showed that RWG during the first 6 months was associated with increased fat mass and waist circumference at 17 years of age (Ekelund et al, 2006).

The physiological mechanisms connecting early RWG with later obesity are not fully understood; however, RWG during early infancy as compared to other age ranges has been shown to have a stronger association (Ekelund et al, 2007; Lanigan et al, 2009; Taveras et al, 2011; Young et al, 2012; Zheng et al, 2018). One longitudinal study utilizing weight-for-length records from 44,622 children showed that upward crossing of 2 or more weight-for-length percentiles from 0-24 months was associated with obesity at ages 5 years (OR 2.08, 95% CI: 1.84-2.84) and 10 years (OR 1.75, 95% CI: 1.53-2.00) (Taveras et al, 2011). More specifically, when the first 24 months were divided into four 6-month age intervals, the prevalence of obesity at 5 and 10 years was greater for those children who crossed percentiles during the 1-6 month age interval as compared to the 6-12, 12-18, and 18-24 month age intervals. One prospective cohort of 128 infants observed weight gain during the first 6 months as well as weight gain from 3-6 years of age and showed that RWG during the first 6 months and not during early childhood (3-6 years) was significantly correlated with risk factors for metabolic syndrome at 17 years of age, even when adjusting for birth weight, maternal fat mass, and socioeconomic status (Ekelund et al, 2007).

The first 6 months postpartum are a time of great plasticity where the infant is experiencing substantial development and is more vulnerable to metabolic changes (Pray, 2015). Although it has been well-established that infants with a low birth weight are more susceptible to RWG (Zheng et al, 2018), multiple studies have shown that infants born with a normal weight are also susceptible to RWG (Demerath et al, 2006; Dennison et al, 2006; Ekelund et al, 2007; Zheng et al, 2018). Therefore, the first 6 months postpartum have been highlighted as an opportune window for obesity prevention (Lanigan and Singhal, 2009; Young et al, 2012), and healthy feeding practices during this time are an essential component for healthy development.

2.2 Parental Feeding Practices and Infant Weight

Although genetics, birth weight, and maternal BMI can impact the rate of weight gain during infancy, the more modifiable factor of parental feeding practices has also been linked to infant weight gain trajectories (Appleton, et al 2018; Heinig et al, 1993; Karaolis-Danckert et al, 2007; Lanigan and Singhal, 2009; Li et al, 2012; Young et al, 2012). Parents decide what, when, and how to feed their infant. Decisions such as the type of feeding (breast- or formula-feeding), the mode of feeding (breast- or bottle-feeding), and the style of feeding (responsive or nonresponsive) can affect the weight outcomes of the infant. Therefore, this modifiable risk factor is an appropriate focus for intervention efforts.

The choice of breast- or formula-feeding (and also which type of formula) can impact the amount of energy that the infant consumes and thus the weight that he/she gains (Heinig et al, 1993). Studies have shown that formula-fed infants have faster weight-gain trajectories than breastfed infants and reach a higher weight-for-age and length-for-age Z-score by 6 months (Appleton et al, 2018). One contribution to the weight-related outcomes of formula-feeding is the composition of different types of formula. Randomized control trials have shown that formulas with higher amounts of protein (Koletzko et al, 2009), less-hydrolyzed protein (Rzehak et al, 2009), and/or higher energy density (Lucas et al, 1992) are associated with more RWG during infancy.

In addition to the composition of the formula, the practice of bottle-feeding is also associated with RWG. One longitudinal study of 1,899 infants showed that in the first year postpartum, bottle-fed infants gained more weight than breastfed infants, regardless of whether the milk in the bottle was formula or breast milk (Li et al, 2012). Although there is no direct explanation for these differences in weight-related outcomes from breastfeeding versus bottle-feeding, multiple studies have highlighted the differences between these two modes of feeding.

Breastfeeding allows for more infant control than bottle-feeding (Ventura and Terndrup, 2016). With breastfeeding, the infant needs to get a proper latch in order to ensure appropriate milk transfer (Riordan, 2005). Additionally, the initiation of milk flow from the breast occurs with stimulation, and this act of stimulation requires the infant to be more of an active participant in the feeding (Mizuno and Ueda, 2006). In contrast, with bottle-feeding a proper latch is not required for milk transfer and milk flows from the bottle immediately upon sucking. Therefore, infants have the option to be more of a passive participant during bottle-feeding. Subsequently, bottle-feeding allows for more maternal control during the feeding. Observations of mother-infant feeding interactions have shown that, in comparison to breastfeeding, the actions of bottle-feeding are more determined by the mother than the infant (e.g. the mother pushes the nipple into the infant's mouth or removes it) (Crow et al, 1980). With bottle-feeding, it is also easier for the mother to focus her attention on external feeding cues, such as the amount of milk left in the bottle, instead of the infant's feeding cues (Crow et al, 1980; Ventura and Hernandez, 2019).

Infant feeding studies have underlined that healthier feeding practices are those that are contingent upon the infant's hunger and satiety cues and support the infant's ability to self-regulate intake (Disantis et al, 2011; Perez-Escamilla et al, 2017). Young infants have shown an ability to regulate their own energy intake (Fox et al, 2006; Shea et al, 1992) and this ability can help them consume appropriate amounts of breast milk and/or formula. Therefore, feeding practices that are structured around the infant's cues and promote infant self-regulation of intake have been associated with healthier weight-related outcomes (Disantis et al, 2011; Perez-Escamilla et al, 2017).

Responsive feeding has been highlighted as a healthier feeding style and has been linked to less RWG (Paul et al, 2011; Paul et al, 2014; Savage et al, 2016; Wen et al, 2012). Responsive feeding is the act of being sensitive to the infant's hunger and satiation cues and responding to these cues in a timely and appropriate manner (See *Figure 2.1*). An example of this feeding style would be a mother that sees her infant opening his mouth and showing flexed arms and interprets this as hunger (expressing her sensitivity to his hunger cues). Then she proceeds to feed her infant (appropriately responding to his hunger cues) and then stops feeding her infant after he relaxes his arms and turns his head away from her (being sensitive to and appropriately responding to his satiation cues). Randomized clinical trials have shown that responsive feeding can lead to slower, less-rapid weight gain during infancy as well as a decreased risk of obesity during early childhood (Paul et al, 2011; Paul et al, 2014; Savage et al, 2016; Wen et al, 2012). One of the key components to responsive feeding is that the mother is only feeding her child when he/she is hungry and not for other reasons.

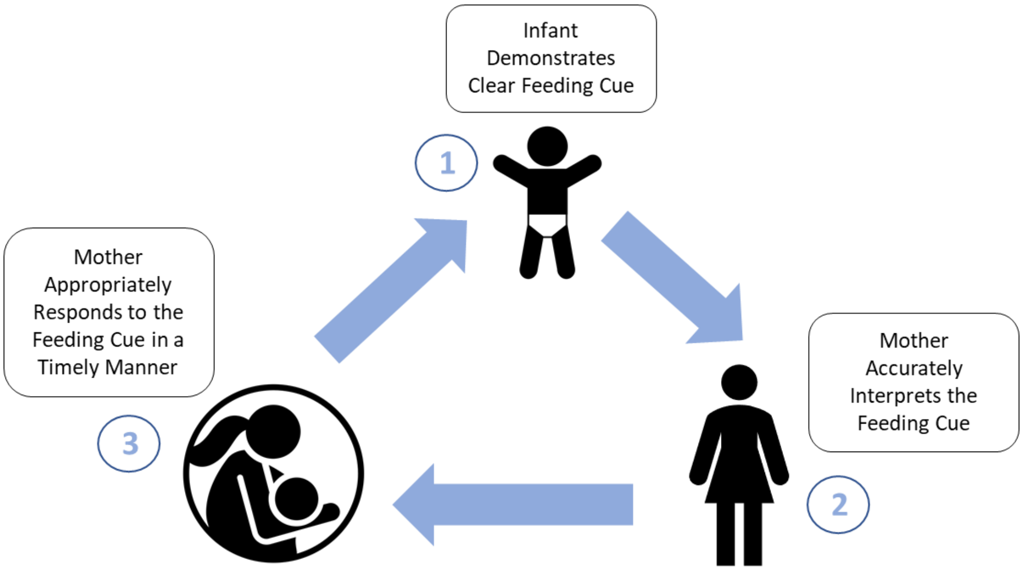

Figure 2.1

Key Steps to Responsive Feeding

2.3 Food to Soothe: Definition and Associations with Eating and Weight Outcomes

Food to soothe (FTS) is the act of feeding a child when he/she is upset for reasons other than hunger. The term "food to soothe" was originally utilized in 2011 by Stifter and colleagues, but the practice of feeding a child to regulate his/her emotions has been studied and referenced in the literature for a few decades (See *Table 2.1* for summary of FTS studies). Some of the various labels for this practice have been "feeding to calm" (Rametta et al, 2015), "food as a pacifier" (Sherry et al, 2004), "feeding to regulate emotions" (Musher-Eizenman & Holub, 2007), and "emotional feeding" (Wardle et al, 2002).

Multiple studies have highlighted the effectiveness of food to alleviate infant distress (Benoit et al, 2017; Efe and Ozer, 2007; Gray et al, 2002). This soothing effect from food appears to be an innate response, with infants as young as one day old showing a significant decrease in crying in response to oral sucrose solution (Smith et al, 1990). Additionally, sucrose solution and breastfeeding have both been noted as effective analgesics for minimally painful procedures during infancy (Benoit et al, 2017; Blass and Watt, 1999; Efe and Ozer, 2007; Gray et al, 2002; Stevens et al, 2016). The mechanisms driving these soothing effects from food are not fully understood. However, studies have shown that the release of certain neurotransmitters and the pleasure experienced from sweet flavors can both help alleviate negative emotions (Macht and Simons, 2011). Despite the evidence suggesting that humans are biologically wired to be soothed by food, some studies have shown that the use of food to alleviate distress might not be the healthiest choice, particularly during childhood.

Studies examining the use of FTS in school-aged children have shown that this practice is correlated with unhealthy eating behaviors during childhood. In one cross-sectional study of 8-10-year-old children, emotional feeding by the mother was the factor most related to emotional eating by the child, even when factoring in maternal depression and other confounding variables (Braden et al, 2014). Additionally, in a lab observation study of 3-5-year-olds, children whose parents used food to regulate emotions were more likely to eat in the absence of hunger (Blisset et al, 2010). These two eating behaviors, emotional eating and eating in the absence of hunger, have been closely linked to obesity in children (Braet and Vanstrien, 1997). Lastly, the use of feeding to regulate emotions has been associated with poorer diets during childhood. Multiple studies have shown that emotional feeding is related to increased intake of high-energy snacks (e.g. cookies, cakes, and chocolate) and decreased intake of fruit, both cross-sectionally and longitudinally (Blisset et al, 2010; Rodenburg et al, 2012; Sleddens et al, 2014).

There have only been a few FTS studies that have focused on infants, but these studies have shown that the use of FTS during infancy is a relatively common practice. In a study of 3,960 participants, about 53% of mothers answered “Sometimes” when asked how often they had used food to comfort their 6-month infant and 23% answered “Often” which was the highest possible option (Jansen et al, 2019). Additionally, in a longitudinal, lab-based study of 160 mother-infant dyads, infants were put through an emotional challenge and then it was observed whether the mother used food to comfort her upset infant. The results showed that 32%, 31%, and 47% of mothers used food to soothe their 6-month-, 12-month-, and 18-month-old infants respectively (Stifter and Moding, 2015).

FTS studies focused on infants have also shown that this feeding practice is associated with less favorable weight outcomes. In a cross-sectional study of infants ranging from 3-38 months, mothers that reported more frequent use of FTS had babies with a greater weight status, even when controlling for infant age, whether the infant was ever breastfed, and family income (Stifter et al, 2011). FTS has also been associated with greater weight gain during infancy. In a longitudinal study that assessed 160 infants at 6, 12, and 18 months, mothers that used FTS in the lab setting when their baby was 6 months had babies with a faster weight gain from 6 to 18 months compared to babies that were not fed to soothe (Stifter and Moding, 2015). Additionally, the use of FTS during infancy has been associated with health impacts later in life. In a population cohort of 3,960 infants, the use of FTS at 6 months predicted BMI at 6 years and older, even when controlling for birth weight, maternal BMI, and other confounding variables. Children’s emotional eating mediated these results (Jansen et al, 2019).

Randomized control trials aimed at reducing the use of FTS have resulted in healthier infant outcomes. One pilot study showed that families receiving a "Soothe/Sleep" intervention, which taught alternate methods for soothing as a first response to infant distress, had infants that received fewer feedings, slept longer, and had slower weight gain from birth to one year ($p = 0.02$) than infants from families that received no intervention (Paul et al, 2011). The Intervention Nurses Start Infants Growing on Healthy Trajectories (INSIGHT) randomized control trial showed that families receiving the responsive parenting intervention, which educated parents on feeding cues and encouraged them to use other methods than feeding to soothe their distressed infant, had infants with reduced RWG in the first 6 months of life (Savage et al, 2016). Follow-up results from this intervention showed that infants from the responsive parenting group still had reduced overweight status at 1 year of age and lower BMI z-scores at three years of age (Paul et al, 2018).

Taken together, these studies suggest that the use of FTS might not be the best practice to safeguard infant health. However, the research on FTS during the first 6 months postpartum is still limited. Since early infancy has been highlighted as a critical period for later health, a better understanding of the relationship between FTS and infant weight outcomes, as well as the maternal and infant characteristics most closely associated with the use of FTS, is warranted in order to improve obesity prevention efforts.

Table 2.1

Summary of Food to Soothe (FTS) Studies

Author & Year	Type of Study	Ages of children	Sample Size	Study Purpose	Measures of FTS	Additional Measures/Outcomes	Key Findings
Adams et al 2019	Randomized Control Trial	3 and 8 weeks	157	• Determine if FTS was reduced among mothers that received the responsive parenting (RP) intervention	• Ecological Momentary Assessment (5x/day for 5-8 days) assessing order of soothing strategies used • FTS was defined as "Fed-First" in response to infant distress	• Infant cry bouts through Ecological Momentary Assessments	• Mothers in RP group were less likely to use feeding as the first strategy to soothe (at 3 & 8 wks) compared to mothers in control group
Blisset et al 2010	Cross-sectional	3-5 years	25	• Observe if parent-reported use of emotional feeding is predictive of child emotional eating in a conditional lab setting	• Comprehensive Feeding Practices Questionnaire (Emotional regulation subscale)	• Child mood & consumption of snacks after emotion induction • Child weight and length	• Children whose parents reported higher use of emotional feeding were more likely to consume high-energy snacks than children whose parents reported lower use of emotional feeding
Braden et al 2014	Cross-sectional	8-12 years	106	• Observe which parent-related characteristics are most predictive of child emotional eating behavior	• Parent Feeding Style Questionnaire (Emotional feeding subscale)	• Child Eating Behavior Questionnaire (Emotional Overeating subscale) • Parent depression level & binge eating	• Emotional feeding was the most predictive parent characteristic for child emotional overeating

Author & Year	Type of Study	Ages of children	Sample Size	Study Purpose	Measures of FTS	Additional Measures/Outcomes	Key Findings
Carnell & Wardell 2007	Cross-sectional	3-5 years	439	• Assess relationship between parental feeding practices and child weight status	• Parental Feeding Styles Questionnaire (Emotional Feeding subscale)	• Child weight and length measured at school site and converted to BMI z-score	• No significant association between the use of emotional feeding and child BMI z-score
Evans et al 2011	Cross-sectional	1-5yr	721	• Explore the relationships between parent demographics and parental feeding practices	• Preschooler Feeding Questionnaire (Food to Calm subscale)	• Parent demographics: age, gender, ethnicity/race, education, household income, and primary language	• Food to calm was used more prevalently by Black and Hispanic Spanish-speaking respondents. • No significant differences in the use of food to calm by income or education level
Jansen et al 2019	Population Cohort	6mo followed through 10yr	3960	• Assess the relationship between use of FTS at 6mo and child body composition and child emotional eating over time	• Single item question administered when infant was 6mo to assess level of emotional feeding in the past 2 weeks	• Child weight-for-length at 3,4,6, &10yo • Body composition at 6 &10yo • Child Eating Behavior Questionnaire (Emotional Eating subscale) at 4 & 10yo • Maternal demographics	• Frequent use of FTS at 6mo was positively associated with child BMI z-scores at 6 & 10yo and with child emotional eating at 4 & 10yo • Results suggested that child emotional eating mediates the relationship between FTS and child BMI z-score

Author & Year	Type of Study	Ages of children	Sample Size	Study Purpose	Measures of FTS	Additional Measures/Outcomes	Key Findings
Paul et al 2011	Intervention; 4 groups	2-3wk; 6mo	110	• Soothe/Sleep intervention aimed at reducing the use of FTS, increasing infant sleep duration, and decreasing rapid weight gain	• FTS not measured • Intervention nurses educated mothers on infant feeding cues and encouraged alternative soothing efforts aside from feeding when the infant wasn't demonstrating hunger cues	• Weight-for-length percentile at 1yo • Conditional weight gain score from 2wk to 1yo • Sleep duration and feeding frequency (measured with sleep/feeding diaries)	• Infants in the Soothe/Sleep intervention had fewer feedings overall, increased sleep duration, and lower weight-for-length and conditional weight gain scores compared to infants in the control group
Rametta et al 2015	Cross-sectional	4mo	486	• Observe the relationships between feeding mode/type, parental beliefs, and parental feeding practices	• Infant Feeding Questionnaire (Food to Calm subscale) completed when infant was 4mo	• Feeding mode (BF vs FF), maternal education level, and maternal-reported awareness of infant cues	• Mothers that were fully BF and university-educated were more likely to use food to calm their infant • Use of food to calm was negatively associated with maternal-reported awareness of infant cues
Rodenburg et al 2012	Longitudinal and cross-sectional	8, 9, and ~10yr	1,275	• Observe relationships between parental feeding practices at 9yr and child dietary behavior one year later	• Parental Feeding Styles Questionnaire (Emotional Feeding subscale) completed when child was 9yo	• Child snack intake via food frequency questionnaires administered at 8, 9, and 10yr	• Emotional feeding was negatively associated with child fruit intake and positively associated with child energy-dense snack intake one year later

Author & Year	Type of Study	Ages of children	Sample Size	Study Purpose	Measures of FTS	Additional Measures/Outcomes	Key Findings
Rodgers et al 2013	Longitudinal; Observational	2 and 3yr	323	• Observe relationships between parental feeding practices at 2yr and child eating behavior one year later	• Preschooler Feeding Questionnaire (Food to Calm subscale) • Parent Feeding Style Questionnaire (Emotional Feeding subscale)	• Child eating behavior via Dutch Eating Behavior Questionnaire (Emotional eating and Tendency to Overeat Subscales)	• Emotional feeding at 2yr was significantly related to increased emotional eating and tendency to overeat, both at 2yr and at 3yr
Savage et al 2016	Randomized Control Trial	2, 3, 16, 28, & 4wk, and 1yr	291	• Determine effects of responsive parenting (RP) intervention aimed at reducing rapid weight gain during infancy	• FTS not measured Intervention nurses educated mothers on infant feeding cues and encouraged alternative soothing efforts aside from the use of FTS	• Infant weight and length at 4, 16, 28, and 40wk, and 1yr • Conditional weight gain scores and weight-for-length percentiles were calculated.	• Infants in the RP group had lower conditional weight gain scores (gained weight more slowly) and had lower weight-for-length percentiles at 1yr
Sherry et al 2004	Observational; Focus groups	2-5yr	101	• Explore maternal beliefs and feeding practices in a diverse sample of mothers	• Structured focus group questions aimed to identify maternal use of feeding in response to child's emotions	• Maternal beliefs about child nutrition, difficulties of feeding, feeding strategies, and child weight	• Use of food as a pacifier was identified as a major theme in majority of focus groups

Author & Year	Type of Study	Ages of children	Sample Size	Study Purpose	Measures of FTS	Additional Measures/Outcomes	Key Findings
Sleddens et al 2014	Prospective Cohort	6 and 8yr	1,654	• Examine relationship between parental feeding practices at 6yr and child dietary behavior at 6 & 8yr	• Parental Feeding Style Questionnaire (emotional feeding subscale) at 6yr	• Child dietary behavior at both 6 & 8yr measured with 10-item FFQ	• Emotional feeding at 6yr related to increased snack intake by child at 6 & 8
Stifter et al 2011	Cross-sectional; Exploratory	3-34 months	78	• Explore use of FTS and its association with maternal and infant characteristics as well as infant weight status	• Baby Basic Needs Questionnaire (BBNQ)	• Infant BMI-for-age z-score (mother-reported from last well-baby visit) • Infant Behavior Questionnaire (Negativity and Surgency subscales)	• Infants that were more frequently fed to soothe had higher BMI-for-age z-scores compared to infants that were less frequently fed to soothe. • This relationship was enhanced if the infant scored higher on negativity
Stifter and Moding 2015	Longitudinal	6, 12, and 18mo	135	• Measure the use of FTS by questionnaire and lab-observation • Determine the longitudinal relationship between FTS and infant weight	• Lab observations at 6, 12, and 18mo (Coded as use of FTS if mother fed in response to fussy/crying infant • Single interview question at 6mo (Yes/No FTS) • FTS Questionnaire	• Infant weight-for-length z-scores measured in lab at 6, 12, and 18mo	• Two measurements of FTS were not related to each other but were similarly related to variables • The use of FTS in the lab at 6mo predicted more rapid weight gain from 6-18mo

Author & Year	Type of Study	Ages of children	Sample Size	Study Purpose	Measures of FTS	Additional Measures/Outcomes	Key Findings
Stifter and Moding 2018	Longitudinal	6 and 18mo	160	• Assess the role of FTS with association of infant temperament and weight gain in the first 2yrs	• 3-day infant cry diary at 6mo (infant states and the soothing techniques used for distressed states)	• Infant Behavior Questionnaire Revised (Negativity and Surgency subscales) • Researcher-observation with Infant Behavior Record • Weight-for-length z-score at 6mo and 18mo	• Surgent infants whose parents more frequently used FTS were more likely to gain weight in 1yr than surgent infants whose parents used less FTS
Wardle et al 2002	Cross-sectional	5.6 ± 1.5yr	214	• Determine if obese mothers used different feeding styles on their children compared to normal-weight mothers	• Parent Feeding-Style Questionnaire (Emotional Feeding Subscale)	• Maternal BMI and obesity status	• Obese mothers were no more likely to use emotional feeding than normal-weight mothers

2.4 Limitations of Previous FTS Research and Areas for Further Exploration

Despite the link between rapid weight gain during the first 6 months and later obesity, few studies on FTS have solely focused on early infancy. In order to improve obesity prevention and parent feeding intervention programs, there is still more that needs to be understood regarding the use of FTS and infant weight outcomes during this critical period. Additionally, in order to tailor these programs and identify the target audience, there needs to be further exploration of the maternal and infant characteristics that are most associated with the use of FTS.

2.4.1 FTS and Infant Weight Status

Due to the mounting evidence attributing RWG in the first 6 months to an increased risk for obesity later in life (Lanigan and Singhal, 2009; Young et al, 2012), there is a need to better understand the relationship between the use of FTS and infant weight gain in the first 6 months. Although the use of FTS has been associated with greater weight status (Stifter et al, 2011) and greater weight gain during later infancy (Stifter and Moding, 2015), few or no studies have measured associations between use of FTS and infant weight gain during early infancy when infants are exclusively fed breast milk and/or formula. Additionally, Rametta et al (2015) showed that infants who had not yet been introduced to solid foods were more likely to be fed to soothe.

The majority of studies that have focused on FTS and weight gain have combined younger infants with older infants and/or toddlers in the same sample population (Jansen et al, 2019; Stifter et al 2011; Stifter and Moding 2015 and 2018). This combined sample makes it difficult to isolate the association of FTS and weight outcomes in younger infants. One of the main issues is that some of the sample population has been introduced to solid foods and some has not. Previous literature has shown that foods commonly used to soothe children are low-nutrient, energy-dense (e.g. sweets and snacks) (Sherry et al, 2004). However, none of the previous FTS studies administered food frequency questionnaires or collected data on the composition of the children's diets. Therefore, the solid foods that were used to soothe infants in previous studies might be confounding the association of FTS and unhealthy weight outcomes. Consequently, these results might also over-shadow the association of weight status and the use of FTS during early infancy when the infants are only consuming breast milk and/or formula.

Studying infants that have not yet been introduced to solid foods can help isolate the associations between FTS and infant weight outcomes since the infant's diet is less complex (e.g., consisting of only breast milk and/or formula). It is hypothesized that greater use of FTS will be associated with greater weight gain, even before the introduction of solids, because the infant is being fed more frequently. In support of this hypothesis, one study showed that a greater number of feedings per day was associated with higher infant weight gain during the first year postpartum (Worobey et al, 2009). In order to gain a better understanding of the association of FTS and infant weight gain, the use of FTS will also need to be characterized by feeding type and feeding mode.

2.4.2 Feeding Type and Mode and the Use of FTS

Few studies have examined the association among FTS, feeding type (exclusive breastfeeding, exclusive formula feeding, or mixed feeding) and/or mode (breast- or bottle-feeding), and infant weight outcomes. Previous studies have shown that infants who are exclusively breastfed (Rametta et al, 2015) and had a longer duration of breastfeeding were more likely to be fed to soothe (Stifter and Moding, 2015). These findings are supported by studies that have highlighted how breastfeeding can uniquely alleviate infant distress and can be an effective analgesic due to the calming properties of skin-to-skin contact, suckling, and sweet taste (Benoit et al, 2017; Efe and Ozer, 2007; Gray et al, 2002).

Previous studies that looked at predictors of FTS focused more on the differences between breastfeeding and formula-feeding (Rametta et al, 2015; Stifter and Moding, 2015), but neither study further categorized breastfeeding mothers by their use of bottle-feeding. Approximately 20% of mothers in the United States use a combination of direct breastfeeding and feeding of pumped breast milk for their 0-6-month-old infant, and the percentages of breast or bottle usage varies within this group (Karmaus et al, 2017). A more precise measure for level of bottle-feeding is needed to better understand the association of bottle-feeding and the use of FTS.

Additionally, it is unknown whether the association between weight gain and the use of FTS is expressed in a different manner for an infant that is predominantly breastfed compared to an infant that is predominantly bottle-fed (either with breast milk or formula). The differences in the feeding interaction between breastfeeding and bottle-feeding have been well established (Ventura and Terndrup, 2016). With breastfeeding, the infant is more of an active participant in the feeding and has to properly latch and stimulate milk flow (Mizuno & Ueda, 2006; Riordan, 2005), whereas with bottle-feeding the infant can choose to passively receive the milk when the mother inserts the nipple (Crow et al, 1980). Additionally, breastfed infants have been shown to be stronger communicators of feeding cues (Shloim et al, 2017) and better self-regulators of intake (Li et al, 2010) than bottle-fed infants.

Furthermore, non-nutritive sucking (NNS) is more common during breastfeeding than bottle-feeding (Mizuno and Ueda, 2006). NNS occurs when the infant is using sucking motions, but there is no milk provided from the nipple. Opposingly, nutritive sucking (NS) is sucking that occurs when the infant is actively receiving milk from the nipple. During breastfeeding, it takes about a full minute of NNS before the milk flow is initiated from the breast, and NNS continues towards the end of the feeding after milk flow has ceased from the breast (Bowen-Jones et al, 1982; Mizuno & Ueda, 2006). Opposingly, the milk flow from a bottle begins the moment that the infant starts sucking on the nipple and NNS rarely occurs during a bottle-feeding (Mizuno & Ueda, 2006).

In general, bottle-fed infants have been shown to consume a greater amount of milk per minute than breastfed infants (Mizuno & Ueda, 2006; Taki et al, 2010). Additionally, predominantly bottle-fed infants have demonstrated more RWG than predominantly breast-fed infants, and this outcome was seen regardless of whether the content of the bottle was breast milk or formula (Li et al, 2012). Due to these differences in feeding, it seems likely that the association between an increased use of FTS and infant weight gain will be more apparent for bottle-fed infants and less apparent or non-significant for breastfed infants.

2.4.3 Dyad Behavioral Characteristics Associated with FTS

Further exploration of the maternal and infant characteristics that are more closely associated with the use of FTS would help tailor obesity prevention programs and infant feeding interventions. The feeding dynamic between a mother and her infant can be complex, and the mother's decision to use certain feeding practices is often based on different factors. For example, a mother's socioeconomic status or personal beliefs can influence her feeding practices (Baughcum et al, 2001; Thompson et al, 2009). Additionally, studies have shown that infant characteristics can also influence parental feeding practices (Ventura and Birch, 2008). Therefore, a mother's decision to use food as a method to soothe her infant's distress might be influenced by multiple factors.

2.4.3.1 Maternal Characteristics and the Use of FTS

Few studies have examined the maternal characteristics that are most associated with an increased use of FTS. Previous studies have shown that higher self-reported emotional eating (Wardle et al, 2002), higher self-reported self-efficacy, and longer duration of breastfeeding (Stifter and Moding, 2015) were all correlated with a greater use of FTS. Studies examining associations between family income and use of FTS have reported mixed findings, with some studies showing the use of FTS is associated with lower income, higher income, or no difference in income (Baughcum et al, 2001; Evans et al, 2011; Stifter and Moding, 2015). Additionally, studies examining maternal education and the use of FTS have reported mixed findings, with one study showing the use of FTS is associated with mothers that have a lower education level (Saxton et al,

2009) and another study showing the use of FTS is associated with mothers that have a university education (Rametta et al, 2015). With regards to maternal weight status, no significant results have been found correlating maternal BMI and the use of FTS (Stifter and Moding, 2015; Wardle et al, 2002). However, certain mother-reported feeding styles have been shown to be associated with the use of FTS (Stifter et al, 2011; Stifter and Moding, 2015) and more objective measures of this association might be helpful to tailor obesity prevention programs targeting infant feeding practices.

2.4.3.1.1 Feeding Styles Associated with the Use of FTS. Infant feeding styles, defined as parenting styles that are specific to infant feeding, can shape which infant feeding practices are used more frequently (Thompson et al, 2009). Various feeding styles have been established (e.g. pressuring, responsive, Laissez-Faire, restrictive, and indulgent) and these styles differ by parental level of control, involvement, and/or responsiveness toward the infant during the feeding. Previous studies have shown that both pressuring and responsive feeding styles are associated with more frequent use of FTS (Stifter et al, 2011; Stifter and Moding, 2015).

Caregivers with a pressuring feeding style tend to use feeding practices aimed at increasing the amount of food that the infant consumes (Thompson et al, 2009). An example of a pressuring feeding style is a mother that forces or coerces her infant to eat even after the infant has demonstrated satiation. This feeding style is considered controlling because the caregiver's actions are not contingent upon the infant's feeding cues. Consequently, this feeding style has been linked to alterations in child eating behavior and self-regulation of energy intake (Birch et al, 1987; Li et al, 2014; Savage et al, 2007). For instance, one longitudinal study showed that a more pressuring infant feeding style, which they defined as frequent encouragement for bottle-emptying, was associated with decreased self-regulation of energy intake when the child was 6 years old (Li et al, 2014).

Since feeding an infant for reasons other than hunger is considered pressuring, this feeding style often encompasses the practice of using FTS. Correspondingly, some of the items in the pressuring subscale from the Infant Feeding Styles Questionnaire (IFSQ) overlap with the items in the questionnaire to measure the use of FTS (Stifter et al, 2011; Thompson et al, 2009). For example, "When my child cries, I immediately feed him/her," is found in the IFSQ subscale for pressuring and this question also shines light on the mother's use of food as the primary action to soothe her infant. Therefore, it is justifiable that two different studies have shown a positive association between a more frequent use of FTS and a higher level of pressuring feeding (Stifter et al, 2011; Stifter and Moding, 2015).

Contrastingly, caregivers with a responsive feeding style tend to use feeding practices that are responsive to the child's hunger and satiation cues (Perez-Escamilla et al, 2017). An example of a responsive feeding style is a mother that accurately interprets her infant's cues as hunger and then feeds her infant until the infant demonstrates satiation cues. This feeding style encourages infant self-regulation of energy intake and has typically been associated with healthier weight-related outcomes (DiSantis et al, 2011; Paul et al, 2011; Paul et al, 2014; Perez-Escamilla et al, 2017; Savage et al, 2016; Wen et al, 2012).

Contrary to what might be expected, a higher maternal-reported responsive feeding style has been associated with an increased use of FTS (Stifter et al, 2011; Stifter and Moding; 2015). One possibility why maternal-reported responsiveness is associated with an increased use of FTS is that there might be discrepancies between a mother's self-reported responsiveness and the mother's actual level of responsiveness. For example, mothers might believe that they are being sensitive and responsive to their infant's needs, but their actions might not be the most appropriate or the healthiest for their infant. In the case of FTS, mothers might be responding to their infant's cries in a timely manner, but might be misinterpreting these cries as hunger or might feel that food is the best way to soothe their distressed infant, even if they know that the infant is not hungry. This possibility is further supported by the finding that mothers with a higher reported use of FTS also reported having higher overall self-efficacy (Stifter and Moding, 2015). Thus, these mothers may have confidence in their abilities as a parent because they believe that they are effective in comforting their distressed infant. However, their actions for soothing might not be the healthiest approach. More objective measures of responsive feeding are needed to better understand the relationship between responsive feeding and the use of FTS.

Observations of feeding interactions are a less-biased measure of responsive feeding than maternal-reported questionnaires. These feeding interactions objectively assess the mother's sensitivity and responsiveness to her infant's distress and feeding cues and can catch discrepancies from the self-reports of responsive feeding. For example, a responsive feeding item on the Infant Feeding Style Questionnaire (IFSQ) is, "I let my child decide how much to eat," and a mother might demonstrate a high score for this self-reported item, but she might physically express her sensitivity to her infant's satiation cues differently during the feeding interaction and might even over-ride the infant’s satiation cues. A feeding observation would therefore be a stronger measure of this interaction than a self-reported questionnaire.

2.4.3.1.2 Objective Measure of Maternal Responsiveness. The Nursing Child Assessment Parent-Child Interaction Feeding Scale (NCAFS) can be a helpful scoring system to objectively measure the mother’s sensitivity and responsiveness to her infant’s cues. The NCAFS was developed at the University of Washington by Dr. Kathryn Barnard and her colleagues in the 1970s to evaluate the quality of interaction between a mother and her infant during a typical feeding (Oxford and Findlay, 2015). Since its development, the NCAFS has been used in hundreds of research studies related to infant health [See (Oxford and Findlay, 2015, pg. 11-12) for a review]. The original goal of the NCAFS was to predict the infant’s later development status based on the mother’s sensitivity and responsiveness to her infant as well as the infant’s ability to communicate his/her needs and respond to his/her caregiver. Dr. Barnard referred to successful caregiver-child interactions as a “dance” where both the caregiver and infant are active partners that adapt to one another. Since the feeding interaction happens often throughout each day, observing this interaction can give some insight into the quality of communication that typically occurs between a mother and her infant.

The NCAFS measures both maternal and infant behaviors (Oxford and Finlay, 2015). The maternal sensitivity to cues subscale and maternal response to distress subscale objectively measure the mother’s level of responsiveness to her infant. The sensitivity to cues subscale measures a mother’s ability to identify her infant’s cues and respond to these cues in an appropriate and timely manner. An example would be a mother that slows the pace of a feeding or pauses when the infant shows a disengagement cue, such as turning his/her head away from the caregiver. The response to distress subscale measures a mother's attempts to relieve her infant's distress (e.g. crying, fussing, whining, coughing, pulling away, and/or back arching) in a timely manner. These attempts can include making sympathetic verbalizations to the infant and/or making soothing non-verbal efforts such as gentle touching or hugging.

Using the sensitivity to cues and response to distress subscales to measure a feeding interaction will highlight how in-tune the mother is with her infant and how adequately she responds to her infant's needs. Subsequently, lower scores on either or both subscales might draw attention to discordant aspects of the mother's responsiveness to her infant and how this might relate to her use of FTS. In other words, the mother's inaccurate interpretations of her infant's cues or inappropriate responses to her infant's cues might be associated with an increased use of FTS. Additionally, the infant's characteristics might also be contributing to the mother's ability to respond to her infant's needs contingently and appropriately.

2.4.3.2 Infant Characteristics and the Use of FTS

Studies have shown that parental feeding practices can be influenced by infant characteristics and behaviors (Ventura and Birch, 2008). Therefore, a mother's choice to use FTS might be affected by her infant's characteristics and behaviors. Further exploration of different infant traits and their association with the use of FTS is warranted in order to tailor future intervention programs. Previous studies illustrate that infants with a more negative temperament were more likely to be fed to soothe, and there was no difference in use of FTS based on infant sex or birth weight (Stifter et al, 2011; Stifter and Moding, 2015). However, there is limited data related to other infant characteristics that might influence the parent's choice to use FTS. Some infants are stronger communicators than others (McNally et al, 2016; Shloim et al, 2017; Ventura et al, 2019a) The infant's ability to clearly communicate his or her needs to their caregiver might influence the caregiver's strategies for soothing. Additionally, infants demonstrate differences in eating behavior, such as enjoyment of food and satiety responsiveness (Llewellyn et al, 2011a; van Jaarsveld et al, 2011). These differences might influence infant susceptibility to being fed to soothe. A closer look at these different infant traits will help to better understand why some infants are more likely to be fed to soothe over others, and this will help guide future feeding interventions.

2.4.3.2.1 Infant Temperament. Infant temperament is generally defined as behavioral differences in reactivity and self-regulation (Rothbart, 1981). The term reactivity describes the extent to which the infant responds to different stimuli, and self-regulation is defined as the infant's ability to modulate his or her own behavioral or emotional responses to these stimuli (Gartstein and Rothbart, 2003). Biological differences in reactivity and self-regulation can be augmented or tempered by upbringing and various experiences over time.

The infant's reactivity and self-regulation is further characterized by specific traits which help define the infant's temperament (Gartstein and Rothbart, 2003). The 14 established traits are: 1) *approach,* which describes the infant's excitement and reactions toward enjoyable activities, 2) *vocal reactivity,* which describes the level of vocalization that the infant exhibits during certain activities, such as making cooing sounds while being dressed 3) *high pleasure,* which describes the infant's enjoyment of high-stimulus activities such as a game of peek-a-boo, 4) *smile/laughter*, which describes the infant's use of these expressions during different scenarios, 5) *activity,* which describes the level of large movements that the infant makes in response to certain activities, such as bath-time, 6) *perceptual sensitivities,* which describes the infant's ability to notice low-level stimuli such as different textures of fabric on their skin, 7) *sadness,* which describes the infant's overall low mood and their low mood in response to negative experiences, such as physical discomfort, 8) *distress to limitation,* which describes the infant's demonstration of distress (i.e. crying) in response to different limitations, such as not being able to grab a toy that he/she desires, 9) *fear,* which describes the infant's reactions to sudden changes in stimuli such as startling with a loud noise, 10) *falling reactivity,* which describes the infant's self-regulation and ability to recover from highly positive or negative emotional states, 11) *low pleasure,* which describes the infant's enjoyment of low-stimulus activities such as playing with their favorite toy, 12) *cuddliness,* which describes the infant's pleasure of molding their body to their caregiver, 13) *duration of orienting,* which describes the infant's ability to hold attention to certain stimuli such as staring at a mobile, and 14) *soothability,* which describes the infant's ability to be soothed by their caregiver after experiencing distress.

Different variations of these 14 behavior traits compile three dimensions of infant temperament: 1) *surgency/extraversion*, 2) *negative affectivity,* and 3) *orienting/regulation capacity* (Gartstein and Rothbart, 2003). The surgency/extraversion dimension is characterized by infant demonstration of high-intensity pleasure, approach, vocal reactivity, smiling/laughter, and low cuddliness. Surgency during infancy has been associated with impulsivity in childhood (Burton et al, 2011). The negative affectivity dimension is characterized by infant demonstration of sadness, distress to limitations, fear, and poor soothability, and falling reactivity. The orienting/regulation capacity dimension is characterized by low-intensity pleasure, duration of orienting, smiling/laughter, perceptual sensitivity, falling reactivity, cuddliness, and soothability. Infants that showcase more traits from the negative affectivity dimension might be viewed as more challenging than an infant showcasing more traits from the orienting/regulation capacity dimension.

Negative and surgent infant temperaments have been positively associated with faster weight gain during infancy. One study showed that infants who were parent-reported as having more difficult temperament (characterized by low rhythmicity, approach, and adaptability and high negativity and intensity) at 6 months were more likely to gain 30 or more percentile points in weight-for-length between 6 and 12 months compared to infants reported as having less difficult temperament at 6 months (Carey et al, 1985). Another study showed that infants with a more difficult temperament were more at risk for rapid weight gain from birth to 6 months (Niegel et al, 2007).

Stifter and colleagues (2011 and 2018) have shown that the use of FTS might be mediating the association between difficult infant temperament and faster weight gain. Infants that were more frequently fed to soothe had higher BMI z-scores on average, and this relationship between FTS and infant BMI z-score was stronger for infants with higher temperamental negativity than those with lower temperamental negativity (*Figure*

2.2). This same study also found a significant positive association between infant negativity and the use of FTS. In another study which used both a parent-reported questionnaire and an observational measure of infant temperament, although there was a significant negative association between infant surgency and the use of FTS, infants with high surgency who were frequently fed to soothe had a greater change in weight-for-length Z-score from 6- to 18-months compared to infants with a high surgency who were seldomly fed to soothe (*Figure 2.3*) (Stifter and Moding, 2018).

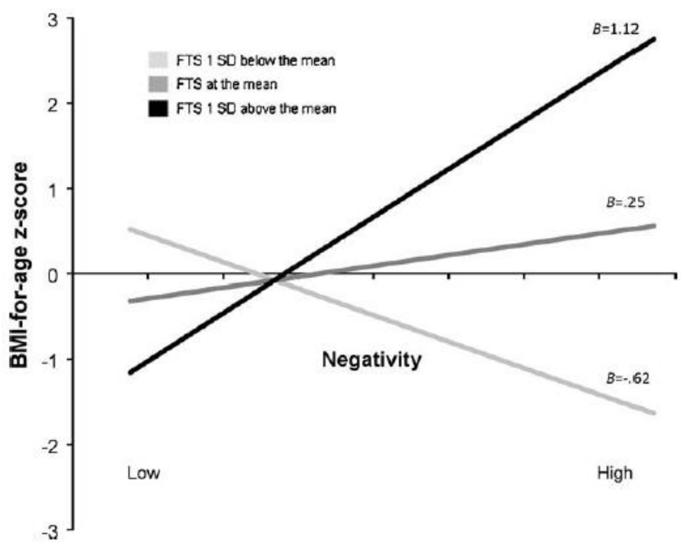

Figure 2.2

Interaction of food to soothe (FTS) on the relationship between infant temperamental negativity and infant BMI-for-age z-score (Stifter et al, 2011).

BMI-for-age Z-score = infant's Body Mass Index expressed and standardized as certain standard deviations from the average BMI for a specific age & sex
Note: Infants with a higher score for temperamental negativity had higher average BMI-for-age z-scores. This relationship was moderated by the use of FTS, with higher FTS scores showing a stronger positive relationship between temperamental negativity and BMI z-score and lower FTS scores trending towards a negative relationship.

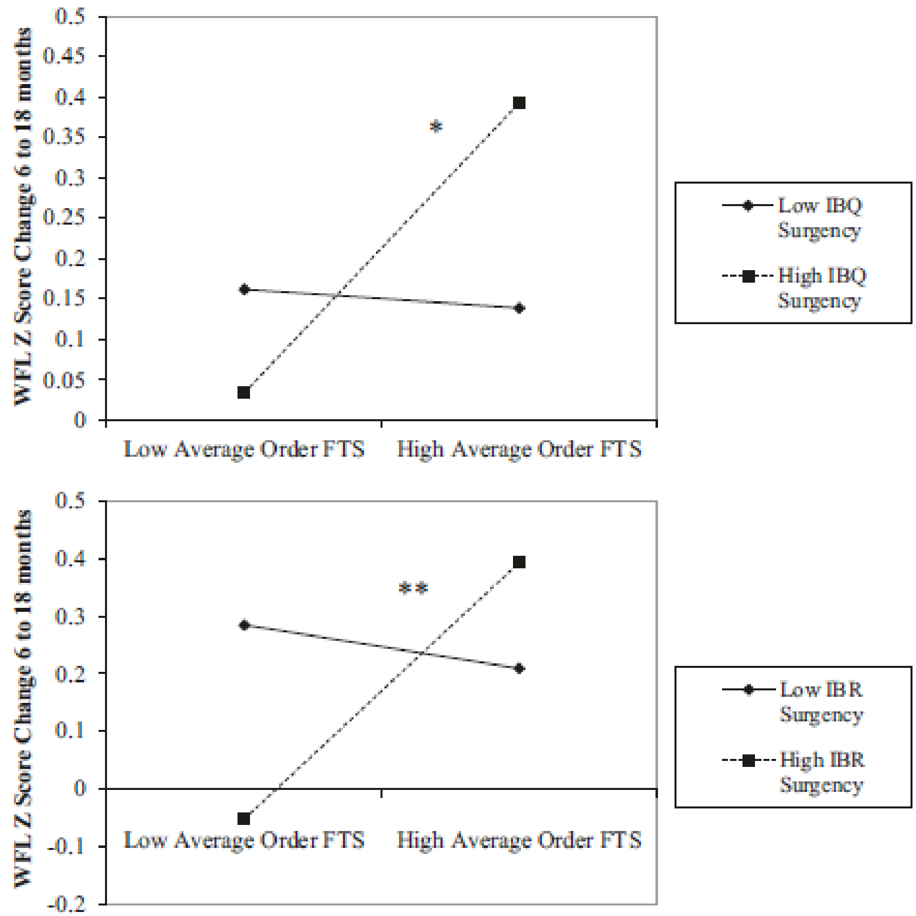

Figure 2.3

Interactions of food to soothe (FTS) on the relationship between parent-rated (top) or observer-rated (bottom) infant surgency at 6 months and infant weight-for-length (WFL) z-scores between 6 and 18 months (Stifter and Moding, 2018).

Average Order FTS = ranked order for using food in response to a cry/fuss bout with a higher average order representing a greater tendency to use FTS, IBQ = Infant Behavior Questionnaire or maternal-reported measure of infant temperament, IBR = Infant Behavior Record or observer-rated measure of infant temperament.

Note*:* Infants with high surgency showed greater changes in WFL z-scores with higher use of FTS and infants with low surgency showed no significant change in WFL z-score with increased use of FTS. *P < .05; **p < .01

Overall, infant temperament has been shown to be associated with infant weight gain, and parental feeding practices such as the use of FTS might be mediating this relationship. Infant temperament is one infant characteristic that might be influencing a mother's use of FTS, but there might be other infant characteristics as well. In addition to infant temperament, the infant's ability to clearly express his or her needs could also influence whether the infant is more frequently fed to soothe.

2.4.3.2.2 Infant Clarity of Cues. Few or no studies have explored the relationship of FTS and clarity of infant feeding cues. Infant clarity of cues is an infant's ability to clearly express their hunger and satiation to their caregiver. Since young infants cannot yet verbally specify their needs, these physical and vocal cues are their form of communicating to their caregiver (Oxford and Findlay, 2015). These cues are categorized as engagement (signifying the desire for an interaction) or disengagement (signifying the need for a break or a change). The cues are then further classified into subtle or potent cues, with subtle cues (i.e. averting gaze) often leading up to the potent cues (i.e. lateral head turn) Feeding cues are typically clusters of both engagement and disengagement cues and together these clusters signify either hunger or satiation. It is hypothesized that an infant's inability to clearly demonstrate hunger or satiation might make it difficult for a mother to understand what the child needs when he/she is distressed, so food might be the easiest solution.

Previous studies have shown that infant clarity of cues is associated with maternal sensitivity and maternal feeding practices. Ventura et al (2019a) showed that higher levels for infant clarity of cues were correlated with higher levels of maternal sensitivity, arguing that it might be easier for a mother to be responsive to her infant when her infant is better capable of expressing his/her needs. These findings suggest that an infant with clearer cues might be less susceptible to being fed to soothe because the infant's mother is better able to appropriately respond to the infant's needs. Correspondingly, one cross-sectional study showed that there was a negative correlation between the use of food to calm and the mother's awareness of her infant's feeding cues (Rametta et al, 2015). These findings reiterate that a mother's ability to appropriately interpret her infant's needs might decrease her use of FTS. In addition to her infant's clarity of cues, a mother's choice to use FTS might also be associated with her infant's eating behavior.

2.4.3.2.3 Infant Eating Behavior. Few or no studies have shown the relationship of FTS and infant eating behavior. The infant's general appetite, as well as more specific eating behaviors, such as food responsiveness, enjoyment of food, and satiety responsiveness, might influence the infant's susceptibility to being fed to soothe. Food responsiveness, according to the Baby Eating Behavior Questionnaire (Llewellyn et al, 2011), refers to the infant's drive to eat in response to external feeding cues (i.e. the presence of milk) and also shines light on whether the infant overrides their own internal cues of satiation. An example of an infant with higher food responsiveness would be an infant that has just eaten well, but will easily feed again if offered. Enjoyment of food refers to the infant's perceived pleasure during a feeding. An example of an infant with higher enjoyment of food would be an infant that seems content and in a positive mood while feeding (Llewellyn et al, 2011). Satiety responsiveness refers to the infant's ability to self-regulate their own intake of milk, therefore infants with higher satiety responsiveness would be better self-regulators. An example of an infant with higher satiety responsiveness would be an infant that shows he's done feeding before drinking the amount of milk that his mother thought he would drink.

Previous studies have shown that infant eating behaviors are associated with infant weight status. Although it has been shown that infant weight status might influence the infant's appetite, one longitudinal study showed that the prediction of infant weight at 15 months based on infant appetite at 3 months was stronger than the prediction of infant appetite at 15 months based on infant weight at 3 months (van Jaarsveld et al, 2011). Therefore, this supports the possibility that an infant with a biological disposition for a greater appetite might consume more energy and will subsequently gain more weight due to this greater intake. One prospective study involving twin infants showed that the twin with the heartier appetite at 6 months (characterized by a higher score for food responsiveness and a lower score for satiety responsiveness) was heavier at 15 months than his/her twin sibling that did not have a hearty appetite (van Jaarsveld et al, 2014).

Just as the use of FTS has been suggested to mediate the relationship between infant temperament and weight status, a better understanding of the relationship between infant eating behavior and the use of FTS might give more insight as to why infants with larger appetites and poorer satiety responsiveness have been shown to have greater weight gain during infancy. Infants reported as having higher food responsiveness and enjoyment of food might be more likely to be given FTS when they are upset because they enjoy mealtimes and will easily take more food if offered. Infants with low satiety responsiveness or a decreased ability to demonstrate fullness during a feed might be more susceptible to being fed upon distress. As this is a cross-sectional study, a consistent use of FTS might also be driving a decrease in satiety responsiveness because the infant is potentially being overfed and therefore his/her internal satiety cues are being overridden. This knowledge will provide more insight about the relationship between the use of FTS and infant eating behavior and will therefore help tailor obesity prevention programs targeted at risk factors during infancy.

2.5 Conclusions

The first 6 months postpartum have been highlighted as an important window for obesity prevention efforts (Lanigan and Singhal, 2009; Young et al, 2012). Multiple studies have shown that RWG during these first 6 months is a strong predictor of later obesity and related comorbidities (Ekelund et al, 2006 & 2007; Taveras et al, 2011; Zheng et al, 2018). Although there are biological factors that are predictive of RWG, studies have shown that certain feeding practices can also affect infant weight gain trajectories (Appleton, et al 2018; Heinig et al, 1993; Karaolis-Danckert et al, 2007; Li et al, 2012).

The use of FTS has been associated with unhealthy eating behaviors during childhood and unhealthy weight outcomes during infancy (See *Table 2.1* for a review). However, few studies have observed the relationship of FTS and weight gain during early infancy. Additionally, few studies have explored the association of FTS, weight gain, and feeding type and/or mode during early infancy before the introduction of solids. Exploration of these relationships will give better insight on the role of FTS and overall infant health.

Furthermore, in order to tailor obesity prevention efforts, there needs to be further exploration of the maternal and infant characteristics that are most closely associated with the use of FTS during early infancy. There were some limitations with previous studies that showed associations between the use of FTS and maternal feeding style. Additionally, few studies have explored infant characteristics, such as infant temperament, clarity of cues, and eating behavior. It is likely that a mother's use of FTS is based on many different factors.

A better understanding of the association of FTS and weight outcomes during early infancy and the maternal and infant characteristics that are more closely associated with the use of FTS would allow for the development of stronger prevention programs targeting infant feeding practices. This secondary analysis will add to the existing evidence on FTS and contribute to the understanding of factors associated with the use of TS and potential targets for obesity prevention efforts.

Chapter III

METHODS

3.1 Overview/Participants

The current study was a secondary analysis of pooled data from four previous infant feeding studies (Ventura and Hernandez, 2019; Ventura and Hupp, forthcoming; Ventura and Pollack, 2015; Ventura et al, 2019b). These studies took place in Philadelphia, PA and San Luis Obispo, CA between June 2013 to January 2020. The Opaque Bottle Study (OBS) took place in Philadelphia, PA from June 2013 to February 2014 and was a within-subject pilot study (n = 25) that assessed the differences in maternal sensitivity during a feeding interaction while using a clear bottle compared to an opaque bottle (Ventura and Pollack, 2015). The Opaque Bottle Study II (OBSII) took place in San Luis Obispo, CA from June 2015 to June 2017 and was a replication of the OBS pilot study, but with an increase in sample size (n = 76) (Ventura and Hernandez, 2019). The Mindless Feeding Study (MFS) took place in San Luis Obispo, CA from August 2015 to September 2017 and was a within-subject study for predominantly breastfeeding mothers which assessed the difference in quality of feeding interaction during a technological distraction versus a control condition (n = 25) (Ventura et al, 2019b). The Breast versus Bottle Study (BvB) took place in San Luis Obispo, CA from September 2018 to January 2020 and was an observational within-subject study (n = 47) that assessed the differences in the quality of feeding interaction while breastfeeding versus bottle-feeding (Ventura and Hupp, forthcoming).

For all studies, mothers with infants under 6 months of age (pooled n = 134) were recruited. Eligibility criteria for infants included: born full-term (>37 weeks), less than 6 months of age, no developmental delays, not on any medication, not below the 5^{th} percentile for weight-for-length, and not yet introduced to solid foods. Eligibility criteria for mothers included: between 18 and 40 years of age and did not smoke during pregnancy. Mothers were recruited through online advertisements (e.g., Craigslist, Facebook), advertisements in local WIC clinics, announcements in infant feeding and birthing classes, flyers displayed locally and distributed to nearby businesses, and word of mouth. The procedures for all studies were approved by the California Polytechnic State University Institutional Review Board. All participants gave written and oral consent before participating.

3.2 Design

The study design was the same across all studies used for this secondary analysis. All studies were cross-sectional, within-subject experiments. Mother-infant dyads visited our laboratory two different days for approximately 2 hours on each day. The two visits were separated by one day at minimum and by one week at maximum. Both visits started at the same time of day to control for changes in the circadian rhythm of the infant (Matheny et al, 1990). The research assistant encouraged the mothers to schedule the two visits at a time when their infants would be most ready to feed. Questionnaires were administered to mothers either electronically or as a paper document after the first visit to the laboratory and were completed before the second visit.

3.3 Feeding Observations

At both visits, the mothers were instructed to feed their infant as they normally would at home. At one of the visits there was an experimental condition (e.g. iPad was used, an opaque bottle was used, or the mother was asked to bottle-feed instead of breastfeed). The other visit was a control, with the mother using her typical mode of feeding. The order of feeding condition was randomized and counter balanced. The feeding room at the laboratory was designed to ensure comfort (e.g. padded rocking chair and minimal sound disruption) and provided the supplies necessary for a normal feeding (e.g. breastfeeding pillow and bottle-warmer). After a brief acclimation period and when the mother signified that she was ready to start the feeding, video cameras were used to record the entire feeding interaction (GoPro Hero5 Black, California, USA and Canon VIXIA HF M41 full HD camcorder; Canon). Depending on the study, either one camera was placed about 10 feet in front of the dyad or 3 small GoPros were placed on three different sides of the dyad, each about 2-4 feet away. For the purposes of this study, only the video footage from the control conditions for each study were analyzed to increase equivalence of measures across the combined dataset and to provide a representation of a typical feeding interaction between the mother and infant.

3.4 Video Analysis

Video recordings from each feeding session were coded by trained raters who were blinded to the study hypotheses. The Nursing Child Assessment Parent-Child Interaction Feeding Scale (NCAFS) was used for the coding scheme. This scale has been widely used to observe and quantitatively measure parent-infant interactions during a feeding session (Oxford and Findlay, 2015). This scale contains 6 subscales: 4 subscales that measure maternal behaviors and 2 subscales that measure infant behaviors. These subscales have been validated for infants aged up to 1 year, for both breast and bottle-feeding, and for home- and lab-based observations. For the purposes of this study, four subscales will be used: Maternal Responsiveness to Infant Distress, Maternal Sensitivity to Cues, Infant Clarity of Cues, and Infant Responsiveness to Caregiver.

The Maternal Sensitivity to Cues subscale contains 16 items that aim to measure the mother's ability to accurately read her infant's hunger and satiation cues during the feeding interaction (Example item: "Caregiver comments verbally on child's satiation cues before terminating the feeding"). The mother is scored on a scale of 0-16 with a higher score representing greater sensitivity to the infant's feeding cues. The Maternal Responsiveness to Infant Distress subscale contains 11 items that primarily focus on the mother's attempts to relieve her infant's distress (i.e. crying, whining, choking, etc). These attempts include altering her level of touch or positioning, vocalizing to her baby, and starting or stopping the feeding. The mother is scored on a scale of 0-11 with a higher score representing greater responsiveness to infant distress. The Infant Clarity of Cues subscale contains 15 items that measure the infant's ability to communicate to his/her mother and express their needs. These cues include signaling a readiness to eat, demonstrating satiation, having periods of alertness, and initiating eye contact with the caregiver during the feeding. Infants receive a score of 0-15, where a higher score signifies greater clarity of cues. The Infant Responsiveness to Caregiver subscale contains 11 items that all measure the infant's ability to respond to the caregiver's efforts to interact. Some of these items include smiling at the caregiver during the feeding, reaching out to the caregiver during the feeding, and showing potent disengagement cues during the last half of the feeding. The infant is scored on a scale of 0-11 with a higher score representing higher responsiveness to their caregiver.

All coders received training from a certified NCAFS trainer and did not begin coding until receiving an NCAFS coding certificate. Additional inter-rater reliability assessments were determined by common coding of 10% of the study videos and intra-rater reliability was determined by double-coding of 10% of the study videos. Inter-rater reliability and intra-rater reliability were established using Pearson's correlation coefficients; both were $r<0.85$.

3.5 Measuring the Use of FTS

The Basic Baby Needs Questionnaire (BBNQ) was used to measure the extent to which mothers use FTS in different situations (Stifter et al, 2011; Stifter and Moding, 2015). The BBNQ has been previously tested on infants and has shown modest convergent validity with similar parental feeding styles and beliefs (Stifter et al, 2011). This maternal-reported 13-item scale assessed how often the mothers used FTS in general as well as in different scenarios (Example item: "How likely are you to use food to soothe when you are stressed?"). The items are scored on a Likert scale of 0-5 with 0 being "Never," 3 being "Sometimes," and 5 being "Often." The effectiveness of FTS was also assessed in one item: "How effective is using food to soothe your child?" This item was scored on a scale of 0-5 with 0 being "Does not work," 3 being "Works about half the time," and 5 being "Works all the time." A composite measure will be taken by averaging the scores for the 13 items.

3.6 Feeding Type and Mode

Within the BBNQ, the mothers were asked a question about how their baby is currently being fed (breastfeeding only, formula-feeding only, or breast- and formula-feeding). After this first question, breastfeeding mothers were asked to use a sliding bar to specify the percentage of breast milk that their infant receives from the breast or bottle ("Please estimate the percentage of breast milk from the breast that your infant receives [versus expressed milk from a bottle]"). This percentage scale was then collapsed into a categorical variable with three groups showcasing the level of bottle-feeding intensity: low bottle-feeding intensity (<20% of daily feedings from a bottle), medium bottle-feeding intensity (20-80% of daily feedings from a bottle), and high bottle-feeding intensity (>80% of daily feedings from a bottle).

3.7 Infant Feeding Style

The Infant Feeding Style Questionnaire (IFSQ) was used to assess infant feeding style. The IFSQ is a maternal-reported measure that is used to better understand parental feeding practices and beliefs (Thompson et al, 2009). The five feeding styles assessed through this questionnaire are: Responsive, Pressuring, Restrictive, Laissez-Faire, and Indulgent. This questionnaire has shown good reliability and validity for diverse samples. For this study, only the Responsive and Pressuring feeding subscales will be utilized because these two feeding styles have been previously associated with the use of FTS (Stifter et al, 2011; Stifter and Moding, 2015).

Both sub-constructs for the responsive feeding style will be assessed; this includes the Satiety sub-construct ($\alpha = .67$), which aims to measure the mother's awareness to her infant's hunger/satiety cues (Example item: "I pay attention when my child seems to be telling me that s/he is full or hungry") and the Attention sub-construct ($\alpha = .60$), which aims to measure the quality of the interaction between the mother and infant (Example item: "I talk to my child to encourage him/her to drink his/her formula or breast milk").

The Finishing and Soothing sub-constructs will be assessed for the pressuring feeding style. The Finishing sub-construct ($\alpha = .75$) aims to measure the mother's attempts to urge her infant to drink more milk regardless of the infant's satiety cues during feeding (Example item: "If my child seems full, I encourage him/her to finish his/her food anyway"). The Soothing sub-construct ($\alpha = .75$) aims to measure the mother's behaviors and beliefs surrounding her use of food to soothe her distressed infant (Example item: "The best way to make an infant stop crying is to feed him or her").

3.8 Infant Temperament

The Infant Behavior Questionnaire - Revised Very Short Form (IBQ-R VSF) was used to assess infant temperament. The IBQ-R VSF is a 37-item instrument (Putnam et al, 2014) that was updated from the Infant Behavior Questionnaire - Revised (Gartstein and Rothbart, 2003) in order to decrease assessment burden. The IBQ-R VSF aims to measure infant behavior and temperament by focusing on infant reactivity and regulation and has been validated for infants younger than three months and up to three years old. This questionnaire has demonstrated good validity across diverse populations and shown consistency with observed measures of infant temperament.

The IBQ-R VSF measures three dimensions of infant temperament: Surgency/ Extraversion, Negative Affectivity, and Orientation/Regulation Capacity. For the purposes of this study, only the Surgency/Extraversion and Negative Affectivity dimensions will be explored. Surgency/Extraversion ($\alpha = 0.77$) is characterized by impulsivity, high activity level, high-intensity pleasure, and low shyness (Example item: "How often during the week did your baby move quickly toward new objects?"). Negative Affectivity ($\alpha = 0.78$) is characterized by sadness, distress to limitations, and fear (Example item: "When you were busy with another activity, and your baby was not able to get your attention, how often did s/he cry?"). All of the questionnaire items are scored on a Likert scale of 0-7, with 0 being "Never" and 7 being "Always."

3.9 Infant Eating Behavior

The Baby Eating Behavior Questionnaire (BEBQ) was used to assess infant eating behavior. The BEBQ is an 18-item instrument that has been adapted from the Children's Eating Behavior Questionnaire and validated for infants that are less than 2 years old (Llewellyn et al, 2011). The BEBQ has 4 subscales: enjoyment of food, food responsiveness, slowness in eating, and satiety responsiveness.

For this study, the enjoyment of food, food responsiveness, and satiety responsiveness subscales were used. All of the questionnaire items from each subscale are scored on a Likert scale of 0-5, with 0 being "Never" and 5 being "Always." The enjoyment of food subscale ($\alpha = 0.81$) contains 4 items which aim to measure the mother's perception of the infant's pleasure during eating (Example item: "My baby enjoys feeding time"). The food responsiveness subscale ($\alpha = 0.79$) has 5 items which help assess infant self-regulation and infant eating based off external cues instead of hunger/satiety cues (Example item: "Even when my baby has just eaten well, s/he is happy to be fed again if offered"). The satiety responsiveness subscale ($\alpha = 0.73$) contains 2 items and aims to measure infant expression of satiation (Example item: My baby gets full before taking all the milk I thought s/he should have").

3.10 Anthropometric Measures and Weight Z-scores

Infant weight and length at birth were given as self-reported measurement from the mother. Infant weight and length at study entry were measured in the lab using triplicate measures on an infant scale/infantometer (models 233, 360, and 374; Seca) and then averages of the triplicate values were calculated. The average weight and length values were normalized to sex- and age-specific z scores using World Health Organization Anthro software, version 3.2.2 (WHO, 2006). Infant weight-for-length z-scores (WLZ) were calculated to include into the analyses because WLZ accounts for the infant's weight as well as their length and is a more robust measurement than weight-for-age z-score (WAZ). WAZ scores were also calculated since these values are more commonly used to identify rapid weight gain (RWG) during infancy (Zheng et al, 2018). Changes in WLZ (ΔWLZ) and WAZ (ΔWAZ) from birth to study entry were calculated. Maternal weight and height at study entry were also measured in the lab with an adult scale/stadiometer (Tanita BWB-800, model 736; Seca and Healthometer) using triplicate measures and the averages were taken to calculate maternal Body Mass Index (BMI = weight [kg]/height [m]^2).

3.11 Additional measures

A family demographics questionnaire was designed specifically for each study. These questionnaires assessed income, education, race/ethnicity, participation in federal assistance programs (i.e. WIC), marital status, parity of children, maternal age, and infant age.

3.12 Statistical Analyses

Statistical analyses were performed using JMP Pro version 14 (JMP, Cary, NC). Preliminary analyses using stepwise regressions were conducted to identify which sociodemographic variables were significant predictors of change in weight-for-length z-score (ΔWLZ), change in weight-for-age z-score (ΔWAZ), and rapid weight gain (RWG). Analyses revealed birth WLZ, maternal race/ethnicity, and parity were all significantly related to the ΔWLZ and therefore were included in all predictive models. The preliminary analyses for ΔWAZ and RWG did not reveal any significant sociodemographic covariates. However, in the interest of maintaining consistency among all predictive models examining associations between the use of FTS and measures of infant weight gain, the same significant sociodemographic variables that were identified in the preliminary analyses for ΔWLZ were also used for all predictive models for ΔWAZ and RWG (i.e. birth WAZ, infant age, race/ethnicity, and parity) to ensure that demographic variables were accounted for. Additionally, infant age at study entry was also included in all predictive models to control for the variance in time that elapsed from birth to study entry.

To test for associations between FTS and infant weight gain, unadjusted and adjusted regression models were used to assess the use of FTS predicting ∆WLZ and ∆WAZ from birth to study entry. Logistic regression models were used to assess the use of FTS predicting RWG. The RWG variable was a binary, yes or no variable. Infants who experienced a ∆WAZ greater than 0.67 were coded as RWG, and infants who experienced a ∆WAZ less than or equal to 0.67 were coded as non-RWG.

To test the association of FTS with feeding type (exclusive breastfeeding [BF], exclusive formula-feeding [FF], or mixed feeding [MF]), a one-way ANOVA was conducted. To test for the association of FTS with bottle-feeding intensity (percentage of daily feedings from bottles), a linear regression was used as well as one-way ANOVA to assess differences in mean score for the use of FTS by level of bottle feeding (3 Groups: <20%, 20-80%, and >80% daily feedings from bottle). To test whether feeding type or bottle-feeding intensity moderated the relationship between the use of FTS and infant conditional weight gain, linear and logistic regressions were used. Linear regression models were used to predict either WLZ or WAZ by use of FTS, feeding type, and the interaction between FTS and feeding type. Linear regression models were also used to predict either WLZ or WAZ by use of FTS, bottle-feeding intensity, and the interaction between FTS and bottle-feeding intensity. Logistic regression models were used to predict RWG by use of FTS, feeding type, and the interaction between FTS and feeding type. Logistic regression models were also used to predict RWG by use of FTS, bottle-feeding intensity, and the interaction between FTS and bottle-feeding intensity. For each model, birth weight z-score, infant age, race/ethnicity, and parity were included as covariates.

To test for the association of FTS and maternal characteristics, individual correlations of FTS and maternal sensitivity to cues, responsiveness to distress, and maternal-reported responsive and pressuring feeding styles were analyzed. Preliminary analyses using stepwise regressions were conducted to identify which sociodemographic variables were significant predictors of FTS. These analyses revealed mother's age, mother's pre-pregnancy BMI, and the study were all significantly related to the use of FTS and therefore were included in all predictive models. Multiple regression was used to examine which characteristics (maternal sensitivity to cues, responsiveness to distress, and maternal-reported responsive and pressuring feeding styles) were most predictive of the use of FTS.

To test for the associations of FTS and infant characteristics, individual correlations of FTS and infant clarity of cues, responsiveness to caregiver, temperament, food responsiveness, enjoyment of food, and satiety responsiveness were analyzed. The same covariates used in the maternal model (mother's age, mother's pre-pregnancy BMI, and study) were use in the predictive models. Multiple regression was used to examine which infant characteristics were most predictive of the use of FTS. A final model that combined both maternal and infant characteristics was used to explore which characteristics were most predictive for the use of FTS.

Chapter IV

RESULTS

4.1 Demographics

Sample characteristics are presented in Table 4.1. The mean age for infants was 14.8 weeks (SD = 7.1, range = 1.7 - 31.0 weeks). The mean age for mothers was 30.6 years (SD = 5.2, range = 18.0 – 40.4 years). Most dyads were living in California (78.4%) and most mothers reported a race/ethnicity of Non-Hispanic White (59.7%), a family income greater than $75,000 (50.4%), completion of a Bachelor's or Graduate degree (62.9%), being of married status (74.4%), being primiparous (54.5%), and having a normal BMI (56.9%). Approximately 63% of mothers were exclusively breastfeeding, 18.7% were exclusively formula feeding, and 17.9% were using a combination of both breast- and formula feeding. Additionally, 46% of mothers reported giving <20% of daily feedings from a bottle, 28.2% reported giving 20-80% from a bottle, and 26.0% reported giving >80% from a bottle.

The mean weight-for-length z-score (WLZ) at birth was -0.6 (SD = 1.5, range = -4.4 – 3.5) and the mean WLZ at study entry was 0.2 (SD = 1.1, range = -1.8 – 2.7). The mean change in WLZ from birth to study entry was 0.8 (SD = 1.8, range = -4.8 – 6.0). The mean weight-for-age z-score (WAZ) at birth was 0.3 (SD = 0.9, range = -1.8 – 3.2) and the mean WAZ at study entry was 0.0 (SD = 0.8, range = -1.6 – 1.9). The mean change in WAZ from birth to study entry was -0.3 (SD = 1.0, range = -3.1 – 3.2). Among the sample of 134 infants, 21 (15.7%) experienced rapid weight gain, defined as a change in WAZ greater than 0.67, during the time from birth to study entry.

Table 4.1

Characteristics of Mothers and Infants who Participated in Infant Feeding Studies

	n	%
Demographics		
Infant Sex		
Male	68	50.7
Female	66	49.3
Study Location		
California	105	78.4
Pennsylvania	29	21.6
Family Income		
Less than $15,000	24	19.2
$15,000 - $35,000	24	19.2
$35,000 – $75,000	14	11.2
Greater than $75,000	63	50.4
WIC Status		
WIC Participant	39	29.5
Non-WIC	93	70.5
Education		
Did not complete High School	2	1.5
High School Degree	21	15.9
Some college/ Vocational Degree	26	19.7
Bachelor’s or Graduate Degree	83	62.9
Race/Ethnicity		
Non-Hispanic White	80	59.7
Non-Hispanic Black	21	15.7
Hispanic	12	9.0
Other	21	15.7
Marital Status		
Married	99	74.4
Unmarried	34	25.6
Parity		
Primiparous	72	54.5
Multiparous	60	45.5
Pre-Pregnancy BMI		
Overweight or Obese	56	43.1
Not Overweight or Obese	74	56.9
Feeding Type		
Breast feeding	85	63.4
Formula feeding	25	18.7
Mixed feeding	24	17.9
Bottle Feeding Intensity		
Low [a]	60	45.8
Medium [b]	37	28.2
High [c]	34	26.0

BMI, Body Mass Index or a weight-to-height ratio using a person’s mass in kilograms and height in centimeters (BMI = weight [kg]/height [m]^2), WIC = Supplemental Nutrition Program for Women, Infants, and Children,
[a] Low bottle-feeding intensity defined as <20% of daily feedings from a bottle, [b] Medium bottle-feeding intensity defined as 20-80% of daily feedings from a bottle, [c] High bottle-feeding intensity defined as >80% of daily feedings from a bottle.

4.2 Use of FTS

As shown in Table 4.2, the average FTS score was a 2.6 (SD = 1.0, Range = 1 - 5) on a possible scoring scale of 1 to 5, with higher scores representing more frequent use of FTS across a variety of contexts. The sample distribution of scores for use of FTS are presented in Figure 4.1. Correlations between use of FTS and other relevant variables are presented in in Table 4.3. Use of FTS was significantly associated with the percent of daily feedings from a bottle ($r = -0.20$, $p = 0.021$), maternal-reported pressuring feeding style ($r = 0.20$, $p = 0.0198$), and infant negativity ($r = 0.41$, $p < 0.001$).

Table 4.2

Descriptive Statistics for Use of Food to Soothe (FTS) and Other Maternal and Infant Characteristics

	Mean	SD	Sample Range
Maternal Characteristics			
Maternal-Reported			
Food to Soothe (FTS) [a]	2.6	1.0	1.0 – 5.0
Pressuring Feeding [a]	2.0	0.5	1.1 – 3.9
Responsive Feeding [a]	4.1	0.5	2.2 – 5.0
Observed			
Sensitivity to Infant Cues [b]	13.6	2.0	6.0 – 16.0
Response to Distress [c]	9.8	1.4	6.0 – 11.0
Infant Characteristics			
Maternal-Reported			
Surgency [e]	4.5	1.0	1.8 – 6.9
Negativity [e]	4.1	1.1	1.1 – 6.8
Appetite [a]	3.4	1.0	1.0 – 5.0
Enjoyment of Food [a]	4.4	0.6	2.0 – 5.0
Food Responsiveness [a]	2.5	0.8	1.0 – 4.5
Satiety Responsiveness [a]	2.4	0.7	1.0 – 5.0
Observed			
Clarity of Cues [d]	12.3	1.7	4.0 – 15.0
Responsiveness to Caregiver [c]	6.5	2.0	1.0 – 10.0

[a] Possible score range = 1 to 5, [b] Possible score range = 0 to 16, [c] Possible score range = 0 to 11, [d] Possible score range = 0 to 15, [e] Possible score range = 1 to 7

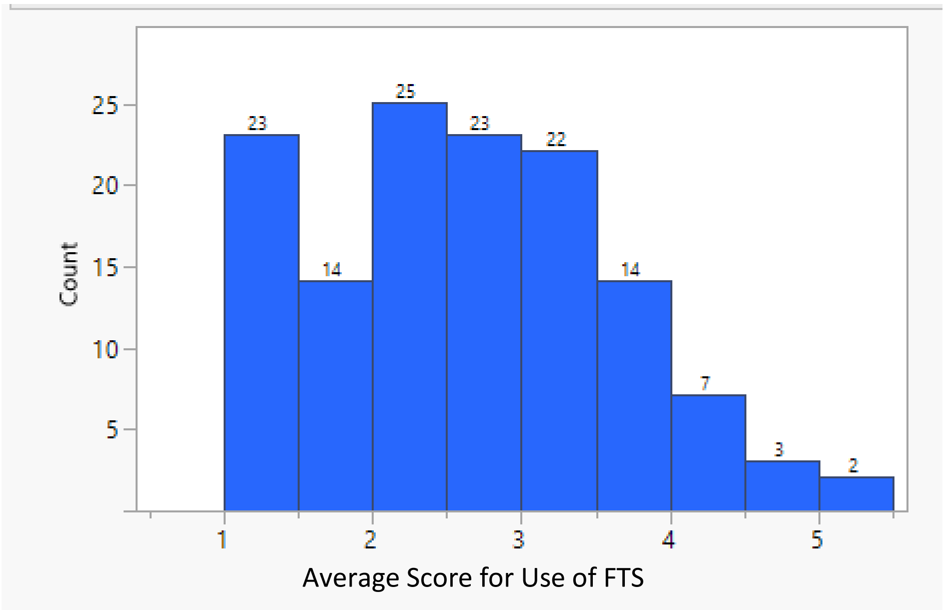

Figure 4.1

Sample Distribution of Use of Food to Soothe (FTS) Scores

Table 4.3
Intercorrelations Among Study Variables

Variable	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. FTS	.01	-.02	-.03	-.05	.06	-.10	**-.20***	-.05	**.20***	.09	.02	.19	.07	**.41***	.06	.10	.10	.09
2. Δ WLZ		**.55***	**-.79***	**.58***	**.30***	**-.38***	**.19***	-.10	.03	-.03	-.11	**-.16**†	-.02	-.05	-.07	**.15**†	**-.16**†	**-.17**†
3. V1 WLZ			.08	**.61***	**.67***	-.08	**.28***	.02	.04	-.11	-.08	-.06	-.05	**-.17**†	-.10	.14	**-.15**†	**-.29***
4. Birth WLZ				**-.24***	.14	**.39***	-.01	.14	-.01	-.04	.07	.14	-.01	-.06	.01	-.07	.09	-.01
5. Δ WAZ					**.52***	**-.65***	**.16**†	.06	-.11	.08	-.09	-.12	-.06	**-.17**†	-.05	.11	**-.26***	**-.20***
6. V1 WAZ						**.32***	.09	.12	-.09	.03	.02	-.04	-.10	-.01	.05	-.01	**-.17**†	**-.24***
7. Birth WAZ							-.10	.04	.04	-.06	.02	.08	.08	**.17***	.10	-.13	.13	.00
8. % Bottle								-.08	**.22***	**-.48***	-.05	**-.19***	**-.15**†	**-.28***	-.01	-.06	-.05	-.09
Maternal Characteristics																		
Maternal-Reported																		
9. Responsive Feeding									.07	.10	-.03	-.03	-.01	-.12	-.02	-.07	-.08	.04
10. Pressuring Feeding										**-.28***	-.14	-.14	**-.30***	-.01	.01	.02	**.22***	-.00
Observed																		
11. Sensitivity to Infant Cues											**.28***	**.45***	**.53***	**.19***	.10	.07	-.14	.03
12. Response to Distress												.12	**.15**†	.09	.07	-.12	-.06	.04
Infant Characteristics																		
Observed																		
13. Clarity of Cues													**.56***	**.17**†	**.15**†	**.22***	-.06	.05
14. Response to Caregiver														**.19***	**.25***	.06	-.16	.12
Maternal-Reported																		
15. Negativity															**.40***	**-.16**†	**.25***	**.25***
16. Surgency																-.01	-.07	.07
17. Enjoyment of Food																	-.10	**-.33***
18. Food Responsiveness																		**.21***
19. Satiety Responsiveness																		------

Birth WAZ = the infant's weight-for-age z-score at birth, Birth WLZ = the infant's weight-for-length z-score at birth, % Bottle = percent of daily feedings from a bottle, FTS = average reported score for use of food to soothe, V1 WAZ = the infant's weight-for-age z-score at study entry, V1 WLZ = the infant's weight-for-length z-score at study entry, Δ WAZ = the difference between the infant's WAZ at the first study visit and the infant's WAZ at birth, Δ WLZ = the difference between the infant's WLZ at the first study visit and the infant's WLZ at birth, $^{\dagger}p < .10$, $^{*}p < .05$

4.3 Use of FTS and Change in Infant Weight-for-Length Z-score (ΔWLZ)

The overall values for change in infant weight-for-length z-score (ΔWLZ) were normally distributed (Figure 4.2). The mean ΔWLZ was 0.8 (SD = 1.8, Range = -4.9 - 6.0). Correlations between ΔWLZ and other relevant variables are presented in Table 4.3. ΔWLZ was significantly associated with the percent of daily feedings from a bottle (r = 0.19, p = 0.034). These results suggest that as percent of daily feedings from a bottle increases, infant ΔWLZ also increases. There was a trend toward negative associations between ΔWLZ and infant clarity of cues (r = -0.16, p = 0.078), infant enjoyment of food (r = 0.15, p = 0.092), infant food responsiveness (r = -0.16, p = 0.061), and infant satiety responsiveness (r = -0.17, p = 0.056).

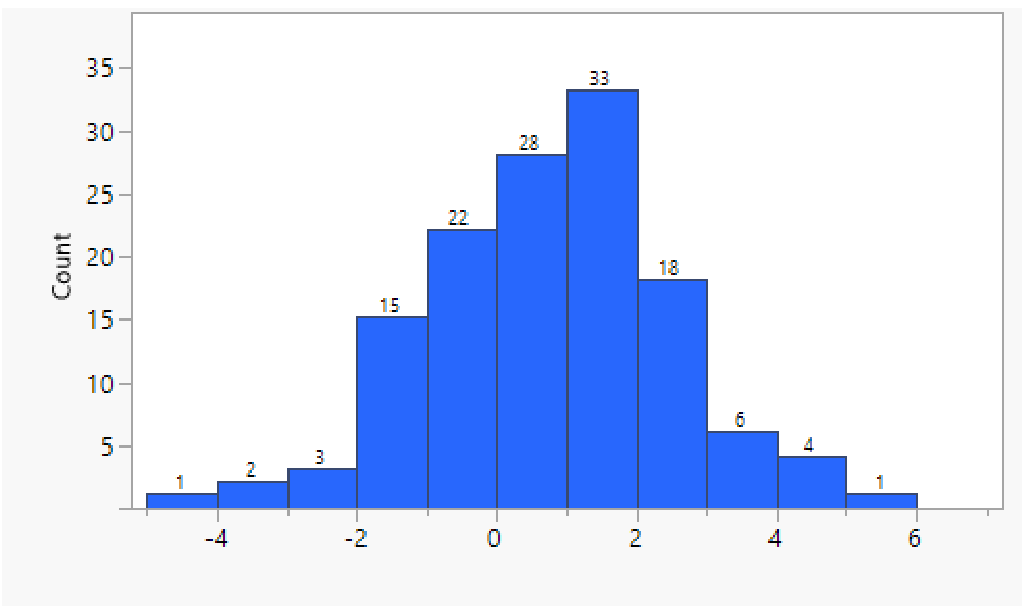

Figure 4.2

Sample Distribution of Change in Weight-for-Length Z-Score (ΔWLZ)

Preliminary analyses using stepwise regressions were conducted to identify which sociodemographic variables were significant predictors of ΔWLZ. These analyses revealed birth WLZ, maternal race/ethnicity, and parity were all significantly related to the ΔWLZ and therefore were included as covariates in all predictive models. Infant age at study entry was also included in the model to control for variance in time that elapsed from birth to study entry.

In a linear regression model regressing ΔWLZ on the use of FTS, the use of FTS was not a significant predictor of infant ΔWLZ (F [1,131] = 0.02, p = 0.902). The multiple regression analysis results showed that the use of FTS was not a significant predictor of infant ΔWLZ when adjusting for sociodemographic variables (F [1,129] = 0.09, p = 0.760).

Table 4.4

Multiple Regression Models for Food to Soothe (FTS) Predicting Change in Weight-for-Length Z-score (ΔWLZ)

	Unadjusted Analysis [a]		**Adjusted Analysis [b]**	
	Estimate	**Std Error**	**Estimate**	**Std Error**
Intercept	0.72	0.43	**0.56**†	0.32
FTS	0.02	0.16	0.03	0.09
Birth WLZ			**-0.94*** **	0.06
Infant Age			-0.01	0.01
Race/Ethnicity				
Non-Hispanic White			Reference	-----
Non-Hispanic Black			**0.89*** **	0.26
Hispanic			**0.74***	0.31
Other			-0.12	0.25
Parity				
Primiparous			Reference	-----
Multiparous			**0.53****	0.18

Birth WLZ = the infant’s weight-for-length z-score (WLZ) at birth.
[a] R^2 = 0.00, F = 0.02, p = .902; [b] R^2 = 0.71, F = 42.07, p < .001
†p < .10, *p < .05, **p < .01, ***p < .001

4.4 Use of FTS and Change in Infant Weight-for-Age Z-score (ΔWAZ)

The overall values for change in infant weight-for-age z-score (ΔWAZ) were normally distributed (Figure 4.3). The mean ΔWAZ was -0.3 (SD = 0.99, Range = -3.1 - 3.1). Correlations between ΔWAZ and other relevant variables are presented in Table 4.3. ΔWAZ was significantly associated with the infant's food responsiveness (r = - 0.26, p = 0.003) and satiety responsiveness (r = - 0.20, p = 0.023). These findings suggest that as infant food responsiveness and satiety responsiveness increase, infant ΔWAZ decreases. There was a trend toward an association between ΔWAZ and infant negativity (r = -0.17, p = 0.054) and percent of daily feedings from a bottle (r = 0.16, p = 0.064).

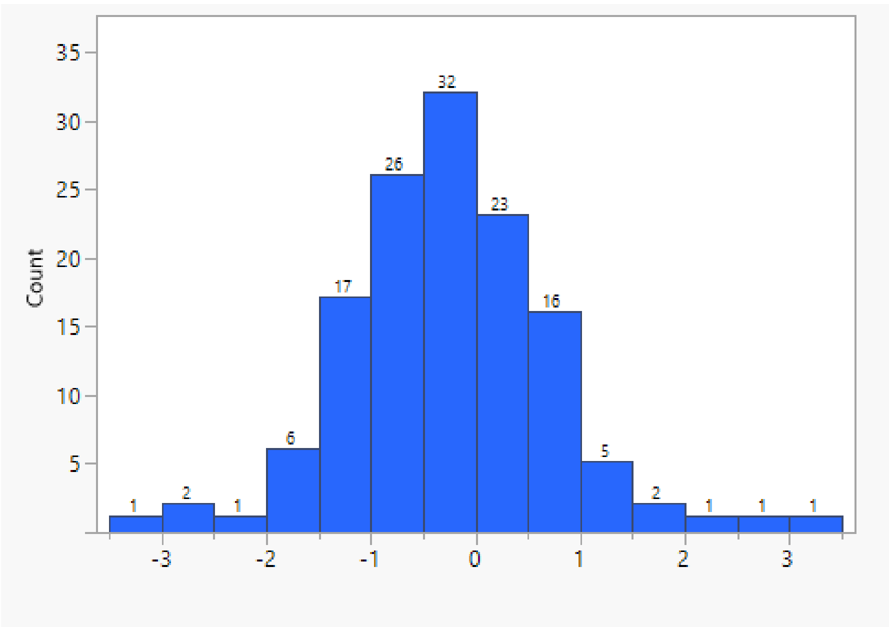

Figure 4.3

Sample Distribution of Change in Weight-for-Age Z-Score (ΔWAZ)

Preliminary analyses using stepwise regressions were conducted to identify which sociodemographic variables were significant predictors of ΔWAZ. These analyses revealed that no sociodemographic variables were significantly related to ΔWAZ. In the interest of maintaining consistency among models examining associations between the use of FTS and measures of infant weight gain, the same significant sociodemographic that were identified in the preliminary analyses for ΔWLZ were included as covariates for all predictive models for ΔWAZ (birth WAZ, infant age, race/ethnicity, and parity) to ensure that demographic variables were accounted for.

In a linear regression model regressing ΔWAZ on the use of FTS, the use of FTS was not a significant predictor of infant ΔWAZ (F [1,132] = 0.27, p = 0.606). The multiple regression analysis results showed that the use of FTS was not a significant predictor of infant ΔWAZ when adjusting for certain sociodemographic variables (F [1,130] = 0.34, p = 0.559).

Table 4.5

Multiple Regression Models for Food to Soothe (FTS) Predicting Change in Weight-for-Age Z-score (ΔWAZ)

	Unadjusted Analysis [a]		**Adjusted Analysis** [b]	
	Estimate	**Std Error**	**Estimate**	**Std Error**
Intercept	-0.17	0.23	-0.30	0.24
FTS	-0.04	0.08	0.04	0.07
Birth WAZ			**-0.70*** **	0.07
Infant Age			0.01	0.01
Race/Ethnicity				
Non-Hispanic White			Reference	-----
Non-Hispanic Black			0.16	0.19
Hispanic			0.41	0.22
Other			-0.12	0.18
Parity				
Primiparous			Reference	-----
Multiparous			0.20	0.13

Birth WAZ = the infant's weight-for-age z-score at birth
[a] $R^2 = 0.00$, F = 0.27, p = .606; [b] $R^2 = 0.44$, F = 14.04, p < .001
†p < .10, *p < .05, **p < .01, ***p < .001

4.5 Use of FTS and Rapid Infant Weight Gain (RWG)

Among the sample of 134 infants, 21 infants (16%) experienced rapid weight gain (RWG) from birth to study entry, defined as a change in weight-for-age z-score (ΔWAZ) greater than 0.67. As illustrated in Figure 4.4, a two-sample T-test examining the difference in use of FTS score between infants who exhibited RWG versus infants who did not, without controlling for covariates, revealed that infants in the RWG group had a significantly lower score for use of FTS (M = 2.24, SD = 0.83) than the non-RWG group (M = 2.65, SD = 1.00; t = 1.97, p = 0.029).

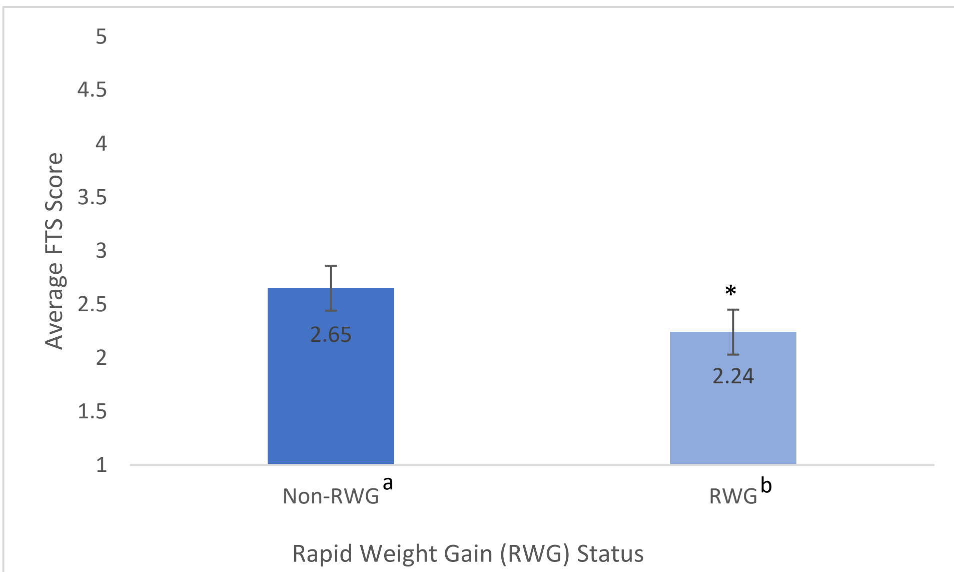

Figure 4.4

Two-Sample T-test Results for Use of Food to Soothe (FTS) by Rapid Weight Gain (RWG) Status

[a] Non-RWG = Non-rapid weight gain, defined by a change in weight-for-age z-score less than or equal to 0.67
[b] RWG = Rapid weight gain, defined by a change in weight for age z-score greater than 0.67
* RWG group had a significantly lower score for use of FTS than Non-RWG group at the $p < .05$

Preliminary analyses using stepwise regressions were conducted to identify which sociodemographic variables were significant predictors of RWG. These analyses revealed that no sociodemographic variables were significantly related to RWG. In the interest of maintaining consistency among models examining associations between the use of FTS and measures of infant weight gain, the same significant sociodemographic that were identified in the preliminary analyses for ΔWLZ and ΔWAZ were included as covariates for all predictive models for RWG (birth WAZ, infant age, race/ethnicity, and parity) to ensure that demographic variables were accounted for.

In a simple logistic regression model regressing RWG on the use of FTS, the use of FTS was not a significant predictor of infant RWG (OR = 0.63, 95% CI: 0.37 – 1.07). When adjusting for sociodemographic variables, the logistic regression analysis showed that the use of FTS was not a significant predictor of infant RWG (OR = 0.85, 95% CI: 0.45-1.61).

Table 4.6

Logistic Regression Models for Food to Soothe (FTS) Predicting Rapid Weight Gain (RWG)

	Unadjusted Analysis [a]		Adjusted Analysis [b]	
	Estimate	**Std Error**	**Estimate**	**Std Error**
Intercept	-0.61	0.67	**-3.02*** **	1.17
FTS	**-0.46†**	0.27	-0.16	0.32
Birth WAZ			**-1.93*** **	0.47
Infant Age			**0.10***	0.05
Race/Ethnicity				
Non-Hispanic White			Reference	-----
Non-Hispanic Black			1.07	0.84
Hispanic			1.13	0.89
Other			-1.50	1.20
Parity				
Primiparous			Reference	-----
Multiparous			0.47	0.65

Birth WAZ = the infant's weight-for-age z-score at birth
[a] $R^2 = 0.03$, $\chi^2 = 3.09$, p = .079; [b] $R^2 = 0.34$, $\chi^2 = 38.41$, p < .001
†p < .10, *p < .05, **p < .01, ***p < .001

4.6 Use of FTS by Feeding Type and Bottle-feeding Intensity

To assess whether feeding type (exclusive breastfeeding, exclusive formula feeding, or mixed feeding) predicted FTS, a one-way between subject ANOVA was conducted. The results showed that there was a statistically significant difference between groups (F[2,132] = 3.07, p = 0.049). A Tukey post hoc test revealed that the average score for use of FTS was significantly lower for the exclusively formula feeding group (M = 2.20, SD = 0.20) compared to the mixed feeding group (M = 2.87, SD = 0.20) (Figure 4.5). The average score for use of FTS in the exclusively formula feeding group was also lower than the exclusively breastfeeding group (M = 2.62, SD = 0.20), however this difference was not significant (p = 0.141).

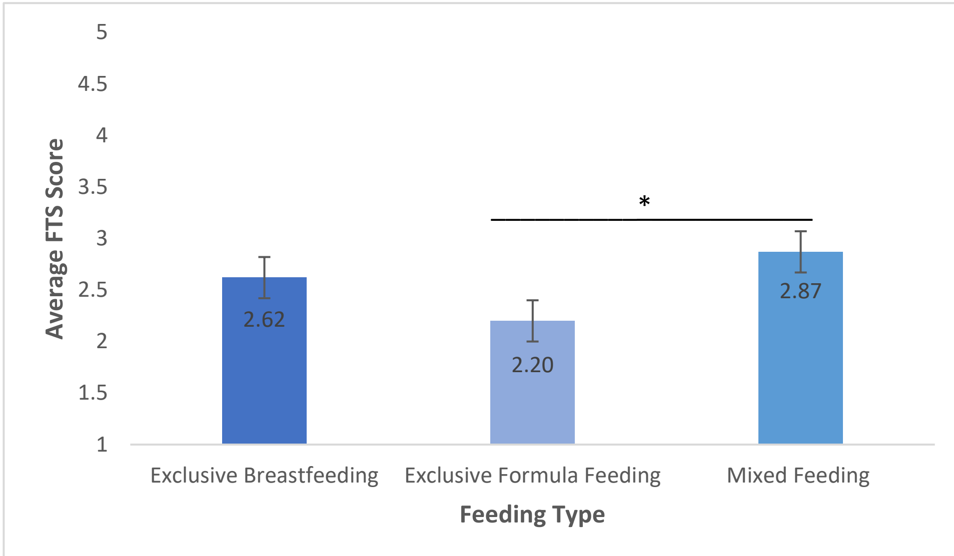

Figure 4.5

ANOVA Results to test for Use of Food to Soothe (FTS) by Feeding Type

* Significant difference of FTS score among Exclusive Formula Feeding group compared to Mixed Feeding group at the $p < .05$

To assess whether feeding mode or bottle-feeding intensity predicted the maternal-reported score for FTS, a one-way between subject ANOVA was conducted (3 groups: <20%, 20-80%, or >80% of daily feedings from a bottle). The results showed that there was not a statistically significant difference between groups ($F[2,129] = 1.72$, $p = 0.183$) (Figure 4.6).

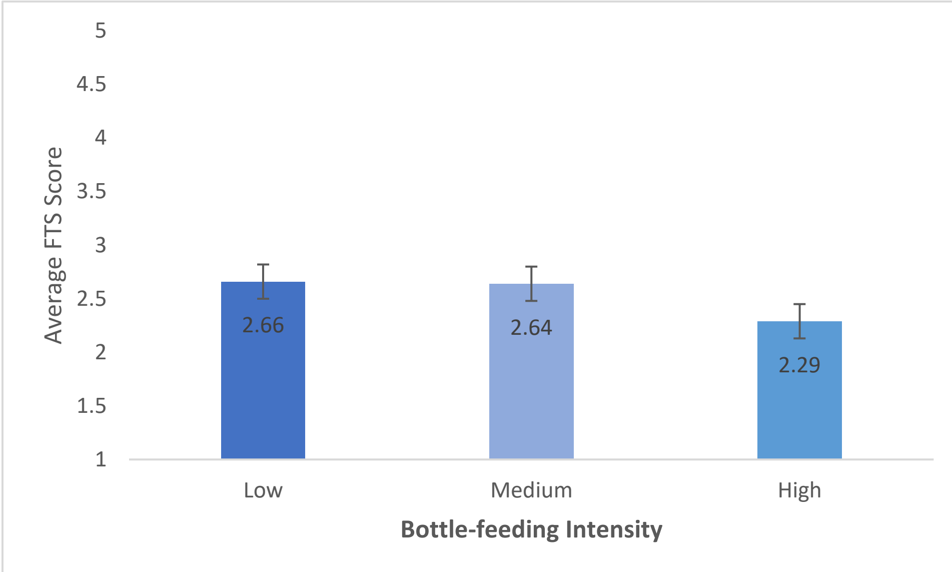

Figure 4.6

ANOVA Results to test for Use of Food to Soothe (FTS) by Bottle-feeding Intensity [a]

[a] Bottle-feeding intensity = percent of daily feedings from a bottle, with low intensity defined as <20% of daily feedings from a bottle, medium intensity defined as 20-80% of daily feedings from a bottle, and high intensity defined as >80% of daily feedings from a bottle

4.7 Feeding Type and/or Bottle-feeding Intensity Moderating the Relationship of FTS and ΔWLZ

Multiple regression was used to assess whether the use of FTS, feeding type, and/or the interaction effect between feeding type and FTS predicted ΔWLZ. In the unadjusted model, neither the use of FTS ($F[1,131] = 0.38$, $p = 0.539$) nor feeding type ($F[2,131] = 2.0$, $p = 0.140$) significantly predicted ΔWLZ. Additionally, there was no significant interaction effect for these two variables ($F [2,131] = 1.49$, $p = 0.230$). When adjusting for relevant sociodemographic variables (birth WLZ, infant age, maternal race/ethnicity, and parity), neither the use of FTS ($F[1,129] = 0.32$, $p = 0.578$) nor feeding type ($F[1,129] = 0.49$, $p = 0.614$) significantly predicted ΔWLZ. Additionally, there was no significant interaction effect for these two variables predicting ΔWLZ (F [2,129] = 0.78, p = 0.460).

Table 4.7

Multiple Regression Results for Interaction of Food to Soothe (FTS) and Feeding Type Predicting Change in Weight-for-Length Z-score (ΔWLZ)

	Unadjusted Analysis [a]		**Adjusted Analysis** [b]	
	Estimate	**Std Error**	**Estimate**	**Std Error**
Intercept	0.58	0.48	0.41	0.35
FTS	0.11	0.17	0.06	0.10
Feeding Type				
BF	Reference	-----	Reference	-----
FF	**0.83***	0.42	0.03	0.35
MF	0.06	0.41	-0.22	0.24
FTS [c] *x Feeding Type*				
FTS x BF	Reference	-----	Reference	-----
FTS x FF	-0.29	0.39	-0.13	0.23
FTS x MF	0.51	0.40	0.21	0.23
Birth WLZ			**-0.93*** **	0.06
Infant Age			-0.01	0.01
Race/Ethnicity				
Non-Hispanic White			Reference	-----
Non-Hispanic Black			**0.87***	0.36
Hispanic			**0.77***	0.32
Other			-0.14	0.26
Parity				
Primiparous			Reference	-----
Multiparous			**0.25****	0.09

Birth WLZ = the infant's weight-for-length z-score at birth BF = exclusively breastfeeding, FF = exclusively formula-feeding, MF = mixed feeding

[a] $R^2 = 0.06$, F = 1.73, p = .1320; [b] $R^2 = 0.71$, F = 42.07, p < .0001, [c] Within the interaction, FTS was mean-centered

†p < .10, *p < .05, **p < .01, ***p < .001

Multiple regression was also used to assess whether the use of FTS, bottle-feeding intensity, and/or the interaction effect between bottle-feeding intensity and FTS predicted ΔWLZ. In the unadjusted model, neither the use of FTS (F [1,128] = 0.33, p = 0.565) nor bottle-feeding intensity (F [2,128] = 1.41, p = 0.248) significantly predicted ΔWLZ.

Additionally, there was no significant interaction effect for these two variables (F [2,128] = 2.37, p = 0.098). When adjusting for relevant sociodemographic variables, neither the use of FTS (F [1,126] = 0.14, p = 0.710) nor bottle-feeding intensity (F [2,126] = 0.14, p = 0.872) significantly predicted ΔWLZ. Additionally, there was no significant interaction effect for these two variables predicting ΔWLZ (F [2,126] = 0.31, p = 0.736).

Table 4.8

Multiple Regression Results for Interaction of Food to Soothe (FTS) and Bottle-feeding Intensity Predicting Change in Weight-for-Length Z-score (ΔWLZ)

	Unadjusted Analysis [a]		**Adjusted Analysis [b]**	
	Estimate	**Std Error**	**Estimate**	**Std Error**
Intercept	0.54	0.45	0.53	0.34
FTS	0.09	0.16	0.04	0.10
Bottle-Feeding Intensity [c]				
Low [d]	Reference	-----	Reference	-----
Medium [e]	0.31	0.37	0.03	0.22
High [f]	0.64	0.39	0.15	0.29
FTS [g] x Bottle-Feeding Intensity				
FTS x Low	Reference	-----	Reference	-----
FTS x Medium	**0.75†**	0.41	0.19	0.24
FTS x High	-0.13	0.37	0.04	0.22
Birth WLZ			**-0.93*****	0.06
Infant Age			-0.01	0.01
Race/Ethnicity				
Non-Hispanic White			Reference	-----
Non-Hispanic Black			**0.81***	0.33
Hispanic			**0.69***	0.32
Other			-0.10	0.27
Parity				
Primiparous			Reference	-----
Multiparous			**0.55****	0.19

Birth WLZ = the infant's weight-for-length z-score at birth

[a] $R^2 = 0.06$, F = 1.69, p = .1412; [b] $R^2 = 0.68$, F = 25.61, p < .0001

[c] Bottle-feeding intensity = percent of daily feedings from a bottle, [d] Low bottle-feeding intensity defined as <20% of daily feedings from a bottle, [e] Medium bottle-feeding intensity defined as 20-80% of daily feedings from a bottle, [f] High bottle-feeding intensity defined as >80% of daily feedings from a bottle, [g] Within the interaction, FTS was mean-centered

†p < .10, *p < .05, **p < .01, ***p < .001

4.8 Feeding Type and/or Bottle-feeding Intensity Moderating the Relationship of FTS and ΔWAZ

Multiple regression was used to assess whether the use of FTS, feeding type, and/or the interaction effect between feeding type and FTS predicted ΔWAZ (Table 4.9). In the unadjusted model, neither the use of FTS ($F[1,132] = 0.03$, $p = 0.871$) nor feeding type ($F[2,132] = 0.91$, $p = 0.407$) significantly predicted ΔWAZ. Additionally, there was no significant interaction effect for these two variables ($F [2,132] = 2.00$, $p = 0.14$). When adjusting for relevant sociodemographic variables (birth WAZ, infant age, maternal race/ethnicity, and parity), neither the use of FTS ($F[1,130] = 0.67$, $p = 0.415$) nor feeding type ($F[2,130] = 0.65$, $p = 0.526$) significantly predicted ΔWAZ. Although close to reaching significance, there was also no statistically significant interaction effect for the use of FTS and feeding type predicting ΔWAZ ($F [2,130] = 2.93$, $p = 0.057$).

Table 4.9

Multiple Regression Results for Interaction of Food to Soothe (FTS) and Feeding Type Predicting Change in Weight-for-Age Z-score (ΔWAZ)

	Unadjusted Analysis [a]		**Adjusted Analysis** [b]	
	Estimate	**Std Error**	**Estimate**	**Std Error**
Intercept	-0.22	0.26	-0.47	0.25
FTS	-0.02	0.09	0.06	0.07
Feeding Type				
BF	Reference	-----	Reference	-----
FF	0.30	0.23	-0.08	0.26
MF	-0.01	0.22	-0.20	0.18
FTS [c] *x Feeding Type*				
FTS x BF	Reference	-----	Reference	-----
FTS x FF	-0.25	0.21	-0.24	0.17
FTS x MF	0.26	0.22	0.26	0.17
Birth WAZ			**-0.69*** **	0.07
Infant Age			**0.02†**	0.01
Race/Ethnicity				
Non-Hispanic White			Reference	-----
Non-Hispanic Black			0.21	0.27
Hispanic			0.47	0.24
Other			-0.16	0.18
Parity				
Primiparous			Reference	-----
Multiparous			0.15	0.14

Birth WAZ = the infant's weight-for-age z-score at birth, BF = exclusively breastfeeding, FF = exclusively formula-feeding, MF = mixed feeding

[a] R^2 = 0.06, F = 1.51, p = .1904; [b] R^2 = 0.47, F = 9.72, p < .0001

[c] Within the interaction, FTS was mean-centered

†p < .10, *p < .05, **p < .01, ***p < .001

Multiple regression was also used to assess whether the use of FTS, bottle-feeding intensity, and/or the interaction effect between bottle-feeding intensity and FTS predicted ΔWAZ (Table 4.10). In the unadjusted model, neither the use of FTS (F [1,129] = 0.13, p = 0.722) nor bottle-feeding intensity (F [2,129] = 0.85, p = 0.430) significantly predicted ΔWAZ. Additionally, there was no significant interaction effect for these two variables (F [2,129] = 0.51, p = 0.602). When adjusting for relevant sociodemographic variables, neither the use of FTS (F [1,127] = 0.31, p = 0.577) nor bottle-feeding intensity (F [2,127] = 0.63, p = 0.535) significantly predicted ΔWAZ. Additionally, there was no significant interaction effect for these two variables predicting ΔWAZ (F [2,127] = 0.69, p = 0.502).

Table 4.10

Multiple Regression Results for Interaction of Food to Soothe (FTS) and Bottle-feeding Intensity Predicting Change in Weight-for-Age Z-score (ΔWAZ)

	Unadjusted Analysis [a]		**Adjusted Analysis** [b]	
	Estimate	**Std Error**	**Estimate**	**Std Error**
Intercept	-0.20	0.24	-0.32	0.25
FTS	-0.03	0.09	0.04	0.07
Bottle-Feeding Intensity [c]				
Low [d]	Reference	-----	Reference	-----
Medium [e]	-0.02	0.20	-0.15	0.16
High [f]	0.25	0.21	0.08	0.21
FTS [g] *x Bottle-feeding Intensity*				
FTS x Low	Reference	-----	Reference	-----
FTS x Medium	0.06	0.22	0.09	0.18
FTS x High	-0.16	0.20	-0.13	0.16
Birth WAZ			**-0.70*** **	0.08
Infant Age			0.01	0.01
Race/Ethnicity				
Non-Hispanic White			Reference	-----
Non-Hispanic Black			0.02	0.24
Hispanic			0.38	0.24
Other			-0.09	0.19
Parity				
Primiparous			Reference	-----
Multiparous			0.16	0.14

Birth WAZ = the infant's WAZ at birth

[a] R^2 = 0.03, F = 0.72, p = .6127; [b] R^2 = 0.45, F = 8.78, p < .0001

[c] Bottle-feeding intensity = percent of daily feedings from a bottle, [d] Low bottle-feeding intensity defined as <20% of daily feedings from a bottle, [e] Medium bottle-feeding intensity defined as 20-80% of daily feedings from a bottle, [f] High bottle-feeding intensity defined as >80% of daily feedings from a bottle, [g] Within the interaction, FTS was mean-centered

†p < .10, *p < .05, **p < .01, ***p < .001

4.9 Feeding Type and/or Bottle-feeding Intensity Moderating the Relationship of FTS and RWG

Logistic regression was used to assess whether the use of FTS, feeding type, and/or the interaction effect between feeding type and FTS predicted RWG (Table 4.11). In the unadjusted model, the use of FTS was not a significant predictor of RWG (OR =

0.81, 95% CI 0.41 – 1.58). Compared to the exclusively breastfeeding group, the odds of RWG was not higher among the exclusively formula-feeding group (OR = 1.67, 95% CI 0.40 – 7.02) or the mixed feeding group (OR = 0.47, 95% CI 0.07 – 3.32). Additionally, there was no significant interaction effect for FTS and feeding type predicting RWG (p = 0.14). When adjusting for relevant sociodemographic variables (birth WAZ, infant age, maternal race/ethnicity, and parity), the use of FTS was not a significant predictor of RWG (OR = 1.09, 95% CI 0.48 – 2.44). Compared to the exclusively breastfeeding group, the odds of RWG was not higher among the exclusively formula feeding group (OR = 0.14, 95% CI 0.01 – 1.73) or the mixed feeding group (OR = 0.19, 95% CI 0.02 – 2.17). There was a trend toward significance for the interaction between the use of FTS and feeding type predicting RWG (p = 0.073).

Table 4.11

Logistic Regression Results for Interaction of Food to Soothe (FTS) and Feeding Type Predicting Rapid Weight Gain (RWG)

	Unadjusted Analysis [a]		Adjusted Analysis [b]	
	Estimate	**Std Error**	**Estimate**	**Std Error**
Intercept	-1.45	1.02	**-4.76****	1.63
FTS	-0.22	0.34	0.08	0.41
Feeding Type				
BF	Reference	-----	Reference	-----
FF	0.51	0.73	-1.99	1.30
MF	-0.76	1.00	-1.64	1.23
FTS [c] x Feeding Type				
FTS x BF	Reference	-----	Reference	-----
FTS x FF	-0.57	0.69	-1.06	0.89
FTS x MF	0.85	0.86	1.35	1.01
Birth WAZ			**-2.14 *****	0.53
Infant Age			**0.13***	0.05
Race/Ethnicity				
Non-Hispanic White			Reference	-----
Non-Hispanic Black			**2.86***	1.41
Hispanic			2.02	1.05
Other			-1.61	1.21
Parity				
Primiparous			Reference	-----
Multiparous			0.18	0.70

Birth WAZ = the infant's weight-for-age z-score at birth BF = exclusively breastfeeding, FF = exclusively formula-feeding, MF = mixed feeding

[a] $R^2 = 0.08$, $\chi^2 = 8.64$, p = .124; [b] $R^2 = 0.40$, $\chi^2 = 45.26$, p < .0001

[c] Within the interaction, FTS was mean-centered

†p < .10, *p < .05, **p < .01, ***p < .001

Logistic regression was also used to assess whether the use of FTS, bottle-feeding intensity, and/or the interaction effect between bottle-feeding intensity and FTS predicted RWG (Table 4.12). The results showed that without controlling for relevant sociodemographic variables, the use of FTS was not a significant predictor for RWG (OR = 0.64, 95% CI 0.34 – 1.19). Compared to the group with less than 20% of daily feedings from a bottle, the odds of RWG were not higher among the group with 20-80% of daily feedings from a bottle (OR = 0.79, 95% CI 0.21 – 2.91) or the group with greater than 80% of feedings from a bottle (OR = 0.99, 95% CI 0.21 – 4.53). Additionally, there was no significant interaction effect for FTS and bottle-feeding intensity predicting RWG (p = 0.368). When adjusting for relevant sociodemographic variables, the use of FTS was not a significant predictor of RWG (OR = 0.96, 95% CI 0.42– 2.16). Compared to the group with less than 20% of daily feedings from a bottle, the odds of RWG were not higher among the group with 20-80% of daily feedings from a bottle (OR = 0.25, 95% CI 0.04 – 1.57) or the group with greater than 80% of feedings from a bottle (OR = 0.09, 95% CI 0.01 – 1.16). Additionally, there was no significant interaction effect for FTS and bottle-feeding intensity predicting RWG (p = 0.124).

Table 4.12

Logistic Regression Results for Interaction of Food to Soothe (FTS) and Bottle-feeding Intensity Predicting Rapid Weight Gain (RWG)

	Unadjusted Analysis [a]		**Adjusted Analysis** [b]	
	Estimate	**Std Error**	**Estimate**	**Std Error**
Intercept	-0.81	0.78	-4.46	1.59
FTS	-0.45	0.32	-0.04	0.42
Bottle-feeding Intensity [c]				
Low [d]	Reference	-----	Reference	-----
Medium [e]	-0.24	0.66	-1.37	0.93
High [f]	-0.01	0.78	-2.44	1.32
FTS [g] *x Bottle-feeding Intensity*				
FTS x Low	Reference	-----	Reference	-----
FTS x Medium	0.59	0.74	1.50	1.02
FTS x High	-0.58	0.75	-0.83	0.96
Birth WAZ			**-2.47*** **	0.64
Infant Age			**0.15***	0.06
Race/Ethnicity				
Non-Hispanic White			Reference	-----
Non-Hispanic Black			**2.58†**	1.45
Hispanic			**2.07***	1.03
Other			-1.84	1.28
Parity				
Primiparous			Reference	-----
Multiparous			0.36	0.74

Birth WAZ = the infant's weight-for-age z-score at birth

[a] $R^2 = 0.06$, $\chi^2 = 6.78$, p = .237; [b] $R^2 = 0.43$, $\chi^2 = 46.14$, p < .0001

[c] Bottle-feeding intensity = percent of daily feedings from a bottle, [d] Low bottle-feeding intensity defined as <20% of daily feedings from a bottle, [e] Medium bottle-feeding intensity defined as 20-80% of daily feedings from a bottle, [f] High bottle-feeding intensity defined as >80% of daily feedings from a bottle, [g] Within the interaction, FTS was mean-centered

†p < .10, *p < .05, **p < .01, ***p < .001

4.10 Maternal Characteristics Predicting the Use of FTS

The intercorrelations for the use of FTS and maternal characteristics can be seen in Table 4.3. Use of FTS was significantly associated with maternal-reported pressuring feeding style ($r = 0.20$, $p = 0.020$). These results suggest that as maternal-reported pressuring feeding style increases, maternal-reported use of FTS also increases.

Preliminary analyses using stepwise regressions were conducted to identify which sociodemographic variables were significant predictors of FTS. These analyses revealed mother's age, mother's pre-pregnancy BMI, and study were all significantly related to the use of FTS and therefore were included as covariates in all predictive models.

Multiple regression was also used to assess which maternal characteristics most predicted the use of FTS (Table 4.13). Before adjusting for significant sociodemographic characteristics, only the mother's self-reported pressuring was a significant predictor of the mother's reported use of FTS ($F [1,128] = 8.62$, $p = 0.004$). After adjusting for significant sociodemographic characteristics, only the mother's self-reported pressuring was a significant predictor of the mother's reported use of FTS ($F [1,124] = 10.05$, $p = 0.002$). These results suggest that a higher score for pressuring feeding was predictive of a higher score for the use of FTS.

Table 4.13

Maternal Characteristics Predicting Use of Food to Soothe (FTS)

	Unadjusted Analysis [a]		**Adjusted Analysis** [b]	
	Estimate	**Std Error**	**Estimate**	**Std Error**
Intercept	0.99	1.17	1.87	1.35
Maternal-Reported				
Pressuring Feeding	**0.50****	0.17	**0.53****	0.17
Responsive Feeding	-0.18	0.19	-0.02	0.19
Observed				
Sensitivity to Infant Cues	0.08	0.05	-0.04	0.05
Response to Distress	0.02	0.07	0.05	0.0600
Study				
Breast Versus Bottle Study			Reference	-----
Mindless Feeding Study			-0.38	0.31
Opaque Bottle Study 1			**-0.96****	0.3000
Opaque Bottle Study 2			**-0.93*****	0.20
Mom Age			-0.01	0.18
Pre-pregnancy BMI				
Not Overweight/Obese			Reference	-----
Overweight/ Obese			**-0.40***	0.17

BMI, Body Mass Index or a weight-to-height ratio using a person's mass in kilograms and height in centimeters (BMI = weight [kg]/height [m]2)

[a] $R^2 = 0.07$, F = 2.50, p = .0457; [b] $R^2 = 0.27$, F = 4.69, p < .0001

†p < .10, *p < .05, **p < .01, ***p < .001

4.11 Infant Characteristics Predicting the Use of FTS

The intercorrelations for the use of FTS and infant characteristics can be seen in Table 4.3. Use of FTS was significantly associated with greater levels of negative affect (r = 0.41, p < 0.001). These results suggest that as maternal-reported infant negativity increases, maternal-reported use of FTS also increases.

Multiple regression was also used to assess which infant characteristics most predicted mothers' reported use of FTS (Table 4.14). Before adjusting for significant sociodemographic characteristics, only maternal-reported infant negativity (F [1,128] = 26.59, p < 0.001) was a significant predictor for the mother's reported use of FTS. After adjusting for significant sociodemographic characteristics, maternal-reported infant negativity (F [1,124] = 13.60, p < 0.001) and surgency (F [1,124] = 4.85, p = 0.030) were both significant predictors for the mother's reported use of FTS. These results suggest that a higher maternal-reported score for infant negativity was predictive of a higher maternal-reported score for the use of FTS. Conversely, a higher maternal-reported score for infant surgency was predictive of a lower maternal-reported score for the use of FTS.

Table 4.14

Infant Characteristics Predicting Use of Food to Soothe (FTS)

	Unadjusted Analysis [a]		**Adjusted Analysis** [b]	
	Estimate	**Std Error**	**Estimate**	**Std Error**
Intercept	0.08	0.97	2.37	1.22
Maternal-reported				
Negativity	**0.42*****	0.08	**0.32****	0.09
Surgency	-0.14	0.09	**-0.19***	0.09
Enjoyment of Food	0.30	0.15	0.13	0.15
Food Responsiveness	-0.05	0.11	-0.06	0.12
Satiety Responsiveness	0.06	0.13	0.18	0.13
Observed				
Clarity of Cues	0.01	0.06	0.02	0.06
Responsiveness to Caregiver	-0.01	0.05	-0.10	0.05
Study				
Breast Versus Bottle Study			Reference	-----
Mindless Feeling Study			-0.20	0.32
Opaque Bottle Study 1			**-0.65***	0.29
Opaque Bottle Study 2			**-0.92*****	0.22
Mom Age			-0.02	0.02
Pre-pregnancy BMI				
Not Overweight/Obese			Reference	-----
Overweight/Obese			-0.31	0.16

BMI, Body Mass Index or a weight-to-height ratio using a person's mass in kilograms and height in centimeters (BMI = weight [kg]/height [m]2)

[a] $R^2 = 0.21$, F = 4.66, p = .0001; [b] $R^2 = 0.35$, F = 5.06, p < .0001

†p < .10, *p < .05, **p < .01, ***p < .001

4.12 Maternal and Infant Characteristics Predicting the Use of FTS

A multiple regression model was conducted including all the maternal and infant characteristics (Table 4.15). The same covariates used in the previous models predicting the use of FTS were used for these models. Before adjusting for sociodemographic characteristics, maternal-reported pressuring feeding style (F [1,127] = 8.86, $p = 0.004$), infant negativity (F [1,127] = 26.83, $p < 0.0001$) and infant surgency (F [11,127] = 3.92, $p = 0.049$) were all significant predictors for the use of FTS. After adjusting for significant sociodemographic characteristics, maternal reported pressuring feeding style (F [1,123] = 8.28, $p = 0.005$), infant negativity (F [1,123] = 13.10, $p = 0.001$), and infant surgency (F [1,123] = 5.83, $p = 0.018$) remained as significant predictors for the use of FTS. These results suggest that a higher reported score for pressuring feeding style and infant negativity and a lower reported score for infant surgency were all predictive of a higher reported score for the use of FTS.

Table 4.15

Maternal and Infant Characteristics Predicting Use of Food to Soothe (FTS)

	Unadjusted Analysis [a]		**Adjusted Analysis** [b]	
	Estimate	**Std Error**	**Estimate**	**Std Error**
Intercept	-1.13	1.42	0.62	1.64
Maternal Characteristics				
Maternal-Reported				
Pressuring Feeding	**0.49****	0.16	**0.47****	0.16
Responsive Feeding	0.01	0.18	0.05	0.18
Observed				
Sensitivity to Infant Cues	0.02	0.05	-0.01	0.06
Response to Distress	0.03	0.06	0.06	0.06
Infant Characteristics				
Maternal-Reported				
Negativity	**0.43*****	0.08	**0.31****	0.09
Surgency	**-0.17***	0.09	**-0.21***	0.09
Enjoyment of Food	0.27	0.16	0.14	0.15
Food Responsiveness	-0.10	0.11	-0.06	0.12
Satiety Responsiveness	0.06	0.13	0.15	0.12
Observed				
Clarity of Cues	0.00	0.06	0.01	0.06
Responsiveness to Caregiver	0.02	0.06	-0.06	0.06
Covariates				
Study				
Breast Versus Bottle Study				
Mindless Feeding Study			-0.13	0.33
Opaque Bottle Study 1			**-0.69***	0.33
Opaque Bottle Study 2			**-0.91*****	0.23
Mom Age			-0.02	0.02
Pre-pregnancy BMI [b]				
Not Overweight/Obese				
Overweight/Obese			**-0.38***	0.16

BMI, Body Mass Index or a weight-to-height ratio using a person's mass in kilograms and height in centimeters (BMI = weight [kg]/height [m]2)

[a] $R^2 = 0.27$, $F = 3.93$, $p < .0001$; [b] $R^2 = 0.40$, $F = 4.52$, $p < .0001$

†p < .10, *p < .05, **p < .01, ***p < .001

Chapter V

DISCUSSION AND CONCLUSION

The present study was a secondary analysis of data from infant feeding studies and aimed at assessing the associations between mothers' use of food to soothe (FTS) and feeding type (any breastfeeding, exclusive formula-feeding, or mixed feeding), bottle-feeding intensity (percentage of daily feedings given from a bottle), maternal and infant characteristics, and infant weight gain during the first 6 months postpartum. The key objectives were to explore whether the use of FTS was associated with change in infant weight-for-length z-score (WLZ), weight-for-age z-score (WAZ), or rapid weight gain (RWG) in the first 6 months postpartum and whether feeding type or bottle-feeding intensity moderated this relationship. Additionally, different maternal and infant characteristics associated with the use of FTS were explored.

5.1 Use of FTS

The majority of mothers in this study reported using FTS on average between "Never" and "Sometimes." This frequency of use of FTS was less than a previous study where the majority of mothers reported that they used FTS "Sometimes" (Jansen et al, 2019). However, in the Jansen et al (2019) study, only a single-item questionnaire with a 3-point Likert scale ("Never," "Sometimes," and "Often" as possible answers) was administered, whereas the measure for the use of FTS in the present study was based on a 13-item questionnaire with a 5-point Likert scale and a composite average score calculated from all answers. A study done by Stifter and colleagues in 2011 used the same 13-item questionnaire and found an almost identical average score for the use of FTS as the present study. These findings suggest that, on average, the use of FTS is a feeding practice that is used occasionally by mothers. However, a larger and more diverse sample is needed to understand whether the frequency of use of FTS reported in the present sample and Stifter et al sample can be generalized to the broader population.

5.2 Use of FTS and Change in Infant Weight

It was hypothesized that a greater use of FTS would be associated with a greater conditional change in weight-for length z-score (ΔWLZ) and/or weight-for-age z-score (ΔWAZ) from birth to study entry. It was also hypothesized that a greater use of FTS would be associated with RWG, or a ΔWAZ that is greater than 0.67. Without controlling for any covariates, a two-sample T-test showed that mothers of infants with RWG had a significantly lower score for use of FTS than infants who did not experience RWG. However, this significance disappeared when including covariates in the regression models. The results from the regression models showed that there was no significant association between maternal-reported use of FTS and ΔWLZ, ΔWAZ, or RWG from birth to study entry. These results do not reflect previous findings from infant studies which showed that a greater use of FTS was associated with greater infant weight status (Stifter et al, 2011) and greater infant weight gain from 6 to 18 months (Stifter and Moding, 2015).

One possible explanation for discrepancies between the findings in the present study and those from previous research is that the short timespan between birth to study entry was not enough time to see potential associations between FTS and WLZ or WAZ change. Within the Stifter and Moding (2015) study, infants were observed at 6 months of age, then assessed at 12 months and 18 months of age. This study illustrated that the use of FTS was significantly associated with increased WLZ from 6 to 18 months. Thus, it is possible that more time is needed for mothers' use of FTS or emotional feeding to influence the infant's eating behavior and subsequent weight gain. In support of this speculation, a study done by Rodgers et al (2013) with a sample of 323 two-year-old children showed that emotional feeding at two years old was significantly related to increased emotional eating and tendency to overeat, both at two years and at three years old. Future studies that include longer-term follow-ups of FTS, children's eating behaviors, and weight gain patterns are needed.

Another possible explanation for non-significant associations between FTS and infant weight gain is that all the infants in this study had not yet been introduced to solid foods. Both studies by Stifter and colleagues (Stifter et al, 2011; Stifter and Moding, 2015) included samples of infants ranging from 3 to 34 months old, which likely included many infants that had been introduced to solid foods. Previous studies have shown that foods commonly used to soothe children are low-nutrient, energy-dense (e.g. sweets and snacks) (Sherry et al, 2004) and these food choices might play a role in the weight gain that is associated with FTS. In the present study, infants were only being fed breastmilk and/or formula; thus, it is possible that the use of FTS before the introduction of solids was not associated with infant weight gain because of the limited variability in nutrient- and energy-density in the infants' diets.

It is also possible that mothers of younger infants might not have been able to tell the difference between infant distress related to hunger and infant distress for other reasons. When asked how often they used FTS, the mothers might have responded based on how often they fed their infant when he or she was upset, which might also include times of hunger. Studies have shown that mothers become more aware of infant cues around 4 to 6 months (Skinner et al, 1998) and the cues are clearer and easier to read as the infant gets older (Hodges et al, 2008; McNally et al, 2016). Therefore, mothers of younger infants (less than 4 months) might find it more difficult to interpret their infants' cues and this misinterpretation might make it difficult to decipher between their use of feeding to soothe and feeding on demand (or responsive feeding). Further supporting this speculation, the questionnaire used in the present study to measure the use of FTS had not been validated for infants younger than 3 months (Stifter et al, 2011); given approximately 43% of the infants in the present study were younger than 3 months of age, it is possible that the measure of FTS used in the present study was not the best measurement tool for these younger infants with hunger cues that are more difficult for mothers to interpret. Future studies would need to find or create measurement tools for FTS that have been validated for younger infants.

5.3 Use of FTS by Feeding Type and Bottle-feeding Intensity

It was hypothesized that mothers who predominantly breastfeed would more frequently use FTS compared to mothers that predominantly bottle-feed. The results from the present study somewhat supported this hypothesis. Mothers who were exclusively formula-feeding had a significantly lower score for use of FTS compared to mothers who used a combination of both breast- and formula-feeding. Mothers who were exclusively formula-feeding also had a lower score for use of FTS compared to mothers who were exclusively breastfeeding, however this difference was not statistically significant. Additionally, although not statistically significant, mothers who provided greater than 80% of daily feedings from a bottle had the lowest average score for use of FTS compared to mothers who provided less than 20% of daily feedings from a bottle and 20-80% of daily feedings from a bottle.

Previous studies have shown that infants who were exclusively breastfed (Rametta et al, 2015) and had a longer duration of breastfeeding (Stifter and Moding, 2015) were more likely to be fed to soothe. Studies have also highlighted how breastfeeding can uniquely alleviate infant distress and can be an effective analgesic due to the calming properties of skin-to-skin contact, suckling, and sweet taste (Benoit et al, 2017; Efe and Ozer, 2007; Gray et al, 2002). In the present study, the results showed a statistically significant difference in use of FTS by feeding type and not by bottle-feeding intensity. These findings suggest that it is not just the use of the breast or the bottle during feeding that influences whether the mother is more likely to use FTS, but perhaps other additional factors about the mother and her feeding choices.

Of note, mothers who reported a combination of breastfeeding and formula-feeding had the highest average score for use of FTS compared to mothers that exclusively breastfed or exclusively formula fed. One possible explanation for this finding is that mothers who supplement with formula might already be concerned about their infant's level of hunger. Previous studies have shown that some breastfeeding mothers choose to supplement with formula because they believe they have an inadequate milk supply, perceive their infant's crying as a sign of hunger, and/or need to rest and take a break from breastfeeding (DaMota et al, 2012; Pierro et al, 2016). Therefore, mothers who supplement with formula might more frequently use FTS because they are unsure if their infant is crying for hunger or for other reasons and might believe that feeding is the best solution to calm their infant.

5.4 Feeding Type and/or Bottle-Feeding Intensity Moderating the Relationship of FTS and Weight Gain

It was hypothesized that feeding type and/or bottle-feeding intensity would moderate the relationship between the use of FTS and ΔWLZ or ΔWAZ, with a stronger positive relationship between the use of FTS and weight gain for infants who were predominantly bottle-fed compared to infants who were predominantly breastfed. Few or no previous studies have explored the moderating effects of feeding type and/or bottle-feeding intensity on the relationship between use of FTS and infant weight gain. The initial hypothesis was derived from studies that have shown the differences in feeding interaction between breastfeeding and bottle-feeding. Breastfeeding requires the infant to be more of an active participant (e.g. properly latching and initiating milk flow) and involves more non-nutritive sucking (NNS) where the infant is sucking and no milk is being transferred, whereas bottle-feeding allows the infant to be more of a passive participant and involves more nutritive sucking (NS) where milk is continuously being transferred (Crow et al, 1980; Mizuno and Ueda, 2006; Riordan, 2005). Therefore, it was hypothesized that bottle-feeding infants who are more frequently fed to soothe might be consuming more milk during this process and might be more susceptible to greater weight gain.

The results from this study did not correspond with the speculated outcomes. Regression models showed that neither the interaction of feeding type and use of FTS nor the interaction of bottle-feeding intensity and use of FTS were significant predictors of ΔWLZ, ΔWAZ, or RWG. One possible explanation for there being no statistically significant relationship between the interaction of FTS and feeding type or bottle-feeding intensity and infant weight gain might be that the questionnaire asked mothers how they are currently feeding their infant and did not ask how long this feeding type and/or bottle-feeding intensity had been occurring. A longitudinal study of 1,899 mothers in the United States showed that infant feeding in the first 6 months can be complex and it is common for mothers to transition from different feeding types and modes during this time (Karmaus et al, 2017). For example, mothers who provided a combination of breastmilk and formula in the first month eventually transitioned to only formula feeding or only breastfeeding in the second month. In the present study, it is possible that some mothers might have switched feeding methods from birth to study entry. Therefore, the questionnaire, which only asked about the current feeding method, might not have captured the full interaction of feeding type and/or bottle-feeding intensity with FTS on infant weight. Future studies would need to collect more data regarding the feeding types and/or modes that have been used leading up to study entry.

Additionally, the same limitations that potentially led to the findings when predicting ΔWLZ or ΔWAZ from the use of FTS might also be leading to the findings when predicting the change in infant weight from the interaction of FTS and feeding type and/or bottle-feeding intensity. Among these limitations is the short study period which might not have been long enough to show the relationships of FTS and infant weight gain. The FTS questionnaire and its undetermined validity among infants younger than 3 months old (Stifter et al, 2011) might also have made it difficult to identify relationships between the use of FTS and infant weight gain. Future studies would need to follow infants for a longer time period and use a FTS questionnaire that has been validated on young infants.

5.5 Maternal Characteristics and the Use of FTS

It was hypothesized that a greater use of FTS would be associated with greater maternal-reported pressuring and responsive feeding styles, and lower observed scores for maternal sensitivity to infant cues and maternal responsiveness to infant distress. Individual correlations showed that the association between maternal-reported pressuring and use of FTS was significant and positive. This corresponds with similar findings in previous research (Stifter et al, 2011; Stifter and Moding, 2015). This positive relationship makes sense because pressuring feeding can encompass the act of feeding a child in the absence of hunger (Thompson et al, 2009). Correspondingly, the Infant Feeding Styles Questionnaire (IFSQ) that was used to measure the mother's use of pressuring feeding in the present study had questions that were relevant to the mother's use of FTS (e.g. "When my child cries, I immediately feed him/her").

Previous studies have shown a positive relationship between the use of FTS and maternal-reported responsive feeding (Stifter et al, 2011 and Stifter and Moding, 2015).

Responsive feeding is the act of being in-tune with the infant's hunger and satiation cues and then responding to these cues in an appropriate manner that is contingent upon the infant's needs, and has been associated with healthier weight outcomes during infancy (Perez-Escamilla et al, 2017). Therefore, one would assume that responsive feeding and the use of FTS would not be positively associated with one another. However, one speculation for the previous findings of a positive relationship between maternal-reported responsive feeding and the use of FTS is there might be discrepancies between a mother's self-reported responsiveness and the mother's actual level of responsiveness. The mother might believe that she is quickly responding to her infant's needs, but her actions might not be the most appropriate. The findings from the present study did not show a significant association between maternal-reported responsive feeding and the use of FTS.

In terms of observed responsive feeding, few or no previous FTS studies have looked at an objective measure of responsive feeding and its association with the use of FTS. The speculation was that the mother's observed responsive feeding would be a stronger representation of her actual level of responsive feeding and therefore would not be positively correlated with her use of FTS. As the results were not significant, it is not possible to draw conclusions about the relationships between these variables. One speculation for the null findings is that many of the mothers in the present study had high scores for maternal-reported responsive feeding, observed sensitivity, and observed response to infant distress. Therefore, it might have been more difficult to see relationships among these variables with such a uniformly high-scoring sample. Future studies would need to increase the sample size and recruit a more diverse population to potentially see more significant relationships between these variables and the use of FTS.

When conducting multiple regression models with maternal characteristics, only maternal-reported pressuring was shown to be a significant predictor for the use of FTS, both before and after adjusting for mother's age, pre-pregnancy BMI, and the study. These results suggest that a mother who uses pressuring feeding is more likely to also use FTS. Recent infant feeding interventions have started to highlight the benefits of responsive feeding and have therefore discouraged the use of pressuring feeding (Perez-Escamilla et al, 2017). The findings from the present study support the notion that less-favorable feeding practices, such as the use of FTS, might be encompassed within a more pressuring feeding style.

5.6 Infant Characteristics and the Use of FTS

It was hypothesized that a greater use of FTS would be associated with lower observed scores for infant clarity of cues and responsiveness to caregiver, greater maternal-reported negative or surgent temperament, greater maternal-reported enjoyment of food and food responsiveness, and lower maternal-reported satiety responsiveness. Individual correlations showed that only maternal-reported negativity had a significant positive relationship with the use of FTS. These findings suggest that as infant negativity increases, the use of FTS also increases. The positive relationship between these two variables is similar to findings from a previous study (Stifter et al, 2011). Mothers of infants with a more negative temperament face a unique set of challenges. Studies have shown that mothers of infants with a more difficult temperament are more likely to experience concerns with family and work (Hyde et al, 2004), difficulty with infant feeding (Galler et al, 2004), negative feelings toward infants in general (Pizur-Barnekow, 2006), decreased maternal self-confidence (Pizur-Barnekow, 2006), and decreased parental self-efficacy (Solmeyer and Feinberg, 2011). Mothers of infants with a more negative temperament and lower self-efficacy might struggle to soothe their infant and might turn to other methods, such as the use of FTS. Levels of parental self-confidence and self-efficacy have been shown to influence infant feeding practices. A recent systemic review showed that mothers with higher self-efficacy were more likely to use feeding practices that were in line with infant feeding recommendations, such as responsive feeding (Bahorski et al 2019), therefore it seems logical that the opposite might be the case for mothers with lower self-efficacy.

When conducting multiple regression models with infant characteristics, maternal-reported infant negativity and surgency were shown to be significant predictors for the use of FTS after adjusting for mother's age, pre-pregnancy BMI, and study. Similar to the bivariate correlational findings discussed above, the use of FTS was positively associated with infant negativity. However, the use of FTS was also negatively associated with infant surgency, suggesting that as infant surgency increases, the use of FTS decreases. This relationship corresponds with a previous study illustrating a significant negative relationship between observer-rated infant surgency and mother's tendency to use FTS (Stifter and Moding, 2018). Infant surgency is characterized by demonstration of high-intensity pleasure, approach, vocal reactivity, smiling/laughter, and low cuddliness (Gartstein and Rothbart, 2003). Although infant surgency has been associated with impulsivity (Burton et al, 2011), another study highlighted that infants with higher surgency also showcased lower irritability and therefore mothers might not respond as urgently to their cries (Stifter and Moding , 2018). Additionally, infants with a more surgent temperament used more self-comforting and self-distracting behaviors during a still-face paradigm experiment compared to infants with a less surgent temperament (Planalp and Braungart-Reiker, 2015). Self-distracting and self-comforting behaviors can help infants better regulate their own emotions and therefore might also make these infants less susceptible to being soothed by feeding.

With regards to other infant characteristics, the analyses found no significant relationship between observed clarity of cues, responsiveness to caregiver, enjoyment of food, food responsiveness, and satiety responsiveness. There was, however, a trend toward a negative association between infant responsiveness to caregiver and the use of FTS. Theories of early mother-infant interactions highlight the importance of both the mother's and infant's contributions to the feeding interaction in order to create a high quality relationship; it was hypothesized that the infant's responsiveness to the caregiver would be associated with use of FTS because an infant's lack of responsiveness to his or her caregiver might make it difficult for the mother to receive feedback on her actions and work towards providing a more synchronous relationship with her child (Oxford and Findlay, 2015). Therefore, an infant who is not responding to his or her caregiver might make it more difficult for the mother to decide if her actions are appropriately meeting her infant's needs, and therefore might continue with less appropriate actions, such as the use of FTS to ease infant distress.

It was hypothesized that certain infant eating behaviors would be associated with the use of FTS. Ventura and Birch (2008) have highlighted that child eating behavior can influence parental feeding practices. It was speculated that an infant who enjoys food or eats in response to external feeding cues might be more susceptible to being fed to soothe. This speculation is supported by a study of 413 mothers of 4-month old infants which showed that mothers who reported higher infant food responsiveness also reported a higher use of food to calm (Mallan et al, 2016). It was also speculated that infant satiety responsiveness would have a negative relationship with the use of FTS. Infant satiety responsiveness is defined as the infant's ability to recognize their fullness and self-regulate their intake of milk (Llewellyn et al, 2011). One would assume that infants who are less able to recognize and demonstrate their fullness would be more susceptible to being fed when they are not hungry. Just the same, mothers who practice less-responsive feeding and feed their infant outside of times when he or she demonstrates hunger cues might promote poorer self-regulation and satiety responsiveness skills. In support of this, one longitudinal study showed that a more pressuring infant feeding style was associated with decreased self-regulation of energy intake when the child was 6 years old (Li et al, 2014). However, the relationships of infant eating behaviors and the use of FTS in the present study were not statistically significant, and neither causality nor the direction of causality can be determined from this cross-sectional study.

It was hypothesized that infant clarity of cues would have a negative relationship with the use of FTS. Studies have shown that an infant's ability to clearly express his or her needs through their cues might make it easier for the mother to understand when her infant is not hungry and does not need to be fed (Hodges et al, 2008; McNally et al, 2015). Another study has shown that infant clarity of cues is positively associated with maternal sensitivity and responsive feeding (Ventura et al, 2019), therefore supporting the speculation that infants with clearer cues would be less susceptible to pressuring feeding practices, such as the use of FTS. However, a significant relationship between infant clarity of cues and the use of FTS was not seen in the present study.

This is one of the first studies to look at the relationships between these infant characteristics and the use of FTS. As many of these relationships were not statistically significant, it is possible that the sample size was not large enough, nor the sample population diverse enough to be able to detect relationships between these variables. Future studies would need to increase the sample size and recruit participants from multiple different locations and backgrounds.

5.7 Maternal and Infant Characteristics Most Predictive of FTS

A mother's decision to use certain feeding practices, such as the use of FTS, can be based on her own characteristics, as well as the characteristics of her infant. A multiple regression model including all maternal and infant characteristics showed that higher pressuring feeding, higher infant negativity, and lower infant surgency were most predictive for increased use of FTS when adjusting for mother's age, pre-pregnancy BMI, and the study. These results suggest that mothers with a more pressuring feeding style and an infant with a more negative and/or less surgent temperament are most susceptible to the use of FTS. In other words, infants who are frequently in distress with potentially poorer self-comforting skills and mothers who often attempt to feed their infant in the absence of hunger are most at risk for this feeding practice. Therefore, future interventions to prevent the use of FTS might benefit from targeting mothers and infants that exhibit these characteristics.

5.8 Strengths

The present secondary analysis explored the use of FTS, which is a feeding practice that has received minimal attention in previous literature. This study explored the relationship of FTS with infant weight gain and maternal and infant characteristics in the first 6 months post-partum, which is an age range that has also received minimal attention in previous FTS literature. Multiple studies have highlighted that rapid weight gain during the first 6 months postpartum is a strong predictor for later obesity (Dennison et al, 2006; Ekelund et al, 2006 & 2007; Lanigan and Singhal, 2009; Taveras et al, 2011; Young et al, 2012; Zheng et al, 2018). The present study only included infants who were 6 months or younger, whereas previous FTS studies included broader age ranges (Rametta et a, 2015; Stifter et al, 2011; Stifter et al, 2015). Therefore, the present study allowed for an isolation of the associations between FTS and infant weight gain during this critical time window.

Additionally, the present study only included infants who had not yet been introduced to solid foods. Foods that are commonly used to soothe are sweets and high-energy snacks (Sherry et al, 2015) and this consumption might have been a confounding variable in previous FTS studies. Previous infant FTS studies included infants who were consuming solid foods, but did not collect food frequency data to measure if the types of foods consumed were associated with infant weight gain. The present study simplified these analyses because all infants in the sample were only consuming breastmilk and/or formula.

Another strength of the present study was its use of both maternal-reported and observational measures. Maternal-reported questionnaires were used to assess different aspects of the mother's feeding practices, while observational measures were used to assess the feeding interaction among the mother and infant. These diverse measurements provided a well-rounded depiction of both the mother's perceptions of her feeding practices and her infant's characteristics as well as more objective measures of her feeding practices and her infant's characteristics.

5.9 Limitations

The present study was a secondary analysis and the data was not collected with the intended purpose to answer the proposed research questions within this study. Additionally, many of the variables in the present study were collected cross-sectionally and therefore cannot convey causation relationships.

The smaller sample size made it difficult to see statistical significance in the models for the use of FTS predicting change in weight (ΔWLZ, ΔWAZ, and RWG). Based off analyses through G *Power (G *Power, Autenzell, Germany), a minimum sample size of 238 participants would be needed to see a significant effect with a power of 0.80.

The WLZ and WAZ scores (at birth, study entry, and the change from birth to study entry) had a wide range. Some of these z-scores might have been outliers and some infants might have had a low birthweight. These outliers and lower birthweight babies might have altered the findings when predicting the association of FTS and change in weight.

The majority of mothers in this study had a university education, a family income greater than $75,000, and were primiparous, which might have influenced their feeding practices. The mothers in this study were not further analyzed by parity, and first-time mothers might have demonstrated different feeding practices than mothers who were multiparous.

Stepwise regression was used to select significant covariates for all statistical models, and this type of preliminary analysis has its limitations. When following this preliminary analysis, the variable "study" was not shown to be a significant covariate when predicting change in infant weight and was therefore not included in these statistical models. The study that took place in Philadelphia (the Opaque Bottle Study) had mothers with significantly different sociodemographics than those from the other three studies. Within the Opaque Bottle Study, the majority of mothers reported a race/ethnicity of non-Hispanic Black (72.4%), a family income less than $15,000 (57.1%), highest level of education being a high school degree (55.6%), participation in WIC (89.3%), being of unmarried status (75.9%), being overweight or obese (72%), and exclusively formula feeding (75.9%). The Opaque Bottle Study is the primary source of the predominantly bottle-feeding mothers in the present study and therefore is not a fully accurate representation of all predominantly bottle-feeding mothers in the broader population.

The survey used in this study to measure the use of FTS had not been validated for infants under 3 months and therefore might not have been the most appropriate measurement tool. Some mothers might have not yet understood their infants hunger cues during these early months (Hodges et al, 2008; McNally et al, 2016; Skinner et al, 1998) and therefore might not have known if they were feeding their infant in the absence of hunger cues.

5.10 Implications for Future Research and Practice

Future studies exploring the use of FTS in the first 6 months postpartum would need to expand the size and diversity of the sample population in order to make more definite conclusions about relationships between the use of FTS and infant weight gain, maternal characteristics, and infant characteristics. Additionally, structured longitudinal follow-ups in the first 6 months (e.g. measurements taken every 2 or 3 months since birth up until 6 months of age) might be most effective to determine associations between the use of FTS and infant weight gain in the first 6 months postpartum.

As studies have shown that feeding practices can be dynamic in the first 6 months (Karmaus et al, 2017), repeated measurements of feeding type (exclusive breastfeeding, exclusive formula-feeding, or mixed feeding) and bottle-feeding intensity (percent of daily feedings from a bottle) should be taken longitudinally to get a better understanding of the moderating effects of feeding type and/or bottle-feeding intensity on the relationship between the use of FTS and infant weight gain. Future research on the use of FTS among infants under 6 months should also prioritize measurement tools for the use of FTS that are less subjective and more strongly validated for younger infants. Some examples of more objective measurements for the use of FTS are observations in the lab (Stifter and Moding, 2015) and cry diaries (Stifter and Moding, 2018). Overall, these alterations will help future researchers make stronger conclusions about the use of FTS in the first 6 months postpartum.

5.11 Conclusion

The use of FTS was significantly higher among mothers who reported a combination of breastfeeding and formula feeding compared to mothers who reported exclusively formula-feeding. Greater pressuring feeding, greater infant negativity, and lower infant surgency were all significant predictors for the use of FTS. FTS was not significantly associated with infant weight gain during the first 6 months postpartum. Neither feeding type (exclusive breastfeeding vs exclusive formula-feeding vs mixed feeding) or bottle-feeding intensity (percent of daily feedings from a bottle) moderated the relationship between the use of FTS and infant weight gain. Responsive feeding, infant clarity of cues, infant responsiveness to caregiver, and infant eating behaviors were not significant predictors for the use of FTS.

With the mounting evidence showing that rapid infant weight gain is a strong predictor for later obesity, and many studies showing that responsive feeding practices can be protective for rapid infant weight gain, future studies should continue to explore the relationships between non-responsive feeding practices and infant weight gain trajectories. The goal is that these studies will continue to structure obesity prevention efforts targeting infant feeding practices and ultimately help prevent childhood obesity.

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APPENDICES

A. <u>BABY BASIC NEEDS QUESTIONNAIRE (BBNQ)</u>
(Page 1 of 3)

How are you <u>currently</u> feeding your infant?

(1) Breast-feeding only
(2) Formula-feeding only
(3) Breast- and formula-feeding

<u>If you are breast-feeding only</u>, please estimate the percentage of breast-milk from the breast versus breast milk from a bottle (expressed breast milk) your baby receives:

Breast milk from breast: ______________%

<u>If you are currently formula-feeding only</u>:

a. Did your infant ever receive breast milk? YES (1) NO (0)

b. How long did you breast-feed for?

   a. Less than 1 month
   b. 1-2 months
   c. 2-3 months
   d. 3-4 months
   e. 4-5 months
   f. 5-6 months
   g. More than 6 months

c. What kind of formula is your infant receiving? ____________________

d. Has your infant had any other kinds of formula? Please list:

____

<u>If you are breast- and formula-feeding your infant</u>:

e. Please estimate the percentage of breast milk versus formula your infant receives. Breast milk: ______________%

f. What kind of formula is your infant receiving? ______________________

g. Has your infant had any other kinds of formula? Please list:

____

h. At what age (in months) did you introduce formula to your infant? ______

A. <u>BABY BASIC NEEDS QUESTIONNAIRE (BBNQ)</u>
(Page 2 of 3)

Is there anyone else who is responsible for feeding your infant at least half of his or her daily feedings on a regular basis?

YES NO

If yes, how is this person/are these people related to your infant? Select all that apply.

(1) Father
(2) Grandmother
(3) Other relative (e.g., aunt, cousin, grandfather)
(4) Non-relative (e.g., babysitter, nanny)
(5) Licensed child care provider (including child care centers and family day care homes)

Has your infant had any foods other than breast milk or formula? YES (1) NO (0)

If yes, at what age (in months) did you first introduce something other than breast milk or formula?

________ months

If yes, please indicate how often your child receives:

Please indicate the extent to which you use food to soothe your infant in different situations. Please note that "food" includes breast milk and formula.

	Never or Hardly Ever (Less than once a week)	**Sometimes (Not daily, but at least once a week)**	**Every Day or Nearly Every Day**	**At least 2 to 3 times a day**
Water	1	2	3	4
100% juice	1	2	3	4
Milk	1	2	3	4
Soft drinks, sweetened beverages	1	2	3	4
Baby cereal	1	2	3	4
Vegetables (baby food or table food)	1	2	3	4
Fruit (baby food or table food)	1	2	3	4
Crackers, chips or other grains	1	2	3	4
Meat, fish, or poultry	1	2	3	4

A. <u>BABY BASIC NEEDS QUESTIONNAIRE (BBNQ)</u>
(Page 3 of 3)

	Never		**Sometimes**		**Often**
How often do you offer food or liquid to soothe your child (including breast milk and formula)?	1	2	3	4	5
How likely are you to use food to soothe in the grocery store?	1	2	3	4	5
How likely are you to use food to soothe in the doctor's waiting room?	1	2	3	4	5
How likely are you to use food to soothe in church (or similar church institution)?	1	2	3	4	5
How likely are you to use food to soothe in the car?	1	2	3	4	5
How likely are you to use food to soothe when getting ready to leave?	1	2	3	4	5
How likely are you to use food to soothe when preparing foods?	1	2	3	4	5
How likely are you to use food to soothe when attending to another person?	1	2	3	4	5
How likely are you to use food to soothe when you are on the phone?	1	2	3	4	5
How likely are you to use food to soothe when your child wakes at night?	1	2	3	4	5
How likely are you to use food to soothe when you are stressed?	1	2	3	4	5
How likely are you to use food to soothe when you are tired?	1	2	3	4	5
How likely are you to use food to soothe when nothing else works?	1	2	3	4	5
	Does not work		**Works about half the time**		**Works all of the time**
How effective is using food to soothe your child?	1	2	3	4	5

B. <u>INFANT FEEDING STYLE QUESTIONNAIRE (IFSQ)</u>
(Page 1 of 2)

The following statements refer to feeding your child. Once again, these statements are neither right now wrong. We just want to know your opinion. Some of these statements may seem similar but are actually different so please read carefully.
Please rate how often each of the statements are true. **If asked about feeding a certain food item which you have not yet given your child, please mark Not Applicable (NA).**

		Never	Seldom	Half of the time	Most of the time	Always	Not Applicable
1	I let my child decide how much to eat	1	2	3	4	5	NA
2	When my child has a bottle, I prop it up on a blanket, burp cloth, etc.	1	2	3	4	5	NA
3	I keep track of how much my child eats	1	2	3	4	5	NA
4	I give/gave my child cereal in the bottle	1	2	3	4	5	NA
5	I carefully control how much my child eats	1	2	3	4	5	NA
6	I watch TV while feeding my child	1	2	3	4	5	NA
7	I try to get my child to eat even if s/he seems not hungry	1	2	3	4	5	NA
8	I am very careful not to feed my child too much	1	2	3	4	5	NA
9	I try to get my child to finish his/her food	1	2	3	4	5	NA
10	When my child cries, I immediately feed him/her	1	2	3	4	5	NA
11	If my child seems full, I encourage him/her to finish his/her food anyway	1	2	3	4	5	NA
12	My child knows when s/he is full	1	2	3	4	5	NA
13	I try to get my child to finish his/her breast milk or formula	1	2	3	4	5	NA
14	I pay attention when my child seems to be telling me that s/he is full or hungry	1	2	3	4	5	NA
15	I allow my child to eat when s/he is hungry	1	2	3	4	5	NA
16	My child knows when s/he is hungry	1	2	3	4	5	NA
17	I talk to my child to encourage him/her to drink his/her formula or breastmilk	1	2	3	4	5	NA

B. <u>INFANT FEEDING STYLE QUESTIONNAIRE (IFSQ)</u>
(Page 2 of 2)

Please read the following statements carefully. Some of these statements may seem similar but are actually different. These statements are neither right nor wrong. We just want to know your opinion. ***Please rate how strongly you agree or disagree with each statement.***

This section refers to infants (birth to 12 months):		Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree
1	When an infant cries it usually means he or she needs to be fed	1	2	3	4	5
2	An infant less than 6 months old needs more than formula or breastmilk to be full	1	2	3	4	5
3	I think it is okay to prop an infant's bottle up on a blanket, burp cloth, etc.	1	2	3	4	5
4	Putting cereal in the bottle is good because it helps an infant feel full	1	2	3	4	5
5	The best way to make an infant stop crying is to feed him or her	1	2	3	4	5
6	It's important for the parent to decide how much an infant should eat	1	2	3	4	5
7	It's important that an infant finish all the milk in his or her bottle	1	2	3	4	5
8	An infant less than 6 months needs more than formula or breastmilk to sleep through the night	1	2	3	4	5
9	Cereal in the bottle will help an infant sleep through the night	1	2	3	4	5
10	An infant should never eat fast food	1	2	3	4	5
11	My child lets me know when s/he is full	1	2	3	4	5
12	My child lets me know when s/he is hungry	1	2	3	4	5

C. <u>INFANT BEHAVIOR QUESTIONNAIRE REVISED - VERY SHORT FORM (IBQ R-VSF)</u>
(Page 1 of 5)

INSTRUCTIONS:
Please read carefully before starting:

As you read each description of your baby's behavior below, please indicate how often your baby did this during the LAST WEEK (the past seven days) by circling one of the numbers on the scale. These numbers indicate how often you observed the behavior described during the last week.

1	2	3	4	5	6	7	NA
Never	**Very Rarely**	**Less Than Half the Time**	**About Half the Time**	**More Than Half the Time**	**Almost Always**	**Always**	**Does Not Apply**

The "Does Not Apply" (NA) column is used when you did not see your baby in the situation described during the last week. For example, if the situation mentions your baby having to wait for food or liquids and there was no time during the last week when your baby had to wait, circle the (NA) option. "Does Not Apply" is different from "Never" (1). "Never" is used when you saw your baby in the situation but your baby never engaged in the behavior listed during the last week. For example, if your baby did have to wait for food or liquids at least once but never cried loudly while waiting, circle the (1) option.

Please be sure to circle a number for <u>every</u> item.

1. When being dressed or undressed during the last week, how often did your baby squirm
and/or try to roll away?

1 2 3 4 5 6 7 NA

2. When tossed around playfully how often did your baby laugh?

1 2 3 4 5 6 7 NA

3. When tired, how often did your baby show distress?

1 2 3 4 5 6 7 NA

C. <u>INFANT BEHAVIOR QUESTIONNAIRE REVISED - VERY SHORT FORM (IBQ R-VSF)</u>

1	2	3	4	5	6	7	NA
Never	**Very Rarely**	**Less Than Half the Time**	**About Half the Time**	**More Than Half the Time**	**Almost Always**	**Always**	**Does Not Apply**

6. When introduced to an unfamiliar adult, how often did your baby cling to a parent?

1 2 3 4 5 6 7 NA

5. How often during the last week did your baby enjoy being read to?

1 2 3 4 5 6 7 NA

6. How often during the last week did your baby play with one toy or object for 5-10 minutes?

1 2 3 4 5 6 7 NA

7. How often during the week did your baby move quickly toward new objects?

1 2 3 4 5 6 7 NA

8. When put into the bath water, how often did your baby laugh?

1 2 3 4 5 6 7 NA

9. When it was time for bed or a nap and your baby did not want to go, how often did s/he whimper or sob?

1 2 3 4 5 6 7 NA

10. After sleeping, how often did your baby cry if someone didn't come within a few minutes?

1 2 3 4 5 6 7 NA

11. In the last week, while being fed in your lap, how often did your baby seem eager to get away as soon as the feeding was over?

1 2 3 4 5 6 7 NA

12. When singing or talking to your baby, how often did s/he soothe immediately?

1 2 3 4 5 6 7 NA

C. <u>INFANT BEHAVIOR QUESTIONNAIRE REVISED - VERY SHORT FORM (IBQ R-VSF)</u>

(Page 3 of 5)

1	2	3	4	5	6	7	NA
Never	**Very Rarely**	**Less Than Half the Time**	**About Half the Time**	**More Than Half the Time**	**Almost Always**	**Always**	**Does Not Apply**

13. When placed on his/her back, how often did your baby squirm and/or turn body?

1 2 3 4 5 6 7 NA

14. During a peekaboo game, how often did your baby laugh?

1 2 3 4 5 6 7 NA

15. How often did your baby look up from playing when the telephone rang?

1 2 3 4 5 6 7 NA

16. How often did your baby seem angry (crying and fussing) when you left her/him in the crib?

1 2 3 4 5 6 7 NA

17. How often during the last week did your baby startle at a sudden change in body position (e.g., when moved suddenly)?

1 2 3 4 5 6 7 NA

18. How often during the last week did your baby enjoy hearing the sound of words, as in nursery rhymes?

1 2 3 4 5 6 7 NA

19. How often during the last week did your baby look at pictures in books and/or magazines for 5 minutes or longer at a time?

1 2 3 4 5 6 7 NA

20. When visiting a new place, how often did your baby get excited about exploring new surroundings?

1 2 3 4 5 6 7 NA

C. INFANT BEHAVIOR QUESTIONNAIRE REVISED - VERY SHORT FORM (IBQ R-VSF)

(Page 4 of 5)

1	2	3	4	5	6	7	NA
Never	**Very Rarely**	**Less Than Half the Time**	**About Half the Time**	**More Than Half the Time**	**Almost Always**	**Always**	**Does Not Apply**

21. How often during the last week did your baby smile or laugh when given a toy?

1 2 3 4 5 6 7 NA

22. At the end of an exciting day, how often did your baby become tearful?

1 2 3 4 5 6 7 NA

23. How often during the last week did your baby protest being placed in a confining place (infant seat, play pen, car seat, etc.)?

1 2 3 4 5 6 7 NA

24. When being held, in the last week, did your baby seem to enjoy him/herself?

1 2 3 4 5 6 7 NA

25. When showing your baby something to look at, how often did s/he soothe immediately?

1 2 3 4 5 6 7 NA

26. When hair was washed, how often did your baby vocalize?

1 2 3 4 5 6 7 NA

27. How often did your baby notice the sound of an airplane passing overhead?

1 2 3 4 5 6 7 NA

28. When introduced to an unfamiliar adult, how often did your baby refuse to go to the unfamiliar person?

1 2 3 4 5 6 7 NA

29. When you were busy with another activity, and your baby was not able to get your attention, how often did s/he cry?

1 2 3 4 5 6 7 NA

C. INFANT BEHAVIOR QUESTIONNAIRE REVISED - VERY SHORT FORM (IBQ R-VSF)

(Page 5 of 5)

1	2	3	4	5	6	7	NA
Never	**Very Rarely**	**Less Than Half the Time**	**About Half the Time**	**More Than Half the Time**	**Almost Always**	**Always**	**Does Not Apply**

30. How often during the last week did your baby enjoy gentle rhythmic activities, such as rocking or swaying?

1 2 3 4 5 6 7 NA

31. How often during the last week did your baby stare at a mobile, crib bumper or picture for 5 minutes or longer?

1 2 3 4 5 6 7 NA

32. When your baby wanted something, how often did s/he become upset when s/he could not get what s/he wanted?

1 2 3 4 5 6 7 NA

33. When in the presence of several unfamiliar adults, how often did your baby cling to a parent?

1 2 3 4 5 6 7 NA

34. When rocked or hugged, in the last week, did your baby seem to enjoy him/herself?

1 2 3 4 5 6 7 NA

35. When patting or gently rubbing some part of your baby's body, how often did s/he soothe immediately?

1 2 3 4 5 6 7 NA

36. How often did your baby make talking sounds when riding in a car?

1 2 3 4 5 6 7 NA

37. When placed in an infant seat or car seat, how often did your baby squirm and turn body?

1 2 3 4 5 6 7 NA

D. <u>BABY EATING BEHAVIOR QUESTIONNAIRE (BEBQ)</u>

Please indicate the extent to which each statement is true for your baby.

	Never	Rarely	Sometimes	Often	Always
My baby loves milk.	1	2	3	4	5
My baby enjoys feeding time.	1	2	3	4	5
My baby seems contented while feeding.	1	2	3	4	5
My baby becomes distressed while feeding.	1	2	3	4	5
My baby is always demanding a feed.	1	2	3	4	5
If allowed to, my baby would take too much milk.	1	2	3	4	5
Even when my baby has just eaten well, s/he is happy to be feed again if offered.	1	2	3	4	5
If given the chance, my baby would always be feeding.	1	2	3	4	5
My baby frequently wants more milk than I provided.	1	2	3	4	5
My baby could easily take a feed within 30 min of the last one.	1	2	3	4	5
My baby finishes feeding quickly.	1	2	3	4	5
My baby feeds slowly.	1	2	3	4	5
My baby takes more than 30 min to finish feeding.	1	2	3	4	5
My baby sucks more and more slowly during the course of a feed.	1	2	3	4	5
My baby finds it difficult to manage a complete feed.	1	2	3	4	5
My baby gets full before taking all the milk I thought s/he should have.	1	2	3	4	5
My baby gets filled up easily.	1	2	3	4	5
My baby has a big appetite.	1	2	3	4	5

E. <u>FAMILY DEMOGRAPHICS QUESTIONNAIRE</u>
(Page 1 of 5)

About you

What is your date of birth? ___________________

What was your pre-pregnancy weight (in pounds)? _____________ lbs.

Did you have gestational diabetes in your previous pregnancy? YES (1) NO (0)

Are you a student? YES (1) NO (0)

How many years of schooling have you had? (Choose the last grade completed.)

(0) Never attended/ only kindergarten	(11) 11th grade
(1) 1st grade	(12) 12th grade, no diploma
(2) 2nd grade	(13) High school diploma
(3) 3rd grade	(14) GED or equivalent
(4) 4th grade	(15) Some college, no degree
(5) 5th grade	(16) Associate's degree: occupational, technical, or vocational training program
(6) 6th grade	(17) Associate's degree: academic program
(7) 7th grade	(18) Degree (e.g., BA, AB, BS, BBA)
(8) 8th grade	(19) Masters (e.g., MA, MS, MEng, MEd)
(9) 9th grade	(20) Professional school degree (e.g., MD, DDS, DVM, JD)
(10) 10th grade	(21) Doctorate (e.g., PhD, EdD)

E. FAMILY DEMOGRAPHICS QUESTIONNAIRE
(Page 2 of 5)

What is your occupation? ____

What is your ethnic category?

(0) Hispanic or Latino
(1) Not Hispanic or Latino

What is your racial background? (Circle all that apply)

(1) White/Caucasian/European
(2) Black/African American
(3) American Indian or Alaskan Native
(4) Asian Indian
(5) Chinese
(6) Filipino
(7) Japanese
(8) Korean
(9) Vietnamese
(10) Other Asian (please specify) ____
(11) Native Hawaiian
(12) Guamanian or Chamorro
(13) Samoan
(14) Other (please specify) ____
(15) Don't know

About your child's father

What is your child's father's date of birth? ___________________

Is your child's father a student? YES (1) NO (0)

E. <u>FAMILY DEMOGRAPHICS QUESTIONNAIRE</u>
(Page 3 of 5)

How many years of schooling has your child's father had? (Circle the last grade completed.)

(0) Never attended/ only kindergarten	(11) 11th grade
(1) 1st grade	(12) 12th grade, no diploma
(2) 2nd grade	(13) High school diploma
(3) 3rd grade	(14) GED or equivalent
(4) 4th grade	(15) Some college, no degree
(5) 5th grade	(16) Associate's degree: occupational, technical, or vocational training program
(6) 6th grade	(17) Associate's degree: academic program
(7) 7th grade	(18) Degree (e.g., BA, AB, BS, BBA)
(8) 8th grade	(19) Masters (e.g., MA, MS, MEng, MEd)
(9) 9th grade	(20) Professional school degree (e.g., MD, DDS, DVM, JD)
(10) 10th grade	(21) Doctorate (e.g., PhD, EdD)

What is your child's father's occupation?

____

What is your child's father's ethnic category?

(1) Hispanic or Latino
(2) Not Hispanic or Latino

E. <u>FAMILY DEMOGRAPHICS QUESTIONNAIRE</u>
(Page 4 of 5)

What is your child's father's racial background? (Circle all that apply)

(1) White/Caucasian/European
(2) Black/African American
(3) American Indian or Alaskan Native
(4) Asian Indian
(5) Chinese
(6) Filipino
(7) Japanese
(8) Korean
(9) Vietnamese
(10) Other Asian (please specify) ____
(11) Native Hawaiian
(12) Guamanian or Chamorro
(13) Samoan
(14) Other (please specify) ____
(15) Don't know

About your family

What is your infant's date of birth? __________________

What is your infant's sex? Male Female

What was your infant's birth weight (in pounds)? _______ lbs ________ oz

What was your infant's birth length (in inches)? ___________ in.

Please select the response that best describes your marital status.

(1) Married to my child's father
(2) Married, but not to my child's father
(3) Living with, but not married to, my child's father
(4) Living with, but not married to, someone other than my child's father
(5) In a relationship with, but not living with, my child's father
(6) In a relationship with, but not living with, someone other than my child's father
(7) Single
(8) Other: ______________________________________

E. <u>FAMILY DEMOGRAPHICS QUESTIONNAIRE</u>
(Page 5 of 5)

Including the infant in this study, how many children are in your household?

(1) 1	(6) 6
(2) 2	(7) 7
(3) 3	(8) 8
(4) 4	(9) 9
(5) 5	(10) 10

What is your family's total yearly income? (Circle one)

(1) Under $10,000	(5) $35,000 - $49,999
(2) $10,000 - $14,999	(6) $50,000 - $74,999
(3) $15,000 - $24,999	(7) $75,000 - $99,999
(4) $25,000 - $34,999	(8) $100,000 or more

Do you currently participate in federal nutrition education programs such as WIC?

Yes No

If so, but it is not WIC, please specify the name: ___________________________________

If not participating presently, have you participated in the past? Yes No

If yes, when did you participate (dates)?
____