Evaluating Breastfeeding's Role on Early Childhood Feeding and Eating Styles Related to Future Risk of Childhood Overweight

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by
Katherine F. Isselmann, MPH
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ABSTRACT

Title: Evaluating Breastfeeding's Role Early Childhood Feeding and Eating Styles Related to Future Childhood Overweight

Candidate's Name: Katherine F. Isselmann

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Doctoral Advisory Committee Chair: Bradley Collins, PhD

Introduction: Recent research indicates that breastfeeding may be protective against obesity risk. The purpose of the proposed study is to investigate the possible associations between breastfeeding, later maternal feeding strategies, and later child eating behaviors that could protect against obesity. **Methods:** This study examined hypothesized associations between infant feeding type (breastfed [BF], bottle-fed breastmilk [PUMP], bottle-fed formula [FM]) and both current child eating styles (internal cues in eating) and current maternal feeding styles (related to control) in a sample of three to six year old children. Infant feeding information was obtained via retrospective self-report with medical chart verification. Maternal feeding styles of "restriction" and "monitoring" and child eating behaviors of "satiety responsiveness" and "food responsiveness," were measured through validated questionnaires. It was hypothesized that children who were breastfed without bottle would have less maternal restriction and monitoring in their feeding and higher satiety response and lower food responsiveness than children who were breastfed with bottle or formula fed. Exploratory hypotheses were examined: (1) Maternal feeding and child eating behaviors were examined for interrelations and (2) Maternal feeding and child eating styles were explored for their relationship with obesity measures. **Results:** Among the 111 mothers, the mother-child pairs were classified in groups as follows: 41 BF, 25 PUMP, and 45 FORM. One-way ANOVA analyses did not find significant mean differences between these groups in restriction, monitoring, satiety response, and food responsiveness. However, multivariate analyses found the PUMP group had an unadjusted odds ratio of 0.33 (95% CI:

0.12-0.96) for high satiety level and after adjustment for child gender, maternal BMI, maternal educational level, maternal race, and maternal restraint in her own eating, the odds ratio was reduced to 0.27 (95% CI: 0.07-0.98). Correlations were found between the CFQ and CEBQ subscales. Correlations were found between food responsiveness and obesity outcomes, and satiety response and lower BMI. **Discussion:** This evidence supports the suggestion that breastfeeding without a bottle might allow infants to grow to have more positive eating behaviors. Future studies should expand upon these strategies in a prospective manner to promote clearer understanding of the breastfeeding-obesity factors.

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CHAPTER I

INTRODUCTION

I.A. Statement of Problem

The United States is currently facing an epidemic of obesity. The obesity problem is drawing attention from important organizations and governmental agencies, prompting statements like: "increasing [obesity] rates raise concern because of their implications for Americans' health" (Centers for Disease Control and Prevention [CDC], 2007) and "We must act now and we must do this as a nation" (Institute of Medicine [IOM], 2004). This epidemic is best explained by obesity data from the Behavioral Risk Factor Surveillance System [BRFSS] 1990 to 2007. The BFRSS utilizes standard weight status categories for their measurements, meaning obesity is defined as having a BMI of 30.0 or above. In 1990, the BRFSS found 34 states peaked at had an obesity rate of 10-14%. In 1995, the trends shifted substantially with 23 states having an obesity rate of 10-14% and 27 states having a rate of 15-19%. This increased rate trajectory continued into 2000, with 27 states having rates at 15-19% and 20 states having rates at 20% and greater. By 2007, the rates across the country reached new levels with 21 states showing obesity rates of 20-24%, 27 states reporting rates of 25-29%, and three states having rates of 30% or greater. This clear trend in obesity increase is best illustrated in Appendix A, where color-coded maps provided by the Centers of Disease Prevention and Control [CDC].

Those data represent obesity trends found in adults, but similar trends have been seen in younger age groups. Childhood overweight is defined as having a BMI at the 85th percentile to less than 95th percentile of the gender- and age-specific BMI growth charts (CDC, 2008).

Childhood obesity is defined as having a BMI at or above the 95th percentile (CDC, 2008). Nationally, the prevalence of childhood overweight more than doubled in the last quarter of the twentieth century. The NHANES survey found that children 12 years and older had rates of overweight increase from 5.0% in 1980 to 17.4% in 2004. The rate of being overweight in those 6-11 years old grew from 6.5% to18.8% from 1980 to 2004. And in the youngest group, those 2-5 years old, the rate of overweight increased from 5.0% to 13.9% from 1980 to 2004 (Odgen, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006: Odgen, Flegal, Carroll, & Johnson, 2002). This trend has not previously been seen in these age groups.

Overweight and obesity in children is an important public health issue as these children have increased risk for hypertension, high cholesterol, Type 2 Diabetes, and are more likely to experience social discrimination than their leaner peers (U.S. Department of Health and Human Services [USDHHS], 2001). This is of great public health concern hypertension and high cholesterol can increase risk for a major cardiac event and stroke. It has been estimated that a 10% reduction in total cholesterol level could reduce the incidence of heart disease by 30% (Cohen, 1997). Type 2 Diabetes has a major public impact as well, with estimated cost 117 billon dollars per year in medical expenditures and effecting approximately 7.8% of the US population (American Diabetes Association, 2008; National Institute of Health, 2008). And increased obesity in childhood is seen as the primary reason more children are being diagnosed with Type 2 Diabetes, which used to be considered an adult condition (NIH, 2008). Additionally, those who are overweight in adolescence hold a 70% chance of being overweight or obese in adulthood.

The increase in prevalence of overweight and weight-related morbidity calls attention to the need for obesity prevention. Obesity prevention interventions are now taking place in an

effort to provide early interventions. In a systematic review of pediatric obesity interventions, Baustista-Castano and colleagues identified 14 intervention studies that utilized a control group design (Baustista-Castano, Doreste, & Serra-Majem, 2004). Of these 14 studies, 12 were school-based, delivered to children aged 5 years and older and had little parental involvement. However it was concluded that the effective interventions had parental involvement and it was important in the success of interventions. This shows that earlier interventions are being performed but parental involvement is not a common component. It is important to include parents when intervening with younger children, as their parents are still actively involved in feeding. Even events during infancy have been shown to effect obesity outcomes, including rapid weight gain in infancy which is associated with obesity in childhood (Stettler, Zemel, Kumanyika, & Stallings, 2002) and adulthood (Stettler, Kumanyika, Katz, Zemel, & Stallings, 2003).

When investigating obesity prevention in infancy, the focus becomes infant feeding type. Breastfeeding has been suggested to provide protection against childhood obesity; however, the mechanisms behind this are not fully understood. Informative research must be done to understand how infant feeding affect future overweight status. Infant feeding can be investigated beyond the use of breastfeeding versus formula feeding. We now understand that early child eating behaviors predict later maladaptive eating behaviors (Ashcroft, Semmler Carnell, van Jaarsveld, & Wardle 2007); however, it is unclear whether infant feeding and eating behaviors could have any long term effects of behavioral obesity outcomes. The way in which an infant is fed either breastmilk or formula could hold importance in the development of feeding and eating practices. This study was developed in order to explain how behavioral aspects of infant feeding might influence early childhood behaviors that have previously been link to obesity risk.

I.B. Purpose of the Study

The purpose of this study was to investigate associations between maternal feeding styles and childhood eating patterns that could protect against childhood overweight. For this study, maternal feeding practices (i.e. breastfeeding versus bottle use) and the child's use of internal cues for eating were analyzed in terms of retrospective, maternal-reported breastfeeding exposure during the first three months of life, with specific consideration of breastfeeding from breast versus bottle-feeding breastmilk.

I.B.1 Definition of Key Terms

I.B.1.a. Infant Feeding Behaviors. For the purpose of this study, infant feeding behaviors focus on infant feeding type (exclusive breastfeeding or not) and use of a bottle for feeding during the first three months of life. Infant feeding type was defined as either breastfed exclusively or not breastfed exclusively. Exclusive breastfeeding means that during the first three months of life, the infant only received breastmilk and no supplementation was given, including formula, cereal, solids, and juice. The use of a bottle was assessed by asking the mother about bottle use in the first three months and by reviewing the medical charts for confirmation. Any use of a bottle in the first three months was considered "bottle-fed", except for rare events (in most cases within the first 24 hours of birth).

I.B.1.b. Maternal feeding styles. Maternal feeding styles often focus on the level of control, involvement, and concern a mother has in feeding their child. Maternal restriction and monitoring of feeding were the focus of this study. Maternal restriction is defied as the extent to which a mother restricts their child's access to food. Maternal monitoring of feeding is the extent to which a parent supervises their child's eating. Maternal feeding practices were assessed through a validated tool, the Child Feeding Questionnaire [CFQ]. The CFQ has

multiple subscales, but only those measuring maternal restriction and maternal monitoring of eating were examined in this study.

I.B.1.c. Child eating behaviors. Obesity-related child eating behaviors center around how a child reacts when food is presented to them (external cue) and whether they eat based on hunger and to respond to fullness (internal cues). In this study, the use of internal cues for eating was measured through a validated tool, the Childhood Eating Behaviour Questionnaire [CEBQ]. Specific focus was given to the CEBQ subscale of satiety responsiveness [SR] and food responsiveness [FR]. The SR subscale measures a child's utilization of internal cues, as it establishes how a mother perceives their child's ability to react to hunger and fullness. The FR subscale measures a child's utilization of external cues, as it establishes how a mother perceives their child's inability to overeat due to the presence of food.

I.B.1.d. Maternal and child obesity and overweight. Maternal weight status was based on BMI calculations using self-reported pre-pregnancy and current height and weight of the mothers. BMI is considered an alternative for direct measures of body fat, as it estimates body fat without the need for expensive and technical methods, such as dual energy x-ray absorptiometry (DXA). The calculated BMI was then used to categorize the mother's weight status as underweight (BMI<18.5), healthy (BMI=18.5-24.9), overweight (BMI=25-29.9) overweight and obese (BMI≥30). These categories were developed by National Heart, Lung, and Blood Institute (NHLBI) and the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) to determine an individual's health risk related to weight *(*NHLBI, 1998).

Child weight status was also based on BMI calculations. BMI was calculated through height and weight data collected at two- and three-year well-visits and at most recent well-visit. The calculated BMI identified to the growth percentile, which determines child weight status in

children. The weight status categories are as follows: underweight (0-5th percentile), healthy (5-84th percentile), at-risk for being overweight (85th-94th percentile) and overweight (95th percentile or higher). These categories were developed by the CDC and are based healthy growth and changes in body fat composition throughout childhood.

I.B.2. Research Questions

This study examined the following research questions: (1) Do mothers who exclusively breastfed their child during infancy display a less restrictive and controlling maternal feeding style later in their child's life as compared to mothers who did not exclusively breastfeed? (2) Do children who exclusively breastfeed during infancy display use of internal cues rather than external cues later when eating later in childhood as compared to children who had not been exclusively breastfed? (3) Are there differences in maternal feeding and child eating behaviors between those children who were breastfed, bottle-fed breastmilk, and bottle-fed formula? 4) Do maternal feeding styles, child eating behaviors, and BMI interrelate in young children?

I.C. Specific Aims

Based on these research questions, the following primary and exploratory aims of this study were developed. Figure 1 presents the aims and their interrelationships were explored between the variables.

Primary Aims

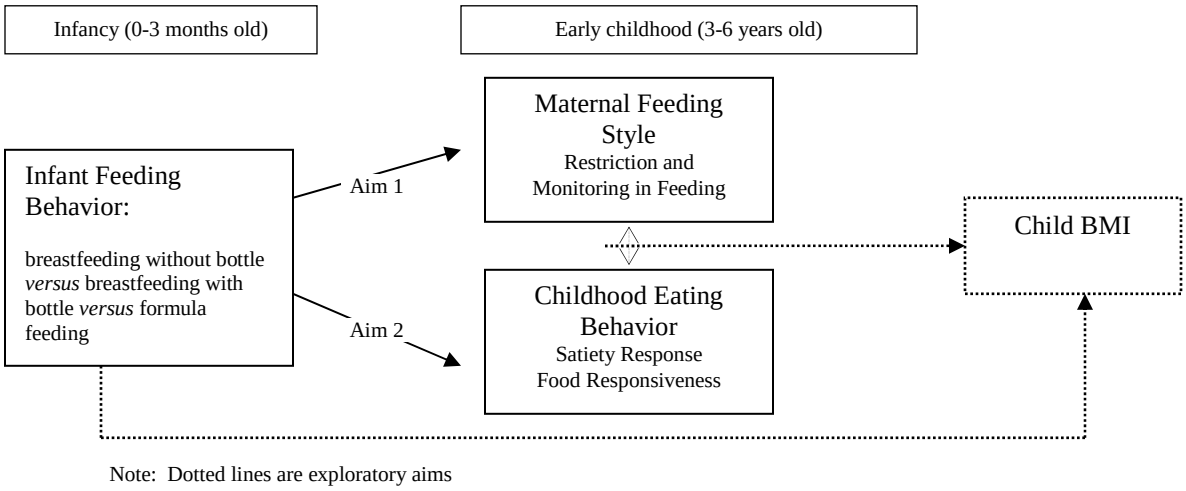
(1) To examine whether breastfeeding during the first 3 months of life, in particular feeding from breast rather than using breastmilk from bottle, is associated maternal feeding in later childhood, specifically lower maternal restriction and maternal monitoring of eating.

(2) To examine whether breastfeeding during the first 3 months of life, in particular feeding from breast rather than using breastmilk from bottle, is associated with an increased use of internal cues for eating in later childhood.

Exploratory Aims

(1) To explore the interrelationship between current maternal feeding styles and childhood eating behaviors in *young* children, their relationship with child BMI.

Figure 1: A Schematic of the Primary and Exploratory Aims.



I.D. Summary

Evidence that childhood obesity is a public health problem and that could be addressed by earlier interventions is apparent. The current study was designed to provide directions for future interventions that intend to focus on the earliest feeding and eating behaviors in infants that may influence risk for childhood overweight. In the chapters that follow, a comprehensive review of the literature on this area will be reviewed, and this project will be described in terms of its potential to contribute to current research. Following this review, the paper explains the research design and analytical methods used to meet the aims of this study. Lastly, the results of

this project will be presented and discussed to provide conclusions and implications for research in this area of infant and child feeding behaviors.

CHAPTER II

BACKGROUND AND SIGNIFICANCE

II. A. Breastfeeding and Obesity

Breastfeeding has been the focus of numerous investigations researching the possible predictors of childhood overweight. Butte (2001) reviewed 19 studies conducted between 1945 and 1999 that investigated the relationship between breastfeeding and future obesity in childhood and adulthood. Six studies found a significant relationship between breastfeeding and obesity, and of these, four studies revealed that breastfeeding exposure at various levels was associated with a significant reduction in obesity outcomes, including BMI and skin fold measurements (Butte, 2001).

One of the most methodologically strong studies reviewed by Butte was a cross-sectional study performed by von Kries and colleagues (von Kries, Koletzko, Sauderwald, Bernart, Grunert & von Voss, 1999). The study included 9,357 children aged 5-6 years in Germany. Data on height and weight were taken from a routine school examination and the BMI of each participant was calculated. Being overweight and obese was defined as being above the 90^{th} percentile and 95^{th} percentile, respectively, on the growth chart. Breastfeeding data were collected retrospectively through mothers' self-report. Children were categorized as being exclusively breastfed (no other food than breastmilk) for 0-2 months, 3-5 months, 6-12 months, or more than 12 months. The odds ratio for being overweight or being obese in the breastfed group (breastfed exclusively for 6 months or more) was 0.77 [95% CI (0.67-0.89)] and 0.62 [95% CI (0.49-0.79)], respectively, with the non-breastfed children as the reference group (von

Kries et al., 1999). There also was a dose-response relationship found for the duration of breastfeeding exposure and prevalence of obesity. The obesity prevalence rates by months of breastfeeding duration in terms of months were: 3.8% for 2 months, 2.3% for 3-5 months, 1.7% for 6-12 months, and 0.8% for more than 12 months (von Kries et al., 1999). However, it should be noted that 10% of parents reported that their children were exclusively breastfed without supplementation beyond 6 months, which is contrary to recommendations of the American Academy of Pediatrics [AAP] (AAP, 2005). With these considerations, von Kries' and colleagues' study does support breastfeeding as a protector against obesity risk, and in a dose-specific manner.

Armstrong and Reilly (2002) investigated the association of breastfeeding and obesity in a population-based study of 32,220 Scottish children who were 39-42 months old when assessing obesity. The investigators measured breastfeeding exposure only in the first 6-8 weeks of life. They utilized data from the Child Health Surveillance Programme in which a health visitor collects infant feeding information at the home of these children at about 6-8 weeks, allowing for a prospective study of breastfeeding and child obesity in the toddler years. Children were only included in these analyses if they were exclusively breastfed or exclusively formula-fed. This classification decreased misclassification bias. In this study, obesity was defined as a growth chart percentile greater than or equal to 95^{th} and severe obesity was greater than or equal to 98^{th}. Children who were breastfed exclusively for the first 6-8 weeks of life had a reduced risk of obesity at 39-42 months [adjusted OR= 0.70, (95% CI 0.61-0.80)]. The large sample and prospective design was the strength of this study, but the investigators were only able to control for socioeconomic status in analyses. An assessment of maternal factors related to childhood overweight, such as maternal BMI and maternal eating styles would add clarity to the findings.

Importantly, the findings demonstrated that even breastfeeding for 6-8 weeks can decrease the risk for obesity in early childhood.

Arenz and colleagues' (2004) meta-analysis provides further support of breastfeeding's potential protective effect on childhood obesity (Arenz, Ruckerl, Koletzko, & von Kries, 2004). Their meta-analysis included studies published from 1966-2003 in four databases (Silver Platter Medline, Embase, Cochrane Library, & Google). The inclusion criteria required all studies to be either population-based cohort, cross-sectional or case-control studies and that the obesity data were collected from children at age 1 or older. They reduced a pool of 954 potentially relevant studies to nine studies meeting the inclusion criteria and that adjusted for at least three of these confounders: birth weight, parental overweight, parental smoking, dietary factors, physical activity, and socioeconomic status. The meta-analysis of more than 69,000 children ranging in age from 3-18 years found an adjusted odds ratio of 0.78 [95% CI (0.71, 0.85)] for becoming obese when exposed to breastfeeding (defined as mostly or exclusively breastfed for 6 months or more). These findings are consistent with those of previous studies and add assurance to the argument of breastfeeding's protective role.

Another systematic review was performed on 2 databases (Medline and Embase) for publications from 1966-2005, and articles were selected that compared measures of obesity between breastfed and formula-fed infants in a quantitative or narrative way (Owens, et al., 2008). Sixty-one studies made the initial inclusion criteria, and 28 were included in the meta-analysis, as they all had estimates of odds of becoming obese between the two groups. The meta-analysis included over 298,900 children ranging 3-17 years old found an odds ratio of 0.87 [95% CI (0.85, 0.89)] for becoming obese in those who were breastfed. They found this relationship was stronger in studies with less than 500 participants as compared to studies with

more than 500 participants. This might be explained by more detailed breastfeeding exposure data collection in smaller studies. Owens et al. noted that future research needs to account for more of the possible confounders including parental obesity and socioeconomic factors.

Weyermann, Rothenbacher, and Brenner (2006) were able to control for numerous confounders when investigating breastfeeding exposure and obesity outcomes in toddlers. Data were collected during the mother's hospital post-delivery, at 12 months and 24 months, and included detailed breastfeeding and child health information. The German sex-specific percentile of the reference population was used to classify the children in terms of overweight (greater than 90th percentile) and severe overweight (greater than 97th percentile). Weyermann et al. (2006) found that those who were breastfed for 6-9 months and greater than 9 months were 70% and 60% less likely to be overweight at 24 months respectively, as compared to those breastfed less than 3 months. This was after adjustment of numerous possible confounders, including maternal BMI, smoking during pregnancy, birth weight, education level of mother. Those exclusively breastfed for more than 6 months were 70% less likely to be overweight at 24 months. Only about 9% of the 855 children analyzed were never breastfed, and this group seemed to be uniquely different than those breastfed; therefore, the group who was breastfed for less than 3 months was used as the reference population. These findings point to prolonged breastfeeding as potentially protective against later childhood obesity, even in very young children.

The original research studies and review analyses presented show consistent support for breastfeeding as a protective factor against later obesity. With data and other research, the AAP stated protection against obesity as one of the numerous benefits of breastfeeding in their policy

statement (AAP, 2005). Additionally, the CDC claimed breastfeeding to be a "promising approach" to preventing obesity in their statement of chronic disease prevention (CDC, 2005).

While these statements support the relationship between breastfeeding and childhood overweight, recent findings of Michels and colleagues do not support these statements (Michels et al., 2007). This study came from the Nurses' Health Study II [NHSII] and was longitudinal. The findings are not supportive of breastfeeding protecting against obesity, but the methods of this study must be probed. The study of 35,526 nurses began in 1989 when they were 25-42 years old. In 2001, the nurses' mothers (if the mother was living) were sent questionnaires asking about the nurse's infant feeding behaviors, and the response rate was 76.5%. These mothers were asked to recall when they started formula and other supplementation, their daughter's birth weight, and gestational age of their daughter. The mean age of the mothers completing this questionnaire was not reported, however the mean age of their daughters was 40.5 and 39.3 years old for the breastfed and not breastfed groups, respectively. There was the potential for recall accuracy problems due to the fact that the mothers' of the nurses were asked to recall breastfeeding behaviors from about 40 years ago. Indeed, a study by Promislow and colleagues demonstrated that among mothers aged 69-79, their recall of breastfeeding behavior was only 54% accurate compared to their prospective diary records obtained when they were breastfeeding (Promislow, Gladen, & Sandler, 2005).

In the Michels et al study (2007), BMI measures (height & weight) were self-reported by the nurses' in 1989, when they were also asked to recall their weight at age 18. With these data, they found that being overweight or obese in 2001 or at age 18 was not significantly associated with any duration of breastfeeding, ranging from 1 week to beyond 9 months. After adjustment for over 20 possible confounders, the association remained statistically insignificant.

In addition to methodological concerns, the ability to generalize of findings is limited. First, the mean BMI in 2001 was in the overweight range (25-29), at 26.4; the sample was also of high income and of high education. Only about 12% of each group (breastfed and not breastfed) had an income of less than $50,000 per year and about 15% of each group (breastfed and not breastfed) had only a high school diploma or less education. Lastly, the sample only included females. Obesity in childhood has been found to be most prevalent in low-income, minority populations; therefore it is important to include them in large studies explaining potential predictors (Ogden, Flegal, Carroll, & Johnson, 2002). While these findings should be recognized, the methodology of this study is not solid enough to dispute the voluminous findings of the past which support breastfeeding's association with future obesity.

The literature presented and the statements of important health agencies present breastfeeding as a promising component of obesity prevention. While findings such as Michels and colleagues (2007) might question this relationship, the data available supports investigations into the potential mechanisms behind breastfeeding's role in obesity prevention. As research has added evidence to breastfeeding's protective role, questions have been raised about the potential mechanisms. The role of breastfeeding in behavioral aspects of obesity risk was been research and evidence will be reviewed regarding its connection with parent feeding styles and child eating behaviors. Understanding whether behavioral mechanism exist is beneficial, because if they are understood, these behaviors could then be taught to all those involved with infant feeding, whether they choose to or are able to breastfed or not.

II.B. Breastfeeding, Parent Feeding Styles, and Eating Behaviors in Childhood

The mechanisms behind breastfeeding preventing childhood obesity could be biological, meaning that the breastmilk itself contains some component (i.e. bioactive factors) that reduces

obesity risk. Another type of mechanism could be behavioral, in that the infant learns certain positive eating habits or styles which reduce obesity risk. Owens et al. (2005) suggested the habits or programming developed during infant feeding could have long-lasting effects because they found that breastfeeding exposure continues to decrease obesity risk with increasing age. The current study focused on the possible behavioral mechanisms behind this relationship.

It is suggested that the nature of breastfeeding allows infants to have increased control of their feedings, which lends support to the idea of a behavioral mechanism. For example, Fomon, an expert in infant nutrition wrote about his suspicion that infants who are breastfed have more control over their feedings than bottle-fed infants (Fomon, 1993). He spoke of infants use suckling as a response to internal hunger cues, leading them to be breastfed by their mother in response to these internal cues (Fomon, 1993). Whereas bottle-fed infants might be fed on a time schedule, possibly leading them to be fed in response to external cues more often than internal cues (Fomon, 1993). Additionally, mothers who bottle-feed might encourage the infant to finish the bottle, but breastfeeding does not allow for any feedback as far as ounces taken by the baby, so they rely solely on the infant's suckling cue (Fomon, 1993). Fomon's report on the nature of infant feeding has led to research investigating maternal control and other feeding styles in relation to infant feeding method.

Fisher and colleagues (2000) examined the relationship between breastfeeding, behavioral measures of obesity risk, and energy intake in 18 month old toddlers, as well as how maternal feeding practices might mediate this relationship in a prospective cohort of 55 mother-child pairs. (Fisher, Birch, Smiciklas-Wright, & Picciano, 2000). Breastfeeding data were collected at the time of enrollment (12-13 months old) and was measured via self-report using two questions. Maternal control in feeding was measured using the subscale from the Child

Feeding Questionnaire [CFQ]. The CFQ is an instrument that has been validated in non-Hispanic white and Hispanic white populations, and is used to evaluate seven different factors of maternal feeding strategies (Birch, Fisher, Grimm-Thomas, Markey, Sawyer, & Johnson, 2001). The subscales can be used together or separately. The maternal control over feeding subscale consisted of 11 questions on a 5-point scale, with a higher score meaning more maternal control during child feeding. Investigators trained mothers to record portion size and types of foods in a food diary, which was analyzed for overall energy intake. Study staff obtained standardized height and weight measurements monthly for the six-month period.

Fisher et al. (2000) found that those who breastfed their infants for 12/13 months reported lower levels of maternal feeding control (β=-.36, P<.01). Lower infant weight at 12/13 months was associated with lower maternal feeding control (β=.30, P<.05). They also performed a mediation analyses through simple slope regression techniques, and they found that breastfeeding during the first year might reduce a toddler's energy intake compared to those who breastfed for less than 12/13 months, with maternal control being a mediating factor (β=-.36, P<.05). These data lend support to the central idea behind the aims of this study: breastfeeding allows mother and child to learn behaviors that allow the child to regulate their own energy intake, thereby instilling positive maternal feeding styles (low restriction and control) and positive later-childhood eating behaviors (high response to internal cues and low response to external cues).

In a large cohort study, Taveras and colleagues (2004) similarly investigated whether the amount of breastfeeding exposure in the first six months of life was associated with decreased maternal restriction and decreased pressure to eat as measured by the CFQ (Taveras, Scanlon, Birch, Rifas-Shiman, Rich-Edwards, & Gillman, 2004). Breastfeeding at six months was the

exposure of interest and was based on both exclusivity and duration, creating four exposure groups (breastfed exclusively, mixed breastfed, weaned, formula fed). Maternal restriction was measured by one question from the CFQ and the pressure to eat was measured by the 5 question subscale from the CFQ. Taveras and colleagues found the breastfeeding group had a significantly reduced odds ratio of maternal restriction in feeding at .27 (95% CI .10-.72) as compared to the weaned and mixed feeding group who did not have significantly reduced odds (Taveras et al., 2004). Mothers who fed infants breastmilk for the first six months of life or longer had decreased risk of restricting their child's food intake at age one, which is protective against obesity risk. After adjustment for numerous possible covariates, the approximate reduction in the odds of restriction was about 10% for each one-month increment of breastfeeding duration. Pressure to eat was not found to be significantly associated with the initiation or continuation of breastfeeding in the analyses performed. They also measured preexisting concerns about child weight in the mothers during pregnancy, and found that mothers having more concern (whether under- or over-weight concerns) decreased breastfeeding duration.

While these studies show support for the hypotheses of this study, they have neglected to directly address possible differences among women who breastfed versus women who bottle-feed with expressed breastmilk, as well as comparing these groups to primarily formula fed infants. A better understanding of the bottle's role in maternal feeding styles later in childhood will more clearly address the speculations of Fomon (1993) as related the infants use of internal eating cues (hunger & satiety) versus the mothers use of external cues (fullness of bottle). Internal cues and the maternal feeding practices of restriction and control were the focus of this research, and their importance lies in their role in obesity prevention.

II.C. Importance of Parent Feeding Styles and Child Eating Behaviors in Obesity Prevention

Certain eating styles have been linked to obesity, making these important outcomes when researching obesity prevention in children**.** Internal cues (hunger and satiety) and external cues (food responsiveness and meal schedules) have been studied extensively in children and have been found to play a role in being overweight. Satiety (internal cue) response has repeatedly been found to protect against obesity (Johnson, 2000; Satter, 1996). By responding to satiety cues, a proper response would be to slow or stop eating. In a commentary by Satter (1996), she spoke of the lack of trust in children's natural growth patterns which can lead to external regulation of food, predominately from parents. She states a key to feeding children is to nurture in a way that the infant can accommodate the external environment and respond to internal cues, including satiety and hunger. If a mother utilizes restrictive feeding styles, such as keeping certain foods out of child's reach and uses sweets which are normally restricted as a reward, than it is thought her child will be less apt to respond to their internal cues related to eating. If a mother utilizes monitoring as a feeding style, such keeping track of how many sweets and high fat foods their child eats, than the mother might feel as though she has a better ability to manage the child's food intake than the child does. Therefore, restriction and monitoring in feeding can lead to an exaggerated response to food presence and desire for certain foods, which is takes focus away from the child's internal cues. Johnson applied these ideas to an intervention study of pre-school children (Johnson, 2000). She found that a mother's use of restraint in her own eating and her controls over child feeding are related to child's energy intake. But importantly, Johnson found that an intervention promoting the use of internal cues in children is effective in lowering energy intake, increasing use of internal cues, and reducing the association between a mother's restraint in her own eating and the child's eating behaviors.

Maternal control over her child's eating has been associated with higher risk of being overweight in childhood, as more maternal monitoring and restrictiveness can lead to decreased use of internal cues by the child (Birch, Fisher, & Davidson, 2003). A longitudinal study of 140 girls beginning at age 5, and following to age 7 and age 9 was performed. They focused on whether parental report of restriction (low versus high) and child weight status would affect results in an eating without hunger laboratory experiment. To do this, girls were given a normally portioned lunch for their age group (sandwich, carrots, applesauce, milk, and cookies) and hunger was measured. Those who reported being "hungry" versus "half-full" or "full" were not included in the analyses related to eating without hunger. Girls were then given free access to a preferred snack food in a laboratory room. The girls were told they could play with any toys and eat as much as they like while the experimenter left the room for 10 minutes. All of the snack food remaining was measured for food weight and caloric intake. From the measurements of snack energy intake, the "eating without hunger" calculations was performed, which assesses how much a child will eat even if they report being "half-full" or "full" following a normal size meal. A higher the calculation score means more calories were consumed without hunger.

Girls with high restriction at age 5 were more likely to eat more calories without hunger at 7 years ($p<0.001$) and at 9 years ($p<0.01$). Those who were overweight and had higher restriction at 5 years had the highest calorie intake of all groups in the eating without hunger sessions ($p<0.05$). The girls who were overweight but had low restriction at 5 years, scored lowest of all groups at 9 years. This study supports the idea that restriction does play a crucial role in developing long-term, positive eating strategies in children, particularly internal hunger response even if a child is overweight at an earlier age.

Sprutijt-Metz, Lindquist, Birch, Fisher, & Goran (2002) investigated the relationship between maternal child feeding styles and adiposity in late childhood. Their investigation was performed in white (n=74) and African American (n=49) children aged 7-14 years old who were normal-weight and obese children. Maternal child feeding practices were measured by five subscales of the CFQ, and body composition (total body mass and total fat mass) was measured by the Dual energy X-ray absorptiometry [DXA]. The control variables were SES and energy intake. Sprutijt-Metz et al. (2002) found that maternal feeding restriction ($r=0.26$, $p<.001$) and maternal concern related to feeding ($r=0.53$, $p<.001$) were positively correlated with total fat mass. These results support the idea that controlled feeding styles interfere with a child's ability to learn self-regulation in eating, thus leading to childhood overweight and obesity outcomes, including high total fat mass in early adolescence.

Farrow and Blissett (2006) investigated the relationship between maternal control over feeding and infant weight gain in the first year of life and understand whether maternal control plays a moderating role. They enrolled 63 six-moth old children and their parents. Maternal control over feeding was assessed at six months through an in-home observation session by a trained researcher. The observations were scored using the Feeding Interaction Scale (FIS) which ranges from 1- 9, with 1 meaning the mother has the greatest control and 9 meaning she has the least control. Twenty percent of the mother-child observations were randomly selected to be recoded by a second trained observer in order to measure interrater reliability of the observations and the inter-rater correlation was .784 ($p<.001$). Birth weight and weight gain from birth to six months was collected retrospectively from medical records and the infants were followed from six months to one year to measure weight gain. Additionally, breastfeeding history, parent's BMI, parent's eating styles, and infant temperament were measured. Farrow and

Blissett (2006) found differences in infant weight gain patterns by separating weight gain from 0-6 months and 6-12 months when examining the role of maternal control as a possible moderator of infant weight gain. Infants with low maternal control at 6 months and high weight gain in 0-6 months had lower weight gain during 6-12 months. Infants with low maternal control at 6 months and low weight gain in 0-6 months had greater weight gain during 6-12 months. Therefore, infants with low maternal control seem to balance out their weight gain over the first year of life. But for infants with high maternal control at 6 months and high weight gain in 0-6 months continue to have high weight gain during 6-12 months. This pattern was also seen in infants with high maternal control and low weight gain in 0-6 months, as they continued to have less weight gain during 6-12 months. So it appears infants with less controlling mothers regulate their growth throughout the first year of life and the infants with more controlling mothers seem to have poor self-regulation. Farrow and Blissett (2006) also found breastfed infants had mothers that were less controlling ($t=-2.208$, $p<.05$) than non-breastfed infants.

These findings and those previously reviewed show that maternal feeding styles can affect infant/child weight gain and eating styles. The use of internal cues in eating and maternal control/restriction in feeding is associated with obesity risk, poor weight outcomes, and breastfeeding behaviors. However, breastfeeding behaviors, internal cue use in child eating and positive maternal feeding styles have rarely been examined together. Infant feeding type has been mainly controlled for rather than focused on as a feeding style. It is through theory that these infant feeding and childhood behavioral obesity outcomes have been linked for the current investigation.

II.D. Social Cognitive Theory and Understanding Development of Eating Styles

The previous review of literature suggests that mothers of infants who are breastfed utilize less restriction and monitoring control over child feeding during the first years of life, which might increase an infant's ability to self-regulate as compared to bottle-fed infants. This association between mothers' feeding style and later offspring eating behavior could be attributed, in part, to the visual and tactile feedback she observes from the amount and weight of milk (breast or formula) in the bottle in the during infant feeding. Bottle feeding leads to a mother's reliance on visual cues of milk intake from the bottle. While breastfeeding leads to a mother's reliance on cues from the baby that signal satiety, such as infant suckling, infant relaxation or drowsiness. This relationship between mother, infant, and the infant's internal eating cues represents the interpersonal relationship that is being established in the first few months of life. Bandura's Social Cognitive Theory [SCT] (or Social Learning Theory) explains that personal behavior is reciprocally influenced by our interpersonal and environmental interaction (Bandura, 1989). One of the crucial interpersonal factors is observational learning.

The interpersonal environment does play a role in a child's development of eating behaviors (Gable & Lutz, 2000). The parental role can profoundly affect obesity outcomes in children given that parental feeding behaviors affect child weight outcomes and are suspected to influence the developing eating behaviors of the child. The concept of reciprocal determinism is relevant when applied to infant feeding. Reciprocal determinism explains that there is a dynamic interaction between the person, behavior, and the environment and that these factors may simultaneously influence each other (Glantz et al., 2002). When applied to infant feeding and the development of eating behaviors early in life, both the infant and mother are interacting to interpret each other's behaviors (i.e. infant suckling, mother's encouragement to finish bottle)

and from the environment (i.e. fullness of a bottle, time of day). Through these observations, a breastfeeding mother learns from the infant that he/she has the ability to self-regulate his/her eating while the infant simultaneously learns that internal cues (e.g., hunger, satiety) are reliable signals for eating and maintaining satisfaction. The SCT constructs of outcome expectancies and expectations support these notions, in that a mother can develop expectations for her feeding strategies (i.e. encouraging infant to finish bottle before bedtime) and how they effect the infants' response (i.e. infant sleeps well). Also, a bottle-feeding mother might focus more on ounces of formula or breastmilk eaten in by the infant and rely on visual cues from the bottle more than from behavioral cues of the infant (Fomon, 1993). Thus, the presence of the bottle and its contents as a cue for signaling completion of baby's eating versus breastfeeding cues might hold more differential salience than breastmilk versus formula (both fed via bottle) in investigations of infant feeding styles and childhood obesity.

The SCT's concept of observational learning explains that the environment provides a model for behavior. A person can learn from observing another's behavior and learn the reinforcements received for certain behaviors (Bandura, 1989). The idea of eating behaviors as being a learned behavior was demonstrated by Johnson. Johnson's (2000) intervention study of 3-4 year olds showed that pre-school children can be taught to self-regulate energy intake. Johnson developed an intervention promoting use of internal cues like hunger and satiety. She tested the effect of this intervention by measuring reduction in eating without hunger. Eating without hunger, as measured through compensation trials, has been accepted as an important predictor of obesity risk as it reveals whether an individual has lack of inhibition when eating and when presented food. Compensation trials involve at least a two day trial. On trial days, 30 minutes before a meal half the children in a group or class are administered high calorie drink

(called a “pre-load”) on Study Day 1 and the other half are given a low-calorie drink. This condition is then reversed for Study Day 2 which often occurs at least a week later. The drinks look and taste the same, whether they are high (150 kcal) or low calorie (3 kcal), and are presented in the same cups. (In some studies, they have 2 additional trial days when the preload drinks are not “disguised” to taste the same). The children are given plenty of time to finish the drinks and are encouraged to finish them. Then children are fed a normal meal 30 minutes later.

In the trials for the Johnson (2000) study, the children were presented with a variety of food at lunch (turkey hot dogs, rolls, cheese, applesauce, carrot sticks, cookies and milk) and they were told they could eat whatever they wanted until they were no longer hungry. Intake is measured by pre- and post-weighing of food. Following Johnson and Birch (1994) methods, COMPX scores were calculated from compensation trials which follow this equation:

$$\frac{\text{(meal intake (kcal) of low-calorie preload – meal intake (kcal)after high-calorie preload)}}{\text{(intake (kcal) of high-calorie preload - intake (kcal) of low-calorie preload)}} * 100$$

The intervention developed by Johnson involved a skit performed in the first week by the researchers on hunger, eating until fullness, signals of over eating, and the body parts used in eating (i.e. esophagus, mouth). The next week the children interactively watched a video with the researcher on similar topics. The next week the children were introduced to doll play which would help them better understand hunger and satiety. The doll had three stomachs which could be attached to the doll by Velcro. The one stomach was empty, one was half-full, and one was full. After a week of learning about these dolls and how to play with them, the following four weeks involved mealtime prompts. Each child was prompted one-on-one by the researcher one day per week before and after their snack-time. The children were asked to identify all three doll stomachs, then to put their hand over their own stomach and select the doll stomach that was

closest to the way their own felt. Lastly, during the normal morning snack-time, all children were prompted at least two times to check and see if they were still hungry.

Johnson (2000) found that 17 of the 25 children improved their COMPX score from pre-intervention to post-intervention and overall the mean changed from 23.4 +/- 20.5 to 65.1 +/- 14.9, with 100 meaning perfect calorie compensation for the high-calorie preload. Most interestingly, Johnson found that at pre-intervention a mother's restraint in her own eating was associated with scores in the compensation trial; however, this association was not present at post-intervention. Johnson's finding support the use of SCT as the basis for this investigation, because it shows that use of internal eating cues can be learned.

However, the question remains: "What do infants learn when feeding from the breast or the bottle that could influence later childhood eating behavior?" The infant learns from both their mother and their environment as they eat. A mother might provide various levels of reinforcement or praise depending on the infant's bottle intake and the infant might begin to learn what a full bottle versus half-full or empty bottle feels like. The current investigation seeks to understand the differences between those who breastfed, bottle-fed breastmilk, and formula-fed in order to understand how these varying feeding methods affect later feeding and eating behaviors. The results from this study could lead to prospective experimental and intervention studies that test whether altering bottle-feeding affects maternal feeding styles and future child eating behaviors later in childhood. The results could also provide important guidance for pediatricians in the area of infant feeding and obesity prevention. Lastly, if important elements of infant feeding are identified as preventing obesity, these elements can be promoted to all those involved with infant feeding, including mothers, fathers and other caretakers.

II.E. Hypotheses of the Current Study

Aim 1: To examine whether breastfeeding during the first 3 months of life, in particular feeding from breast rather than using breastmilk from bottle, is associated with lower maternal restriction and maternal control of eating

Hypothesis 1a

Those children who were breastfed exclusively for at least the first three months of life will score lower on the maternal restriction subscale of the CFQ at 3-6 years of age, as compared to those not breastfed for at least the first three months of life.

Hypothesis 1b

Those children who were breastfed exclusively for at least the first three months of life will score lower on the control/monitoring subscale of the CFQ at 3-6 years of age, as compared to those not breastfed for at least the first three months of life.

Aim 2: To examine whether breastfeeding during the first 3 months of life, in particular feeding from breast rather than using breastmilk from bottle, is associated with an increased use of internal cues for eating.

Hypothesis 2a

Those children who were breastfed exclusively for at least the first three months of life will score higher on the satiety responsiveness subscale of the CEBQ at 3-6 years of age, as compared to those not breastfed for at least the first three months of life.

Hypothesis 2b

Those children who were breastfed exclusively for at least the first three months of life will score lower on the food responsiveness subscale of the CEBQ at 3-6 years of age, as compared to those not breastfed for at least the first three months of life.

Aim 3: To explore the interrelationship between current maternal feeding styles and childhood eating behaviors in young children and child BMI.

Hypothesis 3a: Maternal feeding styles, as measured by the CFQ, and childhood eating styles, as measured by the CEBQ, will be explored for their intercorrelation in children aged 3-6 years.

Hypothesis 3b: The interrelationships between maternal feeding styles, child eating behaviors, and childhood obesity outcomes will be explored in children aged 3-6 years.

CHAPTER III

METHODS

III.A. Study Design

This was a retrospective cohort study, which allowed for an efficient examination of breastfeeding exposure retrospectively while examining concurrent early childhood feeding practices and eating outcomes. The efficiency of the design was the appropriate scope for this project and ensured completion of the study within a dissertation timeline. Study inclusion focused on mothers with children 3-6 years old. This age group allowed for an examination of parent-child behaviors when children remain highly dependent on their parents for food consumption. Mothers of children less than 3 years old were excluded primarily because parents of children in this age group, as well as the children themselves, are only beginning to develop consistent feeding and eating styles with solid foods.

III.B. Subjects

III.B.1. Sample Population

Mothers of children aged 3-6 were recruited through two recruitment methods. The primary method was through in-person recruitment in the waiting area of a private pediatricians' office. The secondary method was through the use of a listserv provided by a specialty breastfeeding center, in the same geographic area as the pediatricians' office. Breastfed and non-breastfed children were included. Breastfeeding was defined in terms of exclusivity and duration and mother-child pairs were assigned to one of three groups.

For the purpose of group classification in this study, only exclusive breastfeeding (only breastmilk and water) were considered breastfed and three months was the minimal duration accepted to be classified in one of the two breastfeeding groups. By defining "breastfed" as only

exclusive breastfed in our sample, we should have decreased the chance of misclassification that can occur when retrospectively assessing breastfeeding behavior. The basis for the minimal duration of three months for breastfeeding classification in this study was two-fold: (1) the empirical evidence suggesting prevention of obesity with three months or less of breastfeeding (Armstrong & Reilly, 2002; von Kries et al., 1999; Weyermann et al., 2006) and (2) the rates of breastfeeding in the United States drop from 41.1% for breastfeeding exclusively at three months to 36.2% for breastfeeding at all at six months (CDC, 2005). Evidence from past studies support using the breastfeeding in first three months as a suitable "dose" for obesity prevention and it was a useful exposure definition because it reflects national trends in breastfeeding, as compared to exclusive breastfeeding until six months, which is uncommon.

III.B.2. Inclusion and Exclusion Criteria

Inclusion and exclusion criteria are listed in Table 1. These criteria were established in order to reduce confounding and to allow for the most accurate data collection possible.

Table 1. Inclusion and Exclusion Criteria for Mother-Child Pairs

Included if:	**Excluded if:**
Mothers must have been aged 18-45 at time of giving birth and child is currently 3-6 years old	Mother had a condition at the time of childbirth that contraindicated breastfeeding (i.e. double mastectomy, illicit drug use)
Mother must be seeking care for their child at pediatrician office or a participant in the Breastfeeding Resource Center's listserv	Mother reports previous or current diagnosis of eating disorder
Mothers must currently live with the child	Child had serious illness that affected weight and/or eating/feeding habits (i.e. cancer, diabetes, food allergies)
Child is a singleton	

III.B.3. Explanation of Inclusion/Exclusion Criteria

The subjects in this study are both mothers and their 3-6 year old children. While the mothers were the primary participant, much of the data collected were about the child. Although other guardians would have been asked to participate (as long as they currently lived with the child full-time and had knowledge of the child's breastfeeding exposure), only mothers were enrolled as they were the guardians who brought the child to the pediatrician. Empirical evidence has shown the associations of interest like parent BMI, parent restraint in their own diet, and child outcomes are more relevant between mother and child than father and child, therefore recruiting mothers was preferable (Johnson, 2000).

Mothers who had a condition when they gave birth that contraindicated breastfeeding, such as a double-mastectomy, illicit drug use, HIV/AIDS, were excluded. This criterion was developed to ensure that all participants had an opportunity to be exposed to breastfeeding, which is crucial when gathering a sample for a retrospective cohort study. Mothers who were not between the ages of 18-45 when they gave birth were excluded. This criterion was developed because it over 96% of births happen during this age range, so those outside would be rare and would be outliers (CDC, 2004). Children who were twins at birth were excluded because of the difficulty of breastfeeding twins. While having twins in no way contraindicates breastfeeding, only breastfeeding is less likely in twins, particularly for prolonged periods (Damato, Dowling, Madigan, & Thanattherakul, 2005). Children with serious illness (i.e. cancer, diabetes, severe food allergies) that might have affected weight and/or eating/feeding habits will not be included in the study. Lastly, mothers who report having a previous diagnosis/treatment of an eating disorder, such as bulimia or anorexia nervosa, were excluded. Because previous literature shows that a mothers own diet issues can affect the way she feeds her

child and the way her child eats, it is important to exclude those severe cases which have been diagnosed or treated.

III.C. Method of Data Collection.

III.C.1. Recruitment Sites.

III.C.1.a. In-clinic Recruitment. The majority of participants were recruited in-clinic at a private pediatrician office. This setting allowed for access to potential participants and their medical charts to verify maternal reported breastfeeding data and child growth information. The medical charts were additionally used to collect height and weight recorded at well-visits from birth to the most recent measurement. The pediatrician office for this study, Abington Pediatrics Associates [AbPeds], was selected based on its patient population (e.g., higher breastfeeding rates compared to the university-affiliated, urban clinics), proximity, and relationships with other student research projects (please see attached Letter of Support). The surrounding community would be defined as middle to upper income, suburban, and primarily white.

III.C.1.b. Breastfeeding Resource Center Recruitment. The Breastfeeding Resource Center [BRC], which was nearby the pediatricians' office, is a non-profit organization that assists mothers in all things related to infant feeding. Their work with in the community includes the development of an email network which updates current and former patients, lactation specialist, and all those interested in breastfeeding and the BRC. The director of the BRC allowed for the distribution of a recruitment email (see Appendix B) via their listserv, which resulted in additional recruitment of eligible participants.

III.C.2. Procedures for Recruitment.

III.C.2.a. Procedures for In-Clinic Recruitment. The researcher approached potential participants in the waiting area of the pediatricians' office. If a mother was interested in

participating, she was asked to complete 30-second screening interview to ensure eligibility criteria were met. Eligible mothers were asked to participate and informed consent was obtained from those who agree to participate. Mothers were asked to complete a survey while they waited and during lag time between the nurse and physician examinations. The survey included items for assessing demographics, confounding variables, the CFQ and CEBQ (see Appendix C). The survey packet took most mothers only 10-25 minutes to complete, when there were few interruptions. The mothers were asked to complete the surveys at the doctor's office if possible and the researcher assisted mothers by offering to fill-out the survey by interview or by entertaining their children while she completed the survey. Children of the participants were offered small toys and/or coloring materials to occupy them as their mother completes the survey. Mothers who were unable to complete the survey during their child's visit received a pre-addressed stamped envelope to return the survey. Contact information was not collected for the participants in order to increase the anonymity. In some cases, participants left before completing the survey and were uninterested in taking it along with them. In these cases, a participant's survey was used as long as the primary variables were completed.

Breastfeeding data was collected by self-report from the mother and was verified in the medical chart. Notes were taken describing the amount of pumping reported at each visit and the time of supplementation. Medical charts were also reviewed for child weight and height at well-visits occurring from birth through their current age. Medical charts were set aside by the staff of the pediatricians' office for the researcher, and the charts were reviewed the same day of the participants' visit, prior to charts being filed at the close of business. When discrepancies occurred between maternal recollection or breastfeeding and the medical chart data, the medical chart value was used as the accepted value for this study. When a mother was unsure of her

breastfeeding behaviors and the data was not found in their child's medical chart, the participant's data was not included in the analyses.

III.C.2.b. Procedures for Breastfeeding Resource Center. A secondary recruitment strategy was developed as a means to increase the recruitment of women into the PUMP group. The BRC provided access to past and current patients as well as others affiliated with the center (i.e. lactation consultants, breastfeeding counselors) through their email listserv. The email asked that those interested in participating in a breastfeeding research study contact the researcher directly by email or phone. The eligibility status was assessed in those who responded. If eligible, a potential participant was mailed the consent form, survey, and an envelope to return the completed survey. The survey was identical to the survey administered at the pediatricians' office; however participants were asked to complete the child growth data from their pediatrician's records and there was no medical chart verification in this group. Participants had access the researcher by phone or email with any questions. Participants were asked to return completed surveys within two weeks of receiving it. Participants were sent and email reminder or given a reminder call if the survey was not received within this time period.

III.D. Measures

III.D.1. Breastfeeding Exposure

Mothers were asked 3 questions taken from the National Immunization Survey [NIS] to establish breastfeeding exposure. These questions include, *"Was [child's name] ever breastfed or fed breastmilk?", "How long was [child's name] breastfed or fed breastmilk?",* and *"How old was [child's name] when [he/she] was fed something other than breastmilk? This includes formula, juice, solid foods, cow's milk, sugar water, or anything else."* Those mothers who answer "no" to the first question or "less than 3 months" to the third question were classified as

"Formula fed" for the purpose of this study. Those who answer "yes" to the first question and "3 months or more" to the third question were classified as "breastfed". The breastfed group was separated into two groups based on this question: *"If you fed your child breastmilk during the first 3 months of your baby's life, what proportion of time did you fed your baby from the breast? (All of the time, Most of the time, Some of the time , None of the time)."* Those who answer "All of the time" were classified as **"Breastfed Exclusively"** for the purpose of this study. Those who answer "Most of the time", "Some of the time", or "None of the time" were classified as **"Bottle fed Breastmilk"** for the purpose of this study. These questions were asked in the pediatricians' office and the medical charts of each child were used to cross-validate the mother's breastfeeding behaviors with the child of interest.

III.D.2. Outcome Measures

Mothers completed the CFQ and CEBQ (Birch et al., 2001; Wardle et al., 2001). These instruments obtained information related to maternal feeding and child eating behaviors via maternal self-report.

III.D.2.a. Maternal feeding behaviors. CFQ is a validated 24-item instrument that includes five subscales. The "Restriction" (8 items) and "Monitoring" (3 items) subscales were focused on for most of the analyses. The CFQ Restriction subscale attempts to assess the extent to which a parent restricts their child's access to food and is measured on a five-point agreement scale, with zero being "disagree" and four being "agree". The CFQ Monitoring subscale assesses the extent to which a parent supervises their child's eating and is measured on a five-point frequency scale with zero being "never" to four being "always". An example item from the CFQ Restriction subscale is: "If I do not guide or regulate my child's eating, he/she would eat too many junk foods." An example question from the CFQ Monitoring subscale is: "How

much do you keep track of the snack food (potato chips, Doritos, cheese puffs) that your child eats?" The CFQ Restriction subscale and CFQ Monitoring subscale have been used in much of the research performed in the area of parent-child feeding practices and both were validated to have a high internal consistency of Cronbach's α=0.78 and Cronbach's α=0.92, respectively (Birch & Fisher, 2000; Birch, Fisher, Grimm-Thomas, Markey, Sawyer, & Johnson, 2001).

III.D.2.b. Eating behaviors of child. CEBQ is a 35-item instrument that includes eight subscales (food responsiveness [FR], enjoyment of eating, emotional overeating, desire for drinks, satiety responsiveness [SR], slowness in eating, emotional under eating, and food fussiness), that has gone through a preliminary validation (Wardle, Guthrie, Sanderson, & Rapoport, 2001). However, Wardle and colleagues have validated the SR and FR subscales (and the Enjoyment of Food subscale) against compensation trials, which are considered a more objective measure (Carnell & Wardle, 2007).

The compensation trials were similar to those of Johnson (2000) previously explained, however Carnell and Wardle (2007) added the disguised and undisguised components to trial. The trial ran for five days, with day one being the control trial, day two and three being the disguised "preload" drink compensation trials, and day four and five being the undisguised "preload" drink compensation trials (the low-calorie and high-calorie "preloads" looked and tasted different). They found that SR subscale scores were significantly associated with lower eating with hunger intake, lower average total energy intake, and slowness in eating. Those scoring high on the SR subscale did have improved average COMPX scores, however this finding was not statistically significant. The FR subscale scores were associated with fast eating and high overall energy intake, but were not significantly associated with COMPX scores. Carnell and Wardle (2007) also found that SR and FR scores were negatively correlated (r=-0.44,

$p<0.001$), which was intended, because SR scores are to represent the positive use of internal cues for eating while FR scores are to represent the negative use of external cues. Additionally, in previous pilot studies, Wardle and colleagues found the SR and FR subscales had high internal validity and reliability with Cronbach's α of .83 and .82 and test-retest correlations of .85 and .83, respectively (Wardle et al., 2001).

The "satiety responsiveness" (5 items) and "food responsiveness" (5 items) subscales were focused on for most of the analyses. The CEBQ SR subscale attempts to measure the degree to which a child relies on perceived fullness to stop eating or to not initiate eating. It is measured on a five-point frequency scale with zero being "never" to four being "always". An example statement from the CEBQ SR subscale is: "My child leaves food on his/her plate at the end of meal." The CEBQ FR subscale attempts to measure general appetite and an appetite that might be maladaptive. It is measured on a five-point frequency scale with zero being "never" to four being "always". An example statement from the CEBQ FR subscale is: "Given the choice, my child would eat most of the time."

III.D.2.c. Demographics and Covariates. Participants completed questions on their and their child's demographic background, including gender, race/ethnicity, household income level, maternal education level, and marital status. Participants also completed a portion of a validated tool measuring adult dietary restraint, called Stunkard and Messick's Eating Inventory (Stunkard & Messick, 1985). This is necessary, as maternal restraint has been found to be associated with child eating measures (Johnson, 2000) and with maternal feeding practices in particular restriction as measured by the CFQ (Francis, Hofer, & Birch, 2001). Potential confounders and co-variates that were measured include: household eating policies, maternal paternal height and weight information, and socioeconomic variables. Maternal BMI is of particular importance as it

has been found to be associated with both BMI and adiposity of children and certain child feeding styles (Burdette, Whitacker, Hall, & Daniels, 2006; Francis et al., 2001). The mother self-reported her height and weight pre-pregnancy and currently, from which BMIs were calculated.

III.E. Parameters and Resulting Power Calculation

Power calculations for the mean comparison analyses were performed using the Power Analysis and Sample Size [PASS] program. For the purpose of the power analysis, the CFQ Restriction and Monitoring subscales and CEBQ of Satiety Responsiveness and Food Responsiveness subscales were used to establish the parameters. All subscales are scored in a manner that the possible score ranges from 1-5, and mean estimates were based on previous studies using these subscales. The parameters found on Table 2 were used in the power calculation to estimate the sample size. The two sets of parameters are based on the subscale with the highest standard deviation out of the two subscales of interest from the CFQ and CEBQ. The standard deviation for the CFQ was taken from a data published by Keller and colleagues who used the CFQ in a pilot study examining maternal feeding patterns as a non-shared environment (Keller, Pietrobelli,

Table 2.

Parameters based on CFQ		Parameters based on CEBQ	
Parameter	Value	Parameter	Value
Power	0.80	Power	0.80
Beta	0.20	Beta	0.20
Alpha	0.05	Alpha	0.05
Mean 1	2.75	Mean 1	2.75
Mean 2	3.00	Mean 2	3.00
Mean 3	3.25	Mean 3	3.25
Standard Deviation	0.74	Standard Deviation	0.80

Johnson, & Faith, 2006). This standard deviation was found in the monitoring subscale. The standard deviation for the CEBQ was taken from a data published by Carnell & Wardle (2007) whom developed the CEBQ. This standard deviation was found in the Food Responsiveness subscale. It was previously determined that the highest sample estimate suggested by the output would be accepted as the sample size. The sample size analysis which utilized the parameters for the CFQ was the highest; therefore, the estimated sample size is 41 participants for each three exposure categories.

III.F. Analysis Plan

III.F.1. Data Management

All data were entered into a Microsoft Office Access® 2003 database and converted in to a SPSS® version 16 database. Seventy-five percent (n=84) of participant data were double-entered to ensure accuracy of data entry. One question of the nine on the restriction subscale of the CFQ was left off the survey. Therefore, the subscale score was calculated for restriction based on eight questions. For maternal restriction in her own eating, the subscale included six questions, but due to consistent incomplete answers to one question it was not used for calculated the subscale. Otherwise all data was used as intended.

III.F.2. Statistical Analyses

The recruitment outcomes were presented in terms of recruitment site, in order to understand any differences in samples from the two sites. Descriptive variables were examined with the entire sample, and compared between the three groups. The four hypotheses developed in this study were all based on the mean scores of subscales from either the CFQ or CEBQ. For all subscales, mean scores ranged from 0-4 and median splits of the subscale scores were

calculated for of the multivariate analyses. Due to the similarity of data collected from the subscales, the analysis plan for all of the primary hypotheses was identical.

A one-way ANOVA with Tukey's post-hoc test was used to compare means of the three exposure groups on the Maternal Restriction and Control/Monitoring subscales of the CFQ, and the Satiety Responsiveness and Food Responsiveness subscales of the CEBQ. Four multiple logistic regressions were performed to examine the effects of infant feeding type (BF versus PUMP, or BF versus FM) on the scores on the subscale criterion variables, maternal feeding restriction, maternal feeding monitoring, child satiety response, and child food responsiveness; scores were dichotomized into "low" or "high" categories for the logistic regression analyses. A median split was used to determine if a mother's/child's mean score was "low" or "high". A model-building approach was used to adjust for possible confounders. The models first accounted for child and mother characteristics (i.e. child BMI, maternal BMI), then demographics (i.e. maternal education level, income level), and lastly the mother's own eating style (i.e. maternal restraint in her own eating). Model 1 adjusted for child gender. Model 2 added maternal BMI. Model 3 added maternal race/ethnicity, maternal education level, and parity at birth. Model 4 added maternal restraint score. This approach was based on literature suggesting confounding effects of maternal and child characteristics on the independent and dependant variables in previous studies.

Finally, secondary exploratory analyses were performed to understand the interrelationships between current child eating and current feeding behaviors. To explore the potential association of concurrent maternal feeding styles and childhood eating behaviors in early childhood, Pearson's correlations were performed comparing scores on the subscales from the CFQ and CEBQ. Pearson correlations between both maternal feeding and child eating

behaviors (scores on subscales) of interest and child overweight outcomes (BMI at 24 months, 36 months and at time of data collection) were conducted. Mean of subscale scores were evaluated through t-test analyses on child weight status at 24 months, 36 months, and at time of the data collection. Weight status classifies children as underweight, normal, at-risk for overweight, or overweight based on their growth percentile; for these analyses participants were classified as either normal weight or at-risk for/overweight (underweight participants were excluded). A small number of underweight child participants were excluded from weight status analyses: six child participants were excluded due to being underweight at 24 months and one child participant was excluded for current underweight. Those in the at-risk for overweight and overweight were grouped together for these analyses because they are both outside of the "normal" weight classification which was developed to ensure healthy growth patterns. Similar reasoning in addition to the low frequency of participants in the underweight status classification led to their exclusion from these analyses. Lastly, Pearson correlations between growth percentile and mean subscale scores were performed. These analyses were done separately for the normal weight children and the at-risk/overweight children to access any differences between these two groups in relationships of child eating and feeding styles and growth percentile.

This statistical plan allowed for an evaluation of the hypotheses developed, while additionally taking into account the numerous confounding variables associated with breastfeeding, maternal feeding styles, child eating behaviors, and childhood obesity risk. Analyzing the outcome data (maternal restriction and monitoring in feeding and child satiety response and food responsiveness subscale scores) in a continuous and dichotomous manner allowed for a broader understanding of the outcomes in this sample and for ease of interpretation when investigating the role of covariates. The secondary aim was likewise evaluated in multiple

ways, using both child BMI and child weight status as overweight indicators. The analytical strategy provided an evaluation of the relationship between infant feeding and later behavioral aspects of obesity (i.e. maternal feeding styles and child eating behaviors) and provided an exploration of the interrelations of these behavioral variables with biological outcomes (i.e. child BMI, child weight status).

CHAPTER IV

RESULTS

IV.A. Introduction

This study evaluated whether maternal feeding styles and child eating behaviors related to obesity in a sample with diverse infant feeding strategies. The primary aims were developed to understand how these feeding styles and eating behaviors in the preschool years may have been influenced by infant feeding styles, in particular breastfeeding versus not breastfeeding and using a bottle versus not using a bottle. The exploratory aims were developed in order to understand the interrelations of maternal feeding styles and child eating behaviors in the preschool years, as well as to understand their effect on obesity outcomes. The results are as follows.

IV.B. Recruitment Statistics

Recruitment occurred between March and June of 2008. In total, 111 women were recruited and completed the survey. There were two main recruitment strategies, and recruitment outcomes for these strategies are presented on Table 3 in order to understand any potential differences (i.e. response rate, criterion group distribution) between the two recruitment strategies to guide future research in this area. Abington Pediatrics [AbPeds] was the setting for in-person recruitment and the majority of participants (75.9%) came from this site. Of 101 participants from AbPeds who completed brief screening forms, six (5.9%) declined participation and nine (8.9%) were ineligible. Those who declined were not required to state their reason. Reasons for ineligibility were a prior serious child health problem that could have

effected eating or growth (n=3), mother's prior or current diagnosis of an eating disorder (n=4), adoptive child with mother having no knowledge of infant feeding remaining (n=1), and mother's inability to breastfeed due to pharmaceutical drug use (n=1). Of the remaining eligible participants, 86 (100%) completed informed consent procedures and 70 (83.7%) of eligible participants returned a completed survey before leaving AbPeds and 16 (18.6%) were given an envelope to return the surveys when completed. Of 16 that took the survey home to complete, 13 participants (81.25%) returned it. For anonymity purposes no contact information was collected from participants, therefore no follow-up contacts were made to remind participants to returns surveys.

The medical charts of the 83 child participants whose mother's did provide completed surveys were reviewed for breastfeeding verification and child growth data. Infant feeding verification was completed on 96.5% of the sample from AbPeds and child growth data was gathered for 92.6% the sample from AbPeds. Incomplete infant feeding verification and child growth data collection occurred in most cases due to incomplete medical records; one participant's chart was never located.

Table 3. Recruitment Statistics for Abington Pediatrics & the Breastfeeding Resource Center

Recruitment	**Abington Pediatrics n=83**	**Breastfeeding Resource Email n=25**
Ineligible Screened	8.9% (9)	0% (0)
Response Rate*	90.2% (83)	80% (24)
Breastfeeding Verification Rate	95.7% (79)	20.8% (5)
Complete Child Growth Information	96.5% (80)	92.6% (23)
Number of BF Group	27.7% (23)	60% (15)
Number of PBM Group	24.1% (20)	20% (5)
Number of FM Group	48.2% (40)	20% (5)

*Non-responders are those who were screen but did not complete survey
**Note: Remaining three participants were recruited by word of mouth

The recruitment took place four days a week for six weeks. Most patients in the waiting area were receptive and interested in the research study. The AbPeds staff was receptive to the research study and facilitated the medical chart review procedures by setting charts aside after appointments were completed. Also, office space was provided in order to review charts.

A secondary recruitment strategy utilizing the BRC listserv resulted in the recruitment 22.5% of the final sample. The email was sent to approximately 63 women. The email was forwarded by some women, so estimating the number of women who received this email is not possible. Numerous responses were received, the majority of which were received in the first 72 hours after sending the email. All BRC responders were contacted by email or phone by the researcher, and were asked whether they had a child aged 3-6 years and if they had the ability to recall detailed information on infant feeding of their youngest child in that age range. From that group, 30 potential participants agreed to complete the survey and were mailed packets. Eighty percent of the surveys were returned and all but three were complete. Two surveys did not have child growth data completed and one survey was missing a page. The participants were contacted about the missing data; the survey missing a page was completed but the others were not. However, those surveys were included in all analyses that did not require child growth data. For participants recruited by the BRC listserv, breastfeeding verification was performed if the mother attended Abington Pediatrics and gave permission for their chart to be reviewed; this resulted in 20.8% of the BRC participants having breastfeeding behaviors verified.

Lastly, three participants were recruited by word of mouth. These participants completed surveys and returned them to the researcher by mail. The medical chart data was verified in 2 of these participants, as their children attend AbPeds. This recruitment resulted in a final sample of

111 mother-child pairs, with an overall breastfeeding behavior verification rate of 77.5% (n=86) for the entire sample.

IV.C. Demographics

Demographics of the sample were examined as a whole and by infant feeding group. Mothers in this sample reflected the demographics surrounding AbPeds and the BRC, and therefore tended to be white, non-Hispanic, highly educated, and of high income. The demographic data is presented in Table 4.

Table 4.
Demographics of Sample and Demographics by Infant Feeding Group

Demographics	**All Participants**	**BF**	**PUMP**	**FM**	**P**
Moms Age, years, mean (SD)	36.00 (4.31)	36.69 (3.97)	35.79 (4.45)	35.32 (4.76)	0.47
Childs Age, mean (SD)	4.05 (1.01)	3.98 (1.04)	3.96 (0.98)	4.16 (1.03)	0.67
Weeks of Breastfeeding, mean (SD)	35.7 (44.37)	73.32 (46.85)	31 (19.47)	9.62 (18.58)	0.00**
Child Gender					0.07
Male	57 (51.8%)	22 (53.7%)	7 (28%)	24 (54.5%)	
Female	53 (48.2%)	19 (46.3%)	18 (72%)	20 (45.5%)	
Mom Race Ethnicity					0.40
White, non-Hispanic	93 (83.8%)	37 (90.2%)	20 (80%)	36 (80%)	
Black, African American	11 (9.9%)	1 (2.4%)	3 (12%)	7 (15.5%)	
Hispanic	3 (2.7%)	2 (4.2%)	1 (4%)	-	
Asian American/Pac. Islander	2 (1.8%)	-	1 (4%)	1 (2.2%)	
Other	2 (1.8%)	2 (4.2%)	-	1 (2.2%)	
Child Race Ethnicity					0.07
White, non-Hispanic	94 (84.6%)	37 (90.3%)	20 (80%)	37 (82.2%)	
Black, African American	9 (8.1%)	-	3 (12%)	6 (13.3%)	
Hispanic	2 (1.8%)	1 (2.4%)	1 (4%)	-	
Asian American/Pacific Islander	1 (1%)	-	1 (4%)	-	
Other	5 (4.5%)	3 (7.3%)	-	2 (4.4%)	
Parity					
Multiparious at Interview	94 (92.1%)	37 (94.9%)	19 (90.5%)	38 (90.5%)	0.73
Primiparious at Child's Birth	48 (43.2%)	19 (46.3%)	14 (58.3%)	16 (35.5%)	0.30
Household Income Level					0.02*
< $50,000	3 (2.8%)	1 (2.6%)	1 (4.3%)	1 (2.3%)	
$50,000-$74,999	11 (10.4%)	4 (10.3%)	0 (0%)	7 (15.9%)	
$75,000-$99,999	22 (20.8%)	2 (5.1%)	6 (26.1%)	14 (31.8%)	
≥$100,000	70 (66%)	32 (82.0%)	16 (69.6%)	22 (50%)	
Maternal Education Level					0.13
High School diploma or less	3 (2.7%)	-	1 (4%)	2 (4.5%)	
Some College	13 (11.8%)	2 (4.9%)	4 (16%)	7 (15.9%)	
College Graduate	39 (34.6%)	14 (34.1%)	5 (20%)	19 (43.2%)	
Beyond college	56 (50.9%)	25 (61%)	15 (60%)	16 (36.4%)	
Mom Overweight or Obese	41.5% (44)	35.9% (14)	24.9% (6)	57% (24)	0.05*
Child At-risk or Overweight	26.2% (27)	20.5% (8)	29.2% (7)	30% (12)	0.35

*p≤0.05 ** p≤0.01

Mothers were 36.69 years old on average, with little variation in age. Forty-one percent of mothers in this study were currently classified as overweight or obese, similar to the Pennsylvania state average of 53.1% for women (CDC, 2007). There were significant group differences in maternal weight status with 35.9%, 24.9%, and 57% of participants being overweight or obese in the BF, PUMP, and FM groups, respectively. Family income varied significantly between groups, with the BF group having fewer participants in the $75,000-$99,999 income level, as compared to the PUMP and FM groups. The children of the participant's recruited ranged from 3-6 years old, with the average age being 4.05. The age of the child did not vary significantly between groups. Child gender was evenly distributed in the entire sample and between groups, except in the PUMP group which was 72% male; however, this difference was not significant. The child participants were similar to their mothers in race with the majority being white, non-Hispanic. About 26% of child participants were at-risk to being overweight or overweight at the time of the interview, and this varied between groups with the FM group having the highest rate at 30%.

Significant differences were found in length of breastfeeding between groups. All those in the BF and PUMP group had a minimum of three months of exclusive breastfeeding. The BF group had a mean of 73.2 weeks (*sd* = 46.84) of any breastfeeding. The weeks of breastfeeding ranged from 16 to 200 weeks of any breastfeeding. In the BF group, only 41.4% of women used formula supplementation ever, and for these women the mean infant age of formula supplementation was 29.24 weeks (*sd* = 10.90). The mean age of solids supplementation was 5.51 months (*sd* = 1.22) for the BF group. The PUMP group had a mean of 31.00 weeks (*sd*= 19.47) of any breastfeeding. The weeks of any breastfeeding ranged from 12 to 76 weeks. In the PUMP group, 76% of women used formula supplementation ever, and for these women the mean

infant age of formula supplementation was 15.32 weeks (*sd* = 3.56). The mean age of solids supplementation was 5.46 months (*sd* = 1.29) for the PUMP group. The FM group reported either breastfeeding or not, and those that breastfed did not do so for three months exclusively. The FM group had a mean of 9.62 weeks (*sd* = 18.59) of any breastfeeding. The weeks of any breastfeeding ranged from 0 to 72 weeks. The mean age of formula supplementation was 1.45 weeks (*sd* = 2.14) in the FM group. The mean age of solids supplementation was 5.09 months (*sd* = 1.40).

IV.D. Primary Data Analyses Results

Primary Aim 1: To examine whether breastfeeding during the first 3 months of life, in particular feeding from breast rather than using breastmilk from bottle, is associated with lower maternal restriction and maternal control of eating.

Maternal restriction was based on the CFQ subscale, which consists of nine questions in the original version. Eight items were used to calculate the restriction subscale score in these analyses. The mean score for the entire sample was 2.35 (sd=0.85). Monitoring was based on the CFQ subscale, which consists of three questions. The mean monitoring subscale score for the entire sample was 3.12 (sd=0.81). The possible score ranges from 0-4 for both subscales. To achieve Primary Aim 1, univariate and multivariate analyses were performed with the score on the restriction and monitoring subscales as the dependent variables and infant feeding group as the independent variable. The data will be presented as it relates to the hypotheses proposed.

Hypothesis 1a : *Those children who were breastfed exclusively for at least the first three months of life will score lower on the maternal restriction subscale of the CFQ at 3-6 years of age, as compared to those not breastfed for at least the first three months of life.*

A one-way ANOVA was computed comparing the mean scores on the CFQ restriction subscale of children in the three infant feeding groups. The mean differences in maternal restriction between the BF, PUMP, FM groups were not found to be statistically significant ($F(2, 108)= 0.59$, $p =0.55$).

Table 5

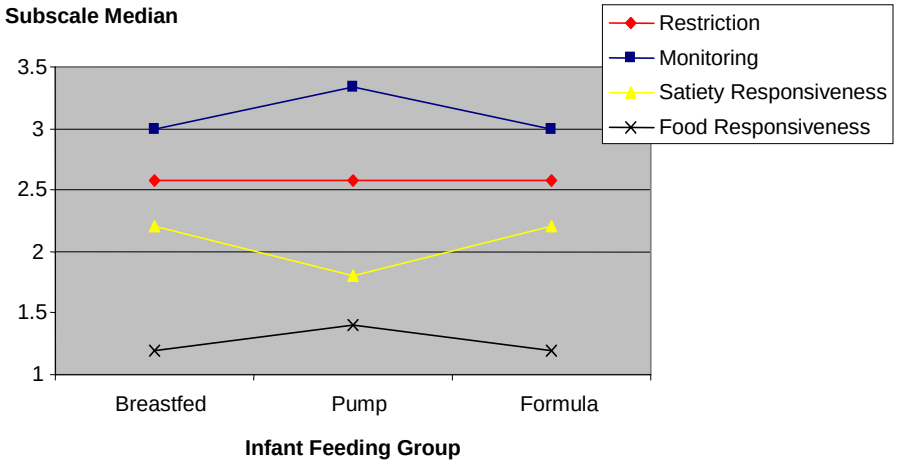
Maternal Restriction and Monitoring Subscale Means by Infant Feeding Group

Infant Feeding Group	N	Mean Scores on Subscales	Std Dev	Sig Level
Restriction Subscale				
Breastfed	41	2.24	0.81	
Pumped Breastmilk	25	2.36	0.90	p=0.55
Formula/Mixed Feeding	45	2.44	0.87	
Monitoring Subscale				
Breastfed	41	3.04	0.87	
Pumped Breastmilk	25	3.31	0.65	P=0.43
Formula/Mixed Feeding	45	3.09	0.83	

Multivariate logistic regression analyses were then performed in order to adjust for covariates. For multivariate analyses, the restriction subscale scores were dichotomized by median split procedures. This resulted 45.9% of the sample reporting low restriction and 54.1% reporting high restriction. The median score for restriction and all the other subscales are illustrated in Figure 2. A stepwise multiple regression was performed with the BF group as the reference group, following this model building approach: Unadjusted, Model 1: child gender, Model 2: child gender and maternal current BMI, Model 3: child gender and maternal current BMI child gender, maternal education level, family income level, and parity at birth, and model 4: child gender, maternal current BMI child gender, maternal education level, family income level, and parity at birth and maternal restraint in eating score. Maternal restriction in eating was

based on a six question series taken from Stunkard and Messick's Three-Factor Eating Questionnaire. For these analyses, the score was calculated based on five questions due to numerous incomplete answers for a question.

Figure 2. Medians CFQ & CEBQ Subscale Scores by Infant Feeding Group



The results the multivariate logistic regression of infant feeding group and restriction level are presented on Table 6, which includes the odds ratios for each model. In the unadjusted model, use of a bottle was not found to be a significant predictor of restriction level at age 3-6 years, when BF group was compared to PUMP group and to the FM group. After adjustment for all covariates, use of a bottle was not found to be a significant predictor of restriction level at age 3-6 years in the final model, when BF group was compared to PUMP group and to the FM group.

Table 6.

Odds of Mothers' High Restriction in Feeding Children at Age 3-6 Years by Infant Feeding Group

	BM	**PUMP** OR (95% CI)	**FM** OR (95% CI)
Unadjusted	1 (Ref)	1.23 (0.41-3.11)	1.21 (0.50-2.93)
Model 1	1 (Ref)	1.41 (0.47-4.22)	1.26 (0.51-3.11)
Model 2	1 (Ref)	1.24 (0.39-3.98)	1.24 (0.49-3.15)
Model 3	1 (Ref)	1.30 (0.39-4.37)	1.33 (0.50-3.57)
Model 4	1 (Ref)	1.36 (0.39-4.72)	1.38 (0.50-3.80)

Hypothesis 1b: *Those children who were breastfed exclusively for at least the first three months of life will score lower on the monitoring subscale of the CFQ at 3-6 years of age, as compared to those not breastfed for at least the first three months of life.*

A one-way ANOVA was computed comparing the mean scores on the CFQ monitoring subscale of children in the three infant feeding groups. The differences in mean restriction subscale scores between the BF, PUMP, and FM groups were not found to be statistically significant ($F(2, 108)= 0.86$, $p = 0.43$). The results of are presented in Table 5.

Multivariate analyses were then performed in order to adjust for covariates. For multivariate analyses, the monitoring subscale scores were dichotomized by median split procedures. This resulted in the sample having 39.6% low and 60.4% high monitoring scores. The median scores are illustrated on Figure 2. The results of the multivariate logistic regression following the stepwise method stated previously to analyze infant feeding group and monitoring level are presented on Table 7. In the unadjusted model, use of a bottle was not found to be a significant predictor of high monitoring level at age 3-6 years, when BF group was compared to PUMP group and to the FM group After adjustment for all covariates, use of a bottle was not found to be a significant predictor of high monitoring at age 3-6 years in the final model, when BF group was compared to PUMP group and to the FM group.

Table 7.

Odds of Mothers' High Monitoring in Feeding Children Age 3-6 Years by Infant Feeding Group

	BF	PUMP OR (95% CI)	FM OR (95% CI)
Unadjusted	1 (Ref)	1.90 (0.58-6.24)	1.21 (0.47-3.11)
Model 1	1 (Ref)	2.03 (0.58-7.05)	1.19 (0.46-3.10)
Model 2	1 (Ref)	1.88 (0.51-6.90)	1.37 (0.51-3.70)
Model 3	1 (Ref)	2.00 (0.50-8.09)	1.17 (0.41-3.32)
Model 4	1 (Ref)	1.89 0.45-7.77)	1.18 (0.41-3.36)

Primary Aim 2: To examine whether breastfeeding during the first 3 months of life, in particular feeding from the breast rather than from a bottle, is associated with an increased use of internal cues for eating later in childhood.

Internal cues for eating were measured by satiety response and food responsiveness. Satiety response is a positive eating behavior, meaning the child responds to fullness, which is an internal cue. Food responsiveness is a negative eating behavior, meaning the child responds greatly to the presence of food, which is an external cue. Satiety response was based on the CEBQ subscales, which consists of five questions rated on a 0-4 response scale. The mean satiety response subscale score for the entire sample was 2.07 (*sd*=0.57). Food responsiveness was based on the CEBQ subscale, which consists of five questions. The mean food responsiveness subscale score for the entire sample was 1.32 (*sd*=0.70). To achieve Primary Aim 2, univariate and multivariate analyses were performed with the score on the satiety response and food responsiveness subscales as the dependent variables and infant feeding group as the independent variable. The data will be presented as it relates to the hypotheses proposed.

Hypothesis 2a: *Those children who were breastfed exclusively for at least the first three months of life will score higher on the satiety responsiveness subscale of the CEBQ at 3-6 years of age, as compared to those not breastfed for at least the first three months of life.*

A one-way ANOVA was computed comparing the mean scores on the CEBQ Satiety Response subscale of children in the three infant feeding groups. No significant difference was found ($F(2, 108)= 1.26$, $p = 0.29$). The results are presented in Table 8. Multivariate analyses were then performed in order to adjust for covariates.

Table 8. Satiety and Food Responsiveness Subscale Means by Infant Feeding Group

Infant Feeding Group	N	Mean (SD) Subscale Score	Sig Level
Satiety Subscale			
Breastfed	41	2.17 (0.65)	
Pumped Breastmilk	25	1.94 (0.45)	p=0.29
Formula/Mixed Feeding	45	2.07 (0.54)	
Food Responsiveness			
Breastfed	41	1.34 (0.62)	p=0.46
Pumped Breastmilk	25	1.45 (0.62)	
Formula/Mixed Feeding	45	1.23 (0.65)	

For multivariate analyses, the satiety response subscale scores were dichotomized by median split. This resulted in 36.9% of the sample having low satiety response scores and 63.1% having high satiety response scores. The median score is illustrated in Figure 2. A stepwise multiple regression was performed, following this model building approach: Unadjusted, Model 1: child gender, Model 2: Child gender and Maternal current BMI, Model 3: Child gender, Maternal current, Maternal Education level, Family Income level, and Parity at birth, and model 4: Child gender, Maternal current BMI, Maternal Education level, Family Income level, Parity at birth, and Maternal Restraint in Eating Score.

The results the multivariate logistic regression of infant feeding group and satiety response level are presented on Table 9. In the unadjusted model, use of a bottle was found to be a significant predictor of satiety level at age 3-6 years, when BF group was compared to PUMP group (OR: 0.33; 95% CI: 0.12–0.96), in that the PUMP group were 67% less likely to have high

satiety level. The FM group did not have significantly reduced odds of high satiety level when compared to the BF group (OR: 1.21; 95% CI: 0.50–2.93). After adjustment for all covariates, use of a bottle was found to be a significant predictor of satiety level in the final model, when BF group was compared to PUMP group (OR: 0.27; 95% CI: 0.07–0.98), with the PUMP group being 73% less likely to have high satiety level. This prediction was seen in all steps of the model-building, as Table 8 illustrates. The FM group did not have significantly reduced odds of high satiety level when compared to the BF group, after adjustments for all covariates.

Table 9. Odds of High Satiety Response in eating at Age 3-6 Years by Infant Feeding Group

	BF	PUMP OR (CI 95%)	FM OR (CI 95%)
Unadjusted	1 (Ref)	0.33 (0.12-0.96)*	0.61 (0.24-1.57)
Model 1	1 (Ref)	0.31 (0.10-0.97)*	0.59 (0.25-1.54)
Model 2	1 (Ref)	0.31 (0.10-0.95)*	0.54 (0.20-1.45)
Model 3	1 (Ref)	0.26 (0.07-0.93)*	0.64 (0.23-1.80)
Model 4	1 (Ref)	0.27 (0.07-0.98)*	0.64 (0.23-1.80)

Hypothesis 2b: *Those children who were breastfed exclusively for at least the first three months of life will score lower on the food responsiveness subscale of the CEBQ at 3-6 years of age, as compared to those not breastfed for at least the first three months of life.*

A one-way ANOVA was computed comparing the mean scores on the CEBQ Food Responsiveness subscale of children in the three infant feeding groups. No significant difference was found ($F(2, 108)= 0.78$, $p = 0.46$). The results of are presented in Table 8. Multivariate analyses were then performed in order to adjust for covariates. For multivariate analyses, the Food Responsiveness subscale scores were dichotomized by median split procedures. This resulted in 29.7% of the sample having low food responsiveness scores and 70.3% having high food responsiveness scores. The median score is illustrated in Figure 2. A stepwise multiple regression was performed, following this model building approach described for satiety response

level, and the results are presented on Table 10. In the unadjusted model, use of a bottle was not found to be a significant predictor of high food responsiveness at age 3-6 years, when BF group was compared to PUMP group and to the FM group. After adjustment for all covariates, use of a bottle was not found to be a significant predictor of high food responsiveness at age 3-6 years in the final model, when BF group was compared to PUMP group and to the FM group.

Table 10. Odds of High Food Responsiveness in eating Age 3-6 Years by Infant Feeding Group

	BF	PUMP OR (CI 95%)	FM OR (CI 95%)
Unadjusted	1 (Ref)	0.93 (0.33-2.68)	0.72 (0.29-1.76)
Model 1	1 (Ref)	0.95 (0.31-2.87)	0.72 (0.29-1.79)
Model 2	1 (Ref)	0.97 (0.32-2.94)	0.72 (0.28-1.83)
Model 3	1 (Ref)	1.21 (0.37-3.97)	0.85 (0.32-2.29)
Model 4	1 (Ref)	1.16 (0.35-3.88)	0.82 (0.30-2.23)

IV.E. Exploratory Data Analyses Results

Exploratory Aim: To explore the interrelationship between current maternal feeding styles and childhood eating behaviors in young children and child BMI.

First, an examination of the CFQ and CEBQ subscales will be performed through correlation analyses in order to understand the relations between maternal feeding styles and child eating behaviors. Then, the association between both maternal feeding styles and child eating behaviors at age 3-6 years and infant growth from 2 years to current age (m = 4.05) will be examined. These analyses provide an exploration on eating and feeding behaviors and their relationship with child growth during infancy and pre-school years.

Hypothesis 3a: *Maternal feeding styles, as measured by the CFQ, and childhood eating styles, as measured by the CEBQ, will be explored for their intercorrelation in children aged 3-6 years.*

Some maternal feeding styles were correlated with each other. Restriction subscale was positively correlated with pressure to eat subscale (r=0.24, p=0.01). The pressure to eat subscale

from the CFQ has four items and asks agreement statements like: "I have to be especially careful to make sure my child eats enough" to which a parent responds “disagree, slightly disagree, neutral, slightly agree, or agree.” Satiety response subscale was positively correlated with the slowness in eating subscale (r=0.23, *p*=0.02). The slowness to eating subscale from the CEBQ contains four items and asks frequency statements like: “My child takes more than 30 minutes to finish a meal”, to which a parent responds “never, rarely, sometimes, often, or always”. Slowness in eating is a positive quality in eating behavior with respect to obesity prevention. Satiety response was negatively correlated with the enjoyment of food subscale (r=-0.56, *p*=0.00). Food responsiveness was positively correlated with the enjoyment of food subscale (r=0.57, *p*=0.00). The enjoyment of food subscale contains four questions and asks frequency statements like: “My child enjoys eating” to which a parent responds “never, rarely, sometimes, often, or always”.

Some of the CFQ and CEBQ subscales were found to be interrelated. The pressure to eat subscale from the CFQ was positively correlated with the slowness in eating subscale from the CEBQ (r=0.21, *p*=0.03). The pressure to eat subscales was negatively correlated with the enjoyment of food subscale from the CEBQ (r= -0.37, *p*=0.00). Satiety response was positively correlated with pressure to eat subscale from the CFQ (r=0.26, *p*=0.01). Food Responsiveness from the CEBQ was positively correlated with restriction from the CFQ (r=0.41, *p*=0.00).

Hypothesis 3b: *The interrelationships between maternal feeding styles, child eating behaviors, and childhood obesity outcomes will be explored in children aged 3-6 years.*

To explore the associations between feeding and eating behaviors and obesity outcomes, three analyses were performed. First, BMI at age 24 months, 36 months, and BMI at the time of data collection were evaluated for potential associations with the four subscales focused on in the

primary aims. BMI is not as effective at evaluating obesity risk in children as in adults, therefore two other analyses were performed using weight status and growth percentile as obesity outcomes in order to best evaluate the relationship between maternal feeding styles, child eating behaviors, and child obesity outcomes.

First, Pearson correlations were performed comparing scores on the restriction, monitoring, satiety, and food responsiveness scales and child BMI at 24 months, 36 months, and Current BMI. Results indicated positive correlations between BMI at 24 months (r=0.20, p=0.05), 36 months (r=0.26, p=0.01), current BMI (r=0.30, p=0.00) with food responsiveness score. The association between BMI and food responsiveness became stronger as the participants in this sample became older. A negative correlation was found between current BMI (r=-0.28, p=0.01) and satiety response score. This correlation was not found between satiety response at time of data collection and retrospective BMI measurements (age 24 months or 36 months).

Next, possible relationships between child feeding and eating behaviors and weight status at 24 months, 36 months, and at time of data collection were evaluated through t-test analyses. For these analyses, six child participants were excluded due to being underweight at 24 months and one child participant was excluded for current underweight. T-tests were performed comparing the mean subscale scores on CEBQ and CFQ subscales of interest of children in the two weight status groups of normal weight and at-risk for overweight/overweight at ages 24 months, 36 months, and at the time of data collection.

The weight status at 24 months of age was calculated for 100 child participants who had complete data and were not underweight. T-tests were performed comparing mean subscale scores on the four subscales of interest of the normal weight child participants at 24 months and the at-risk/overweight participants at 24 months. No significant difference was found (t(100)= -

0.24, p=0.82) between the mean restriction subscale score of the children who were normal weight (mean =2.39, sd = 0.86) and at-risk/overweight (mean =2.44, sd = 0.75) at 24 months. No significant difference was found (t(100)= 1.09, p=0.28) between the mean monitoring subscale score of the children who were normal weight (mean =3.15, sd = 0.77) and at-risk/overweight (mean =2.94, sd = 0.88) at 24 months. No significant difference was found (t(100)= 0.88, p=0.38) between the mean satiety response subscale score of the children who were normal weight (mean =2.09, sd = 0.58) and at-risk/overweight (mean =1.96, sd = 0.55) at 24 months. No significant difference was found (t(100)= -1.65, p=0.10) between the mean food responsiveness subscale score of the children who were normal weight (mean = 1.28, sd = 0.74) and at-risk/overweight (mean =1.57, sd = 0.66) at 24 months.

The weight status at 36 months of age was calculated for 103 child participants who had complete data and were not underweight. T-tests were performed comparing mean subscale scores on the four subscales of interest of the normal weight child participants at the time of the interview and the at-risk/overweight participants at 36 months. No significant difference was found (t(103)= -0.36, p=0.72) between the mean restriction subscale score of the children who were normal weight (mean =2.33, sd = 0.85) and at-risk/overweight (mean =2.40, sd = 0.81) at 36 months. No significant difference was found (t(103)= 1.04, p=0.30) between the mean monitoring subscale score of the children who were normal weight (mean =3.17, sd = 0.74) and at-risk/overweight (mean =2.98, sd = 0.92) at 36 months. No significant difference was found (t(103)= 1.6, p=0.11) between the mean satiety response subscale score of the children who were normal weight (mean = 2.14, sd = 0.60) and at-risk/overweight (mean =1.93, sd = 0.43) at 36 months. A significant difference was found (t(103)= -2.36, p=0.02) between the mean food responsiveness subscale score of the children who were normal weight (mean = 1.24, sd = 0.72)

and at-risk/overweight (mean =1.62, *sd* = 0.69) at 36 months. Children who were at-risk or overweight at 36 months had higher mean food responsiveness scores at age 3-6 years old (mean = 4.05 years, sd = 1.01).

The current weight status was calculated for 102 child participants who had complete data and were not underweight. T-tests were performed comparing mean subscale scores on the four subscales of interest of the normal weight child participants at the time of the interview and the at-risk/overweight participants at the time of the interview. No significant difference was found ($t(100)= -0.82$, $p=0.42$) between the mean restriction subscale score of the children who were currently normal weight (*m* =2.32, *sd* = 0.89) and at-risk/overweight (*m* =2.48, *sd* = 0.63). No significant difference was found ($t(100)= -0.02$, $p=0.98$) between the mean monitoring subscale score who were currently normal weight (*m* =3.12, *sd* = 0.77) and at-risk/overweight (*m* =3.12, *sd* = 0.83). No significant difference was found ($t(100)= 1.9$, $p=0.06$) between the mean satiety response subscale score who were currently normal weight (*m* =2.12, *sd* = 0.60) and at-risk/overweight (*m* =1.88, *sd* = 0.47). The mean satiety response subscale score of children who were currently normal weight (*m* =2.12, *sd* = 0.60) and the at-risk/overweight group (*m* =1.88, *sd* = 0.47) approached a significant difference ($t(100)= 1.9$, $p=0.06$), with the normal weight children having a higher score. No significant difference was found ($t(100)= -1.46$, $p=0.15$) between the mean food responsiveness subscale score who were currently normal weight (*m* = 1.29, *sd* = 0.74) and the at-risk/overweight (*m* =1.53, *sd* = 0.66).

Lastly, child participants who were normal weight at the time of the interview and child participants who were at-risk/overweight were separated for following correlational analyses. Pearson's correlations between growth percentile of the child and mean subscale scores of restriction, monitoring, satiety response, and food responsiveness were performed on the normal

weight group (n=78). A positive correlation was found ($r(78) = 0.24$, $p = 0.04$) between the food responsiveness subscale and child growth percentile at the time of the interview, indicating normal weight preschool-aged children with higher food responsiveness had slightly higher growth percentiles. In the children of normal weight, no significant correlations were found between growth percentile and the three other subscales: restriction ($r(78) = 0.00$ $p = 0.99$), monitoring ($r(78) = -0.08$, $p = 0.47$), and satiety response ($r(78) = -0.16$, $p = 0.16$).

Pearson's correlations were then performed between child growth percentile and mean subscale scores of restriction, monitoring, satiety response, and food responsiveness were performed on the children who at-risk/overweight (n=26). A strong positive correlation was found ($r(26) = 0.60$, $p = 0.00$) between the food responsiveness subscale and child growth percentile at the time of the interview, indicating at-risk/overweight preschool-aged children with higher food responsiveness had higher growth percentiles. In the at-risk/overweight children, no significant correlations were found between growth percentile and the three other subscales: restriction ($r(26) = 0.32$, $p = 0.12$), monitoring ($r(26) = -0.15$, $p = 0.47$), and satiety response ($r(26) = -0.26$, $p = 0.20$).

IV.F. Summary

The data presented explained the recruitment and the primary and secondary analyses. The analytic strategy allowed for an understanding the relationships of infant feeding and later childhood feeding and eating outcomes. The results were presented as they related to the hypotheses developed. The final chapter will describe the implications of these results and conclusions of this study will be stated.

CHAPTER V

DISCUSSION

V.A. Summary of Results

V.A.1. Recruitment Results

Recruitment neared the goals set for the study. Recruitment proceeded with few setbacks, and the additional strategy of the BRC email listserv allowed for increased numbers of women in the PUMP group. The recruitment site reported no concerns of disruption due to the recruitment procedures and patients and staff were receptive to the study. Interest in breastfeeding and obesity was expressed by many potential participants and possibly added to the ease of recruitment. The anonymity and brevity of participation likely increased willingness for mothers to participate. The waiting periods during both well and sick pediatric visits allowed sufficient time to complete this short survey.

The greatest difficulty was in recruiting the PUMP group. This was in part due to some mothers reporting pumping, but not until after the three month point and also a limited number of mothers reporting returning to work within three months of giving birth. In future studies, recruitment of women who breastfeed with the use of a bottle might be increased by sampling a more diverse sample in regard to income levels and family structure. Overall, recruitment procedures were successful.

V.A.2. Results of Primary Aims

Hypothesis 1a was not supported. Hypothesis 1a stated that those children who were breastfed exclusively for at least the first three months of life will score lower on the maternal

restriction subscale of the CFQ at 3-6 years of age, as compared to those not breastfed for at least the first three months of life. In univariate analyses, no differences were found in restriction subscale means between the BF, PUMP, and FM groups. The multivariate analyses performed to evaluate this hypothesis likewise did not add support after adjustment for important covariates, as the 95% confidence intervals of the odds ratios were wide.

In this study, maternal restriction in feeding her child did not vary among infant feeding styles (BF, PUMP, FM) in a significant way. A recent study investigating maternal factors related to maternal restriction in feeding during their child's first two years of life found that maternal age and maternal mental health at six months, in addition to breastfeeding, were all negatively correlated to maternal restriction (Blissett & Farrow, 2007). So there are numerous factors that might affect maternal restriction in feeding and it is possible that these were not all accounted for. Additionally, a previous study attempting to understand the potential mediating effect that restrictive feeding practices might have in the breastfeeding-obesity relationship, found it only had a small effect the relationship, even in a large sample (Taveras, Rifa-Shiman, Scanlon, Grummer-Strawn, Sherry, & Gilman, 2006). Due to the multiple factors that are involved in maternal feeding and obesity and due to the possible small effect size, finding a significant relationship proves difficult. But the results from this study are the first assess bottle use, so it is important to look at the null results related to maternal restriction in feeding when assessing whether a potential relationship should be investigated in the future.

Hypothesis 1b was not supported. Hypothesis 1b stated those children who were breastfed exclusively for at least the first three months of life will score lower on the control/monitoring subscale of the CFQ at 3-6 years of age, as compared to those not breastfed for at least the first three months of life. In univariate analyses, significant differences were not

found in monitoring subscale scores means between the BF, PUMP, and FM groups. The multivariate analyses performed to evaluate potential differences in level of monitoring between the BF and PUMP groups and BF and FM groups did not add support after the adjustment for important covariates as the 95% confidence intervals of the odds ratios were wide. In this study, maternal monitoring in feeding her child did not vary among infant feeding styles (BF, PUMP, FM) in a significant way. Previous studies have found that maternal monitoring is related to increase child obesity risk, but one study investigating maternal monitoring and maternal factors related to it found that breastfeeding (measured as a continuous variable by weeks) was related to maternal monitoring in feeding at age 1, but was not related at age 2 (Blissett & Farrow, 2006). This finding might point out that the other factors related to maternal feeding and child obesity might overpower any effect that infant feeding style has, as the child becomes older. Lastly, bottle use was not assessed in previous studies, so the null findings related to maternal monitoring and infant feeding style of the current study are important to consider when assessing whether a potential relationship should be investigated in the future.

Hypothesis 2a was supported. Hypothesis 2a stated those children who were breastfed exclusively for at least the first three months of life will score higher on the satiety responsiveness subscale of the CEBQ at 3-6 years of age, as compared to those not breastfed for at least the first three months of life. In univariate analyses, significant differences were not found in satiety response subscale scores means between the BF, PUMP, and FM groups. The multivariate analysis did provide evidence to partially support Hypothesis 2a. The multivariate analyses were performed to evaluate potential differences in level of satiety response between the BF and PUMP groups and BF and FM groups. Before adjustments for any covariates the PUMP was 67% less likely to have high satiety response when compared to the BF group. The

stepwise model showed this difference slightly increased as covariates were added, with the largest odds ratio increase occurring after maternal demographics (maternal education level, family income level, parity at birth) were added to the model. After adjustment for child gender, maternal BMI, maternal education level, family income level, parity at birth and a mother's restraint in her own eating, the PUMP group was 73% less likely to have high satiety response at 3-6 years old, when compared to those in the BF group. Similar trends satiety response difference were seen between the BF and FM groups with the FM group being less likely to have high satiety response, however the findings were not significant.

Hypothesis 2b was not supported. Hypothesis 2b stated **t**hose children who were breastfed exclusively for at least the first three months of life will score lower on the food responsiveness subscale of the CEBQ at 3-6 years of age, as compared to those not breastfed for at least the first three months of life. In the univariate analysis, there were no significant differences in food responsiveness subscale means between the BF, PUMP, and FM groups. The multivariate analyses performed to evaluate potential differences in the level of food responsiveness between the BF and PUMP groups and the BF and FM groups. The resulting data did not add support for hypothesis 2b, even after adjustment for important covariates as the 95% confidence intervals for the odds ratios calculated were wide.

In conclusion, the hypothesized relationship between infant feeding type and satiety response was supported. The remaining hypotheses could not be accepted with the resulting data. Due to the level of significance in many results, few conclusions can be drawn on hypothesis 1a, 1b, and 2b. The support for hypothesis 2a is partial in that significant differences were found between the BF and PUMP groups, but not between the BF and FM groups. The

results of the primary analyses follow the analytical plan and have allowed for a thorough evaluation of the primary hypotheses.

V.A.3. Results of Exploratory Aim

The secondary aim was to explore the interrelationship between current maternal feeding styles and childhood eating behaviors in young children and child BMI. This aim was met through the development of two related hypotheses and numerous analyses. Hypothesis 3a stated that an exploration of the intercorrelations between maternal feeding styles, as measured by the CFQ, and childhood eating styles, as measured by the CEBQ, in children aged 3-6 years would be performed. To evaluate this hypothesis, correlation analyses were performed on all the subscales of the CFQ and CEBQ. From the results of this study, interrelations between the maternal feeding styles measured by the CFQ and the child eating behaviors measured by the CEBQ was found. A mother's level of pressuring her child to eat was correlated with numerous of child eating behaviors. It was found a mother's level of pressuring her child to eat (CFQ) was positively associated to slowness in eating (CEBQ), which seems intuitive as a parent might prompt a slower eater more often than a fast eater. Mother's pressuring child to eat (CFQ) was negatively associated with enjoyment of food in children (CEBQ), meaning mothers' whose children were less interested in food also tended to use less pressure when feeding their child. Mother's pressuring child to eat (CFQ) was positively associated with satiety response (CEBQ), meaning that mother's who pressure their child to eat more, also report that their children respond more to fullness. Lastly, maternal restriction in feeding (CFQ) was positively associated with a child's food responsiveness (CEBQ), which provides evidence for the association of maternal restriction with maladaptive child eating strategies. Due to the cross-sectional nature of this study in regards to maternal feeding strategies and child eating strategies, it is not possible to

make conclusions on causal relationships between maternal and child behavior; we can only state they are related with each other.

Hypothesis 3b stated that an exploration of the associations between the interrelationships among feeding and eating patterns during infancy and childhood with childhood BMI would be performed. To explore these relationships, three analyses were performed for the purpose of this exploration. First, the linear relationships were examined between child BMI and the four subscales focused on in the primary aims. There was a slight positive correlation between food responsiveness subscale score and BMI at 24 months, 36 months, and current BMI (mean age was 4.05 years). The correlation was strongest with the child's current weight. It was interesting that a linear relationship existed between BMI and food responsiveness overtime, with BMI at 24 months having the weakest correlation compared to BMI at 36 months then current BMI (3-6 years). However, food responsiveness was only measured currently, so this trend might reflect that concurrent obesity outcomes and eating behaviors have stronger relationships, than current eating behaviors and previous obesity outcomes.

A negative association was identified between current BMI and satiety response, meaning that mothers' of preschool-aged children report their children respond less to fullness as their child BMI's increases. To add to this finding, mean differences between currently normal weight children and currently at-risk for overweight or overweight children were evaluated, satiety response was higher in the normal weight children and this difference approached significance. Finally, when correlations between concurrent growth percentile and child feeding and eating behaviors were evaluated in the normal weight and at-risk/overweight groups separately, it was found that food responsiveness was positively associated with growth percentile. This association was much stronger in the at-risk/overweight group which might

point to the importance of child eating behaviors in children who are already at-risk for overweight or who are overweight. In summary, the results support the connection between obesity measures like BMI, growth percentile, and weight status, and child eating behaviors. Maternal feeding behaviors, as measured by the CFQ, were not related to obesity measures in this study.

V.B. Findings

The main findings of this study offer evidence to the role of infant feeding in the satiety response and obesity risk in preschool-aged children. It was found that when compared to breastfed infants who were fed without a bottle in the first three months, breastfed infants fed with a bottle are less likely to respond to fullness while eating during the preschool years. A similar finding was seen in between those who were formula fed, when compared with the non-bottle breastfed group, but the lack of significance of this finding, points to further exploration. The differences identified between these infant feeding groups indicates the necessity of measuring bottle use when investing breastfeeding's role in obesity prevention- particularly in regard to later child eating behaviors.

Additionally, within this sample, satiety response was found to be negatively correlated with BMI. This supports and adds to recent studies connecting satiety response in children to obesity risk (Carnell & Wardle, 2008; Viana, Sinde, & Saxton, 2008). Food responsiveness was correlated with obesity outcomes, including BMI at 24 months, 36 months, and at time of interview. There were also mean differences in food responsiveness scores, with normal weight children having lower scores and the correlation between growth percentile and food responsiveness was stronger in the at-risk/overweight group. This supports previous studies that

found food responsiveness is related to obesity outcomes, and uniquely adds to these findings as it is the first study to my knowledge that focused on preschool-aged children (Viana et al., 2008).

V.C. Limitations of this study

V.C.1. Design Limitations

While theory-based and designed with deliberation, this study does have limitations. First, the retrospective design lends toward misclassification bias. Misclassification is possible as infant feeding group status is being established retrospectively. However, systematic cross-validation of the mother's recollection of breastfeeding with medical chart information will reduce misclassification. Secondly, selection and reporting bias could exist in this study. One concern was whether a potential child participant's weight would be related to refusal to participate. For example, a mother of an overweight child might be hesitant to participate. In this study, the refusal rate was not high and those who did refuse often stated privacy and time as the reason.

This study focused on the behavioral outcomes related to obesity and the behavioral aspects of infant feeding. Due to the scope of this study, it is not possible to investigate the potential biological influences of breastfeeding on these outcome variables. The biological components of breastfeeding should be researched in regard to obesity prevention, but could not be examine in the current study.

V.C.2. Methodological Limitations

The methods of this study were developed to best achieve the aims of the study in a time-efficient manner, considering the limited resources for data collection. The sample came from an area where breastfeeding was more common, particularly exclusive breastfeeding. This led to a

homogenous sample of primarily white, highly educated, and high income women. Therefore, the main limitation of this study is the lack of generalizability of these findings.

The measures utilized had limitations as well. The information related to pumping was collected using one question on a 4-point frequency scale, and only asked about the first three months of infant feeding. In collecting the data, it became apparent that for many mothers, the use of a pump increases after three months for those returning to work. In future investigations, it would be best to not constraining the questions of pump use to the first three months, or to ask questions about pump use across the first year of feeding. Also, the charts at pediatrician's office utilized for this study contain very specific details about pumping, such as the amount of ounces of breastmilk fed per day by bottle at each well visit. Therefore, information collected at well visits could have been used to track changes in bottle use during the first year which would have added to systematic classification of children into a feeding group.

Lastly, while both the CFQ and the CEBQ are validated instruments, these findings would be enhanced through observational data related to the feeding and eating outcomes. Observations of maternal feeding strategies are often performed in the home. This was not possible in the current study, but future research should utilize observations or could add more questions related to parent feeding. Child eating behaviors are best measured in laboratory experiments that measure eating without hunger, speed of eating, and unrestrained eating. Additionally, more detailed infant feeding behavior data could be collected through observations of feeding in the home or laboratory environment. Whether a mother is breastfeeding or bottle feeding, she could be observed for number of feeding prompts she gives to her infant, amount of praise as a result of feeding, and her feelings on the feeding sessions. Maternal control in bottle feeding would also be interesting to measure in a laboratory setting; this could be done through

the use of opaque bottles which would reduce the amount of visual cues received by the mother and infant. In conclusion, to fully understand the findings related to bottle use and satiety response, laboratory studies are necessary.

V.C.3. Analytical Limitations

The subscales from the CFQ and CEBQ have continuous outcomes, which in most cases is preferred to a dichotomous outcome. Dichotomizing a continuous variable can lead to a reduction in statistical power, as weaker statistical tests must then be employed. It can also take away from the variation that exists in a sample. However, a median split procedure was used in this study for the multivariate analyses. This was primarily done for ease of interpretation as the multivariate analyses were exploring differences among three groups with numerous covariates, on an outcome variable that is not intuitive to those unfamiliar with using it. It was also considered because of the minimal variation on subscale scores among the sample. Future studies in a similar sample might require a larger sample due to the lower than expected variation seen in this sample. The sample calculation used expected 0.25 differences the most similar groups, and a 0.50 difference between the outlying groups; however, variations in this sample were smaller ranging from 0.05-0.23. Therefore, sample size was likely a reason for the lack of significance in many of the findings.

Obesity outcomes are best measured by BMI z-scores. Growth Percentile is a similarly accurate measure, however the preferred is BMI z-scores. There for future analyses using the data from this study should calculate BMI z-scores for the child participants across their life and use these to understand the effects of child feeding and eating behaviors and infant feeding on obesity risk and outcomes. Also, when investigating child feeding and eating behaviors and obesity outcomes, it would be most interesting to track these behaviors overtime in concordance

with growth. Unfortunately, the limits of this study only allowed for growth data to be collected across the child's life, but future prospective studies should measure child feeding and eating behaviors across time as well.

In summary, many of the limitations of this study occurred due to the limited resources and time to complete it. Limitations related to the racial composition, educational level, and other demographics were controlled for in multivariate analyses. However, similar data on a more diverse sample is necessary in order to truly understand the role of infant feeding in obesity. Potential for future research in this area will be discussed and further suggestions for addressing these limitations in larger and more resourceful studies.

V.D. Future Research

The development of this study came as a result of the gap in literature between the findings that breastfeeding reduced obesity and findings that obesity was related to behavioral outcomes. Only one previous study, to my knowledge, investigated how breastfeeding affected maternal feeding behaviors (restriction) later in infancy, and this only looked at children who were two years old (Taveras et al., 2004). This study presented important results illustrating that breastfeeding was related to later maternal feeding styles, however it evaluated them using only four questions from the CFQ and did not investigate child eating outcomes. The role of the current study was to investigate breastfeeding with feeding and eating habits in preschool-aged children who might have better established feeding and eating styles, rather than two years old who are still evolving their styles. The current study also investigated the importance of the bottle in infant feeding and whether breastmilk in a bottle was different than breastfeeding, in terms of obesity outcomes. This has led to interesting findings related to satiety response and points to the continuation of this research.

Future studies investigating breastfeeding's effect on obesity risk should emphasize the bottle and cues associated with the bottle (i.e. amount of food remaining, weight) as primary independent variables in their studies. Previous research which has overwhelming connected breastfeeding to reduced obesity risk, has not accounted for the bottle. A study investigating the risk of obesity in children who are exclusively breastfed versus bottle-fed with breastmilk, mixed formula-breastmilk fed, and formula-fed only children is warranted to clarify some studies which have contradicted the larger body of research that finds breastfeeding to be protective against obesity. Also, behavioral research in obesity often focuses on child feeding and eating behaviors, but it is important also to understand more about infant behaviors of eating and feeding. It has been shown that eating behaviors are learned, therefore the more we understand about what both the baby and mother learn about eating and feeding during a child's infancy, the more likely early and effective interventions for obesity will be developed (Johnson, 2000).

Building directly on the current findings, future research should investigate infant feeding in a more diverse sample in respect to race, income, and educational level. More precise measures of pumping use should be considered, as the number of ounces per day could be reported in patient charts. More precise measurement of child eating behaviors should be employed through the use of laboratory sessions that measure eating without hunger, which is a measure of satiety response. Maternal feeding styles could likewise be measured through observations; however this would best be performed in a natural environment. Moreover, employing a prospective study to examine infant feeding, infant growth, maternal feeding styles, and child eating behaviors would allow for an understanding of crucial periods of behavior development in the reciprocal relationship that exists between the mother and child in feeding and eating. Whether a future study builds directly on these findings or uses them to justify

classifying breastfeeding and pumped breastmilk feeding separately, I believe these findings will be useful for those adding to the literature on breastfeeding and obesity risk.

V.E. Implications

In a unique way, this study contributes to the understanding of breastfeeding as protective factor for obesity. It allows for further exploration the behaviors related to breastfeeding versus bottle-feeding and the behaviors that might be formed while breastfeeding. This study presents the importance of identifying bottle use when investigating obesity related breastfeeding. It also provides support for the body of literature identifying child feeding and eating behaviors as important components in the effort to understand obesity. The findings do not warrant changes in advice or practices for mothers feeding their infants, but do present an important area for future exploration.

V.F. Summary

This dissertation study was developed in order to address the gaps in research surrounding the potential behavioral mechanisms behind the breastfeeding and obesity relationship. Evidence for the hypotheses developed came from research showing that child eating behaviors can be learned and are uniquely affected by maternal behaviors (Johnson, 2000). While researchers have implied that bottle use during infant feeding might effect the relationship between breastfeeding and obesity (Fomon, 1993; Satter, 1996), previous studies have not evaluated the role of the bottle in the way this study did. The design of this study allowed for an efficient evaluation of the hypotheses. The retrospective classification of mothers into an infant feeding group was enhanced through medical verification for the majority of the participants. Evaluation of maternal feeding styles and in particular, child eating behaviors would best be performed through observations. However, the use of validated surveys that have

been shown to replicate the observational data provided the ability to evaluate the hypothesis in an efficient and valid manner. The findings that bottle use in breastfed children resulted in reduced levels of satiety response adds support to suspicions that breastfeeding and bottle feeding with breastmilk are two different feeding styles. The connection between satiety response and food responsiveness with obesity outcomes contributes to the new and growing body of research which connects eating styles in children to obesity outcomes. Future studies should utilize these finding to justify through assessment of breastfeeding in regards to bottle use and should consider further exploring of the role infant feeding has on later childhood eating behaviors and later maternal feeding styles. Lastly, future studies should expand upon the current strategies in a prospective manner as a clearer understanding the breastfeeding-obesity factors may lead to infant feeding strategies (for all infant feeding types) that lower obesity risk, thereby potentially creating significant public health impact in future generations.

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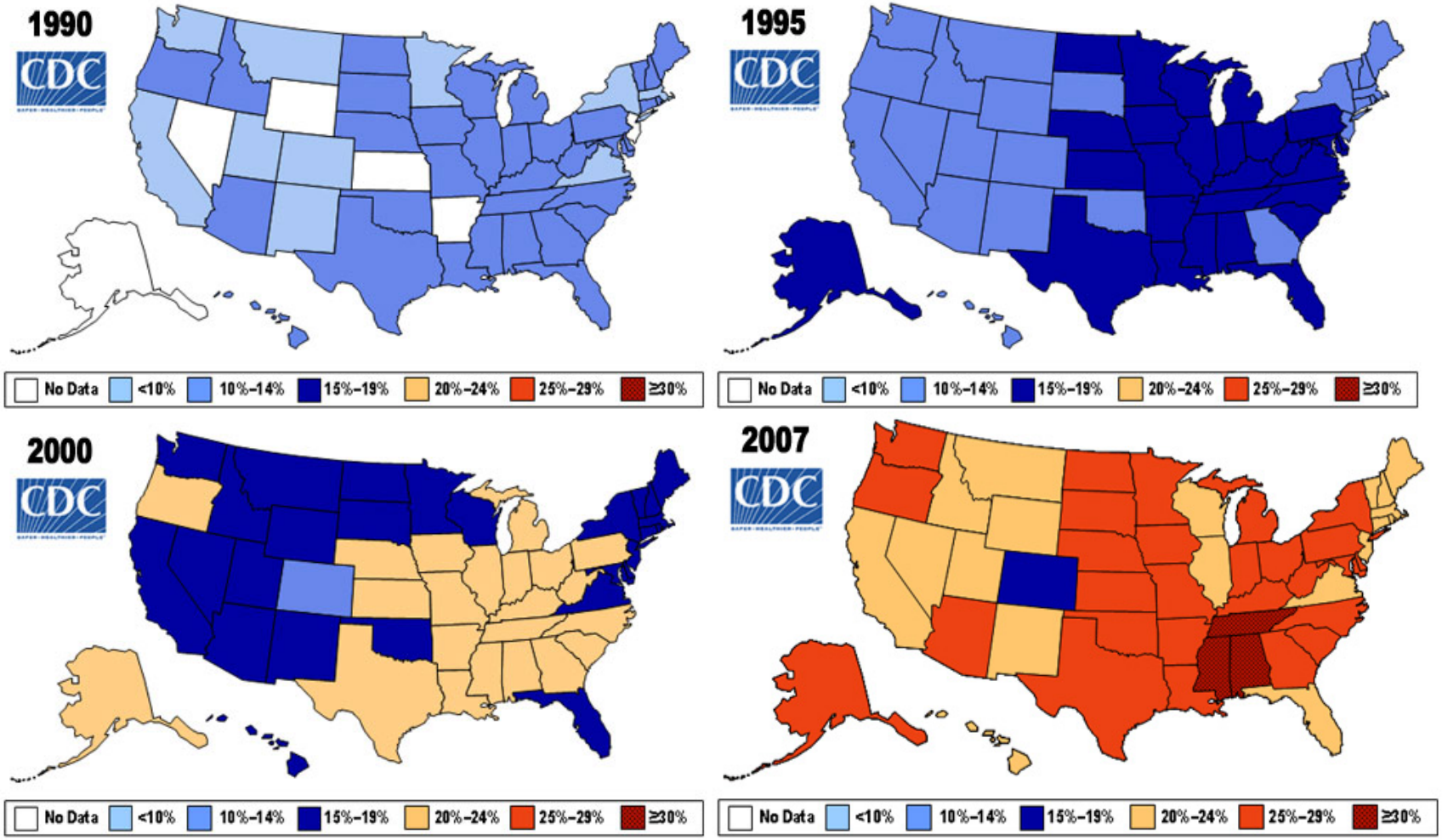
APPENDIX A.

CDC'S MAPPING THE INCREASED PREVALENCE OF OBESITY IN THE US

PERCENT OF OBESE ADULTS (BMI≥30) BY STATE IN THE US



Source: http://www.cdc.gov/nccdphp/dnpa/obesity/trend/maps/index.htm

APPENDIX B

BREASTFEEDING RESOURCE CENTER RECRUITMENT EMAIL

Hello Moms of the BRC:
We have an exciting opportunity for you to participate in a survey research study being performed by Katie Isselmann of Temple University for her dissertation research. Please email (kfi100@temple.edu) or call (610-724-6343) Katie so she can give you the short, 10-minute survey! Your participation will only involve this one-time survey and you will help answer some important questions about childhood obesity prevention. Both Katie and the Breastfeeding Resource Center greatly appreciate your response to this opportunity! Please look below for more detailed information about the study! Call or email Katie at anytime, but before April 30th is preferred!
Sincerely,
Colette M. Acker, BS, IBCLC & Katie Isselmann, MPH

Study Information:
Principal Investigator:Bradley Collins, PhD
Student Investigator: Katherine Isselmann, MPH
Temple University- 1701 N. 13th Street (265-61)
Philadelphia, PA 19122
Tel: (215) 204-6598
Participating in this study involves a one-time, 10 minute survey.
Mothers with a child aged 3-6 months will likely be eligible to participate. Other eligibility requirements are related to both the child's and mother's health. There is no compensation for participating in this study. Please ask Katie any questions by email or by phone: 610 724-6343.

This research study has been reviewed and approved by the Temple University Institutional Review Board and is assigned IRB Protocol #11562.

APPENDIX C

PARTICIPANT SURVEY

ELIGIBILITY SURVEY: By completing this survey, we will be able to know whether you are eligible or not for this study. Thank you for taking the time to answer these questions. If you have more than one child who is aged 3-6, please focus on the YOUNGEST CHILD when answering these questions. Please ask Katie to explain any questions that are unclear.

1. What is *your* date of birth? _____/_____/_____

2a. What is your relationship to this child?

□ BIOLOGICAL MOTHER
□ BIOLOGICAL FATHER
□ GRANDPARENT
□ OTHER FAMILY MEMBER please state relationship: _____
□ OTHER NON-RELATIVE
□ FEMALE LEGAL GUARDIAN
□ MALE LEGAL GUARDIAN

2b. Do you currently live with this child on a full-time basis? □ Yes □ No
If no, what is your custody arrangement? _____

The following questions are about breastfeeding and bottle feeding behaviors you used when your child was an infant.

3. Did you have any condition at the time of delivering this child, that restricted you from breastfeeding *(examples: inverted nipples, mastectomy, prescription drug needs, drug use)*?
□ **Yes** □ **No**

4. Was [child] ever breastfed or fed breastmilk? □ **Yes** □ **No** **(IF NO, Skip to Question 9)**

WE REALIZE IT IS DIFFICULT TO REMEMBER THE DETAILS FOR THE FOLLOWING QUESTIONS BUT PLEASE GIVE YOUR BEST ESTIMATE.

5. How old was your child when he/she completely stopped breastfeeding or being fed breastmilk?
_____ *please circle the time increment*: Days,Weeks, Months

6. How old was your child when (he/she) was first fed formula?
_____ *please circle the time increment*: Days, Weeks, Months

7. How old was your child when he/she was first fed anything other than breastmilk or formula?
_____ *please circle the time increment*: Weeks, Months

8. If you fed your child breastmilk during the first 3 months of your baby's life, what proportion of time did you fed your baby **from the breast (not using pumped breastmilk in bottle)**? *Please circle one of following:*

All of the time *Most of the time* *Some of the time* *None of the time*

9. Has your child had a serious health condition that resulted in changes in eating patterns and/or weight loss or weight gain *(for example: severe food allergies, cancer)*? □**Yes** □**No**
If so, what illness: _____

10. Have you been diagnosed and /or treated for an eating disorder at any time in your life? □**Yes** □**No**

Thank you for answering these questions.
PLEASE HAND FORM TO KATIE AND SHE WILL
LET YOU KNOW IF YOU ARE ELIGIBLE TO PARTICIPATE

PARTICIPANT SURVEY

Thank you for taking the time to answer these questions. If you have more than one child who is aged 3-6, please focus on the YOUNGEST CHILD when answering these questions. Please ask Katie to clarify any questions that are unclear.

Child Feeding Questionnaire:

Please read the following questions and check the boxes most appropriate to you and your child.

	Never	**Seldom**	**Half of the time**	**Most of the time**	**Always**
When your child is at home, how often are you responsible for feeding him/her?	☐	☐	☐	☐	☐
How often are you responsible for deciding what your child's portion sizes are?	☐	☐	☐	☐	☐
How often are you responsible for deciding if your child has eaten the right kind of foods?	☐	☐	☐	☐	☐
	Unconcerned	**A little concerned**	**Concerned**	**Fairly Concerned**	**Very Concerned**
How concerned are you about your child eating too much when you are not around him/her?	☐	☐	☐	☐	☐
How concerned are you about your child having to diet to maintain a desirable weight?	☐	☐	☐	☐	☐
How concerned are you about your child becoming overweight?	☐	☐	☐	☐	☐
	Never	**Rarely**	**Sometimes**	**Mostly**	**Always**
How much do you keep track of the sweets (candy, ice cream cake, pies, pastries) that your child eats?	☐	☐	☐	☐	☐
How much do you keep track of the snack food (potato chips, Doritos, cheese puffs) That your child eats?	☐	☐	☐	☐	☐
How much do you keep track of the high-fatfoods that your child eats?	☐	☐	☐	☐	☐

	Disagree	**Slightly Disagree**	**Neutral**	**Slightly Agree**	**Agree**
I have to be sure that my child does not eat too many sweets (candy, ice cream, cake or pastries).	☐	☐	☐	☐	☐
I have to be sure that my child does not eat too many high-fat foods.	☐	☐	☐	☐	☐
I have to be sure that my child does not eat too much of his/her favorite foods.	☐	☐	☐	☐	☐
I intentionally keep some foods out of my child's reach.	☐	☐	☐	☐	☐
I offer sweets (candy, ice cream, cake, pastries) to my child as a reward for good behavior.	☐	☐	☐	☐	☐
I offer my child his/her favorite foods in exchange for good behavior	☐	☐	☐	☐	☐
If I did not guide or regulate my child's eating, he/she would eat too many junk foods	☐	☐	☐	☐	☐
My child should always eat all of the food on her plate	☐	☐	☐	☐	☐
I have to be especially careful to make sure my child eats enough	☐	☐	☐	☐	☐
If my child says ``I'm not hungry'', I try to get him/her to eat anyway	☐	☐	☐	☐	☐
If I did not guide or regulate my child's eating, she would eat much less than he/she should	☐	☐	☐	☐	☐

The next questions are related to *your weight and your child's weight* throughout your lives. Please read the period of time and check the box most appropriate for your/your child's weight status at that time.

		Markedly underweight	Underweight	Normal	Overweight	Markedly overweight
Your childhood (5 to 10 years old)		☐	☐	☐	☐	☐
Your adolescence		☐	☐	☐	☐	☐
Your 20s		☐	☐	☐	☐	☐
Your weight at present		☐	☐	☐	☐	☐
Your child during the first year of life		☐	☐	☐	☐	☐
Your child as a toddler		☐	☐	☐	☐	☐
Your child as a pre-schooler		☐	☐	☐	☐	☐
Your child kindergarten through 2nd grade	Not in 3rd Grade ☐	☐	☐	☐	☐	☐

PLEASE CONTINUE ON TO NEXT PAGE…

Child Eating Behavior Survey: Please check the box most appropriate to your child's eating behavior.

	Never	Rarely	Some-times	Often	Always
My child loves food	□	□	□	□	□
My child eats more when worried	□	□	□	□	□
My child has a big appetite	□	□	□	□	□
My child finishes his/her meal quickly	□	□	□	□	□
My child is interested in food	□	□	□	□	□
My child is always asking for a drink	□	□	□	□	□
My child refuses new foods at first	□	□	□	□	□
My child eats slowly	□	□	□	□	□
My child eats less when angry	□	□	□	□	□
My child enjoys tasting new foods	□	□	□	□	□
My child eats less when s/he is tired	□	□	□	□	□
My child is always asking for food	□	□	□	□	□
My child eats more when annoyed	□	□	□	□	□
If allowed to, my child would eat too much	□	□	□	□	□
My child eats more when anxious	□	□	□	□	□
My child enjoys a wide variety of foods	□	□	□	□	□
My child leaves food on his/her plate at the end of a meal	□	□	□	□	□
My child takes more than 30 minutes to finish a meal	□	□	□	□	□

	Never	Rarely	Some-times	Often	Always
Given the choice, my child would eat most of the time	□	□	□	□	□
My child looks forward to mealtimes	□	□	□	□	□
My child gets full before his/her meal is finished	□	□	□	□	□
My child enjoys eating	□	□	□	□	□
My child eats more when she is happy	□	□	□	□	□
My child is difficult to please with meals	□	□	□	□	□
My child eats less when upset	□	□	□	□	□
My child gets full up easily	□	□	□	□	□
My child eats more when s/he has nothing else to do	□	□	□	□	□
Even if my child is full up s/he finds room to eat his/her favourite food	□	□	□	□	□
If given the chance, my child would drink continuously throughout the day	□	□	□	□	□
My child cannot eat a meal if s/he has had a snack just before	□	□	□	□	□
If given the chance, my child would always be having a drink	□	□	□	□	□
My child is interested in tasting food s/he hasn't tasted before	□	□	□	□	□
My child decides that s/he doesn't like a food, even without tasting it	□	□	□	□	□
If given the chance, my child would always have food in his/her mouth	□	□	□	□	□
My child eats more and more slowly during the course of a meal	□	□	□	□	□

The following questions will ask about practices at mealtimes in your household and specific questions about the child of interest. Please think back over the past 3 months and choose the answer the best describes the practices in your family.

1. At dinnertime, all family members eat together at a table.
□ Never
□ Seldom
□ Half of the time
□ Most of the time
□ Always

2. At dinnertime, all family members eat the same food *(except for family members with special needs or infants)*.
□ Never
□ Seldom
□ Half of the time
□ Most of the time
□ Always

3. At dinner, my child chooses what food he/she will eat.
□ Never
□ Seldom
□ Half of the time
□ Most of the time
□ Always

The next 6 questions focus on you. Please check the answer that is most true in your life now.

1. I deliberately take small helpings as a means of controlling my weight.
□ definitely true □mostly true □mostly false □definitely false

2. I consciously hold back at meals in order not to gain weight.
□ definitely true □mostly true □mostly false □definitely false

3. I do not eat some foods because they make me fat.
□ definitely true □mostly true □mostly false □definitely false

4. How frequently do you avoid `stocking up' on tempting foods?
□ almost never □ seldom □ usually □ almost always

5. How likely are you to consciously eat less than you want?
□ unlikely □slightly likely □ moderately likely □ very likely

6. **On a scale of 1 to 8,** where 1 means no restraint in eating (eating whatever you want, whenever you want it) and 8 means total restraint (constantly limiting food intake and never `giving in'), what number would you give yourself? _____

General Questions about you and your child

Just before you got pregnant with this child, how much did you weigh?
(Your best estimate is fine.) _____ lbs

What is your current weight? _____ lbs

How tall are you? ____Feet ____Inches

Before you got pregnant with your child, did you ever have any other babies who were born alive? □ Yes □ No

Were you diagnosed with gestational diabetes (diabetes during pregnancy) during the pregnancy of interest? □ Yes □ No

What race/ethnicity to you consider **yourself** to be? *Mark more than one if applicable.*

□ White, Non-Hispanic
□ White, Hispanic
□ African American/Black
□ Black, Hispanic
□ Asian American
□ Native American or Alaskan
□ Pacific Islander
□ Other

What race/ethnicity to you consider **your child** to be? *Mark more than one if applicable.*

□ White, Non-Hispanic
□ White, Hispanic
□ African American/Black
□ Black, Hispanic
□ Asian American
□ Native American or Alaskan
□ Pacific Islander
□ Other

What is your current marital status?

□ Single, never married
□ Living with partner/significant other
□ Married
□ Separated, Divorced
□ Widowed

What is your *current* total household income before taxes? Include your income, your husband's or partner's income, and any other income you may have used. (All information will be kept private.) Check <u>one</u> answer

□ Less than $15,000
□ $15,000 to $24,999
□ $25,000 to $49,999
□ $50,000 to $74,999
□ $75,000 to $99,999
□ $100,000 or more

What is your highest level of education completed thus far?

□Some High School
□ High School or GED
□Some College or Technical School
□ 2-year College (Associates Degree)
□ 4-year College (Bachelors Degree)
□ Beyond College (Graduate courses or degree)

Thank you for answering these questions.
Please contact Katie with any questions!

TO BE COMPLETED BY RESEARCHER

CHILD DOB: _____/_____/_____
CHILD AGE AT INT _____ years
GENDER ___Boy ___Girl

Medical Chart Data:

Baby's Weight:

At birth _____

At 6 months _____

At 12 months _____

At 24 months _____

At 36 months _____

Current Weight _____

Baby's Length/Height (inches):

At birth _____

At 6 months _____

At 12 months _____

At 24 months _____

At 36 months _____

Current Weight _____

Baby's Growth Percentile: ***(Calculate from Data Above)***

Age 1: _____ percentile Weight _____percentile Height

Age 2: _____ percentile Weight _____percentile Height

Age 3: _____ percentile Weight _____percentile Height

Current: _____ percentile Weight _____percentile Height

Breastfeeding Duration:

_____weeks of exclusive breastfeeding

_____weeks of non-exclusive breastfeeding

Notes on pumping versus breastfeeding _____

APPENDIX D

GLOSSARY OF TERMS

Body Mass Index (BMI): A number calculated from a person's weight and height. BMI is a reliable indicator of body fatness for people. BMI does not measure body fat directly, but research has shown that BMI correlates to direct measures of body fat, such as underwater weighing and dual energy x-ray absorptiometry (DXA).

Childhood overweight: Defined as having a BMI at or above the 95th percentile of the gender- and age-specific BMI growth charts (American Public Health Association [APHA], 2003)

Exclusive Breastfeeding: Feeding an infant only breast-milk and water, no other supplements including formula and infant cereal.

Food Responsiveness: The extent to which an individual responds to the presence of food regardless of hunger level

Maternal Restriction: The extent to which a parent attempts to restrict their child's eating during a meal

Maternal Control/Monitoring: The degree to which a parent monitors their child's eating

Satiety Responsiveness: The extent to which an individual responds to fullness cues in order to regulate caloric intake by discontinuing eating or by not initiating eating