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Does Breastfeeding Reduce the Risk of Child Overweight in North Carolina?

by

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Abstract

Objectives: Numerous studies have found an association between breastfeeding and the risk of child overweight. Our objective is to examine the relationship between breastfeeding initiation and duration with child overweight among children and adolescents in North Carolina, while controlling for maternal characteristics.

Methods: From 2007–2009, 3,424 biological mothers completed both the North Carolina Behavior Risk Factor Surveillance System (BRFSS) and the Child Health Assessment and Monitoring Program (CHAMP) surveys. These population-based data were used to analyze child overweight (ages 2 to 17 years) among children who were never breastfed or weaned at an early age (breastfed less than three months), as compared to children who were breastfed for at least three months.

Results: Multivariate analysis found that breastfeeding duration is significantly associated with child overweight/obesity, even after controlling for maternal characteristics including race, education, smoking status, and weight status. Children who were never breastfed were significantly more likely to be overweight/obese (aOR=1.39 [95% CI 1.08, 1.80]), as well as children who were breastfed for less than three months (aOR=1.33 [95% CI 1.03, 1.71]), compared to children who were breastfed for three or more months.

Conclusion: Various initiatives aimed at childhood obesity include recommendations promoting breastfeeding. Providing education and information on breastfeeding, supporting programs to encourage breastfeeding, as well as advancing state breastfeeding legislation may help reduce the rate of child overweight and obesity.

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Introduction

The benefits of breastfeeding in reducing the risk of childhood overweight have been well-documented. Two meta-analyses* conducted by Arenz et al.¹ and Owen et al.² report that breastfeeding has an inverse association with childhood overweight. Arenz and colleagues examined nine studies, consisting of more than 69,000 participants, and concluded that the likelihood of childhood obesity was 22 percent lower for children who were breastfed as infants compared to those never-breastfed (aOR 0.78 [95% CI 0.71–0.85]). Four of the studies in the Arenz et al. review also reported a decreasing prevalence of overweight with increasing duration of breastfeeding, suggesting an inverse dose-response relationship between breastfeeding duration and obesity. Owen and colleagues reviewed 28 studies, consisting of 298,900 subjects, and also found lower adjusted odds of obesity among breastfed children than among formula-fed children. The relationship between breastfeeding and obesity persisted for older children and adolescents indicating that the benefits of breastfeeding were not limited to early childhood.

Low rates of breastfeeding initiation have long been known to be associated with certain maternal characteristics. Results from the Centers for Disease Control and Prevention (CDC) National Immunization Survey^{3,4} found that, among infants born in 2006, the overall national rate of breastfeeding initiation was 74 percent. However, for this same birth cohort, breastfeeding initiation varied by maternal education and race/ethnicity. Among mothers with a high school education, breastfeeding initiation was 65 percent, compared to 86 percent among mothers with a college degree. Furthermore, the breastfeeding initiation rate among non-Hispanic African-American mothers was the lowest of any race or ethnic group at 56 percent. Also, maternal smoking and maternal obesity have been associated with decreased rates of breastfeeding initiation and duration.^{5,6}

In addition to research demonstrating the benefits of breastfeeding, strategies to encourage breastfeeding have recently gained national attention. On May 11, 2010, First Lady Michelle Obama unveiled the White House Child Obesity Task Force action plan: *Solving the Problem of Childhood Obesity Within a Generation*.⁷ In the unveiling of this plan, Mrs. Obama said: “For the first time, the nation will have goals, benchmarks, and measureable outcomes that will help us tackle the childhood obesity

epidemic one child, one family, and one community at a time.”⁸ In this plan, there are several recommendations specific to the promotion of breastfeeding which include eliciting hospitals and health care providers to empower new mothers to breastfeed, improving breastfeeding support among childcare settings, and eliciting local health departments to develop support programs to encourage and sustain breastfeeding for new mothers.

The purpose of the current study is to examine the association between breastfeeding and child overweight status in North Carolina. Using results from the North Carolina Child Health Assessment and Monitoring Program (CHAMP) Survey, we examined whether the likelihood of being overweight was significantly greater among children who were never breastfed or weaned at an early age (breastfed less than three months), as compared to children who were breastfed for at least three months.

Methods

Data

We combined survey data from the 2007, 2008, and 2009 North Carolina Behavioral Risk Factor Surveillance System (BRFSS) and CHAMP surveys to yield a sufficiently large sample for conducting a multivariate analysis of breastfeeding and its association with child and adolescent overweight. The BRFSS is an annual state-wide telephone survey that uses a random-digit-dial computer-assisted telephone interview to assess health characteristics of non-institutionalized adults age 18 years and older. During the BRFSS interview, respondents living in households with children (0 to 17 years) are asked to participate in CHAMP. One child is randomly selected from the household and the adult identified as most knowledgeable about the health of the selected child is called one to two weeks later to complete the CHAMP survey.⁹

From 2007–2009, 43,889 adults participated in the NC BRFSS. A total of 12,767 (29%) reported a child under age 18 living in the household, of which 8,072 (63%) participated in CHAMP. The current study was limited to surveys where the CHAMP child’s biological mother completed both the BRFSS and CHAMP surveys, and provided information on the child’s height and weight (N=3,424).

* Meta-analyses are studies of previously published studies on a given topic which meet certain research criteria. In a meta-analysis, the study itself is the unit of analysis. For the two studies mentioned above, the authors “pooled” the reported results from each study to yield a summary risk estimate, or pooled odds ratio.

Child Weight Status

Child weight status was estimated from maternal report of child's height and weight (ages 2 to 17 years) from which Body Mass Index (BMI) percentiles for age and sex were calculated. BMI-for-Age percentiles are endorsed as the appropriate assessment of weight status in children and are determined via CDC charting of BMI,¹⁰ which is calculated in the same manner for children as it is for adults: weight (in kilograms) divided by height (in meters) squared. In this study, we defined the prevalence of child overweight as having a BMI equal to or exceeding the age-sex-specific 85th percentile, which also includes children defined as obese (greater than 95th percentile). Child overweight was treated as a dichotomous (yes/no) variable. Children with implausible values of height, weight or BMI were excluded from the study, using World Health Organization exclusion criteria.¹¹

Breastfeeding

Breastfeeding initiation and duration were measured in the 2007–2009 CHAMP surveys. For this study, breastfeeding duration was categorized as: (1) never breastfed, (2) breastfed for less than three months (1 to 90 days), and (3) breastfed for three or more months (91+ days).

Maternal Characteristics

Demographic and behavioral characteristics of the mother, including education, race, smoking (current smoker vs. non-smoker), and weight status were obtained from the 2007–2009 BRFSS surveys. Three categories of race were analyzed: white, African American, and other. Hispanic mothers accounted for 64 percent of “other race.” Due to small numbers, Hispanics were not treated as separate group in the logistic regression model.

Maternal weight status was based on self-reported height and weight. Categories for maternal weight status based on BMI were defined as: BMI less than 18.5 classified as underweight; BMI 18.5 to 24.9 classified as normal weight; BMI 25.0 to 29.9 classified as overweight; and BMI greater than 29.9 classified as obese.¹² For this study, underweight and normal weight mothers were collapsed into a single group, while overweight and obese mothers were treated as separate groups.

Statistical Analysis

CHAMP data are weighted to represent the total child population (0 to 17 years) of North Carolina. SUDAAN

10.0 software survey procedures were used to account for the complex survey design. All descriptive and multivariate analyses incorporated the sample weights and variance estimators derived from the survey design. Multiple logistic regression was used to compute the adjusted odds ratios for overweight children (the dependent variable), accounting for the effects of breastfeeding duration, maternal race, education, smoking, and weight status (explanatory variables). In this model of child overweight, we controlled for maternal characteristics that are associated with breastfeeding.

Results

Sample Characteristics

Demographic and behavioral characteristics of survey respondents are presented in Table 1. Seventy-one percent

Table 1
Sample Characteristics: 2007–2009 NC BRFSS and CHAMP Surveys (N = 3,424)

	N	Weighted Percent
Maternal race		
African American	458	19.2
Other race	296	10.2
White	2,659	70.6
Maternal education		
Less than or equal to H.S.	939	27.9
Some College/Tech school	1,065	30.7
College graduate	1,419	41.4
Maternal smoking status		
Current smoker	666	17.8
Non-smoker	2,752	82.2
Maternal weight status		
Obese	961	30.6
Overweight	933	28.7
Normal/underweight	1,363	40.7
Child weight status		
Underweight	209	6.5
Normal weight	2,049	59.0
Overweight	555	16.8
Obese	611	17.7
Breastfeeding duration		
No days	1,092	31.7
Less than 3 months	893	25.3
3 months or more	1,328	43.0

of mothers were white, 19 percent African American, and 10 percent other race. Forty-one percent were college graduates, 31 percent had attended some college or technical school, and 28 percent had a high school education or less. Eighteen percent of mothers were current smokers. Based on BMI categories, 41 percent of mothers were underweight/normal weight, while 28 percent were overweight and 31 percent were obese. Based on child BMI-Age percentile categories, 6 percent of children were underweight, 59 percent were normal weight, 17 percent were overweight, and 18 percent were obese; thus 35 percent of children were categorized as either overweight or obese. Overall, 32 percent of children were never breastfed, 25 percent were breastfed for less than three months, and 43 percent were breastfed for three or more months.

Prevalence and Adjusted Odds of Child Overweight

The unadjusted prevalence and adjusted odds ratios of child overweight for each of the five maternal characteristics included in the logistic regression model are presented in Table 2. Multivariate analysis found that breastfeeding duration is significantly associated with child overweight/obesity, even after controlling for maternal race, education, smoking status, and weight status. Children who were never breastfed were significantly more likely to be overweight/obese (aOR=1.39 [95% CI 1.08, 1.80]), as were children who were breastfed for less than three months (aOR=1.33 [95% CI 1.03, 1.71]), compared with children who were breastfed for three or more months.

In addition, the prevalence of child overweight was found to vary significantly by maternal race, education, smoking

status, and weight status. Although the prevalence of child overweight was significantly lower among whites, multivariate analysis found that race was not a significant predictor of child overweight when controlling for other covariates. However, it was found that the adjusted odds of child overweight among mothers with the least amount of education was significantly higher compared to children of mothers with a college degree (aOR=1.43 [95% CI 1.09, 1.87]). Both the unadjusted prevalence and adjusted odds of child overweight was significantly greater among mothers who were current smokers, compared to non-smoking mothers. The strongest predictor of child overweight was maternal weight status. Obese mothers were more than two times as likely to have an overweight/obese child compared to normal weight mothers. Similarly, children of overweight mothers were also much more likely to be overweight/obese (aOR=1.33 [95% CI 1.03, 1.71]).

Table 2
Prevalence of Child Overweight/Obesity by Maternal Characteristics, 2007–2009 NC CHAMP (N = 3,383).

Maternal Characteristics	Weighted Percent of Child Overweight/Obese % (95% CI)	aOR ¹ (95% CI)
Breastfeeding Duration		
Never breastfed	42.8 (38.9–46.7)	1.39** (1.08–1.80)
Breastfed < 3 Months	35.8 (31.8–40.0)	1.33* (1.03–1.71)
Breastfed 3 or More Months	27.7 (24.7–30.9)	1.0 (referent)
Race		
African American	43.8 (38.4–49.4)	1.28 (0.97–1.69)
Other Race	40.5 (33.5–47.8)	1.40 (0.97–2.03)
White	31.1 (28.8–33.4)	1.0 (referent)
Education		
Less than or Equal to H.S.	44.8 (40.6–49.1)	1.43** (1.09–1.87)
Some College/Tech School	35.6 (31.9–39.5)	1.08 (0.85–1.38)
College Graduate	26.6 (23.7–29.6)	1.0 (referent)
Smoking Status		
Current Smoker	44.1 (39.3–49.1)	1.41** (1.10–1.82)
Non-smoker	32.4 (30.1–34.7)	1.0 (referent)
Maternal Weight Status		
Obese	49.3 (45.2–54.8)	2.49** (1.95–3.17)
Overweight	33.8 (29.9–37.8)	1.39** (1.08–1.79)
Underweight/Normal Weight	23.9 (21.1–26.9)	1.0 (referent)

* p < .05;
 ** p < .01
¹ aOR = Adjusted Odds Ratio; adjusted for breastfeeding duration, maternal race, education, smoking status, and weight status.

Discussion

Key Findings

The results of this study support the extensive body of research that has demonstrated the protective effect of breastfeeding on childhood obesity.^{1,2} Most notably, we found that, in comparison to children who were breastfed for three or more months, the likelihood of child overweight increased by 39 percent for children who were never breastfed, and by 33 percent for children breastfed for less than three months. This relationship was statistically significant when controlling for factors associated with low rates of breastfeeding initiation, specifically maternal race, education, smoking status, and weight status.

Among the model explanatory factors, the strongest relationship was found between maternal weight status and child weight status. Children of obese mothers were more than twice as likely to be classified as overweight or obese, as compared to children of normal weight mothers. Indeed, much of the research on maternal obesity has found that mothers who are overweight or obese entering pregnancy are likely to have infants with higher birth weight, and, in turn, these infants are also at increased risk for obesity later in life. Longitudinal birth cohort studies have shown that maternal pre-pregnancy obesity was a significant predictor of overweight among older children and adolescents.^{13,14} Findings from the current study of children ages 2 to 17 underscores the influence of maternal weight status on child weight status from early childhood through late adolescence. Nevertheless, breastfeeding duration remained an independent predictor of child overweight, even when controlling for the strong relationship between maternal and child weight status.

Biological Mechanisms of Breastfeeding

Several theories have been proposed to explain why breastfeeding protects against obesity.¹⁵ One theory suggests that breastfed babies work for their food by feeding at the breast; consequently, their satiety center is intact and active. Infants are thus able to self regulate their intake of breast milk by sensing when they are hungry and when they are full, rather than relying on external cues (e.g., bottle feeding).¹⁶ Other theories focus on the biochemical role of two hormones, insulin and leptin. Excessive amounts of insulin may lead to increased deposition of fat tissue, while leptin is thought to promote satiation. Breast milk has lower concentrations of insulin than formula, and formula fed infants have been shown to have higher plasma insulin concentration, likely due to higher protein intake.¹⁷ Conversely, leptin levels in breastfed babies have been found to be higher than in their

formula fed counterparts.¹⁸ Lower levels of insulin and higher levels of leptin in breast milk could influence the set points of appetite or metabolism, potentially leading to longer term effects in reducing risk of child overweight.¹⁹ Further research in these emerging areas of interest is warranted.

Barriers to Breastfeeding

A mother's decision to breastfeed can be met with barriers that affect both the desire to breastfeed and the sustainability of breastfeeding. Results from the 2008 North Carolina Pregnancy Risk Assessment Monitoring Program (PRAMS)²⁰ found that, among mothers who never breastfed, the most common reasons for not breastfeeding were that the mother did not like breastfeeding (44%), the mother had other children to take care of (24%), or the mother had to return to school or work (23%). Other study results have shown that breastfeeding may be inhibited by underestimating the health benefits of breastfeeding,^{21,22} by lack of support from the baby's father,²³ and by the mother's perceived lack of social support, or support from peers.^{24,25}

The reasons for short-duration breastfeeding point to additional challenges for the mother. Lactation issues (baby had trouble sucking) and nutrition issues (breast milk alone did not satisfy baby) are most often cited as the primary reasons for early weaning (less than three months).²⁶ Mother's perception of milk insufficiency and low sense of breastfeeding self-efficacy can lead to short duration breastfeeding.²⁷ Early weaning is also associated with birth characteristics, including prematurity, admission to a neonatal ward, and Caesarean birth.²⁸ Women who are overweight or obese before pregnancy are also more likely to breastfeed their infants for shorter duration.²⁹ Obesity and the hormones associated with obesity may also play a role in lactation failure.^{30,31} For many mothers, however, the principal reason for discontinuing breastfeeding is associated with the need to return to work.³²

Strategies to Promote Breastfeeding

The Baby-Friendly Hospital Initiative (BFHI) is a well-recognized strategy that seeks to protect and promote breastfeeding worldwide. Launched in 1991, the initiative is an effort by the United Nations Children's Fund (UNICEF) and the World Health Organization (WHO) to ensure that all maternity facilities become centers of breastfeeding support. Through implementing all UNICEF/WHO policies, known as the Ten Steps, hospitals can become certified as "baby-friendly."³³ As of July 2,

2010, only 94 hospitals in the U.S. were certified as baby-friendly. Two of these hospitals are in North Carolina: the Mission Memorial Hospital in Asheville, and the Women's Birth and Wellness Center in Chapel Hill.³⁴

A number of studies both in the U.S. and in other countries have shown a positive impact of the BFHI on breastfeeding initiation and duration. An institutional survey of Oregon's maternity hospitals (N=57) found that hospitals that had higher compliance with the BFHI Ten Steps were more likely to have higher rates of breastfeeding for their maternity patients at two days and at two weeks postpartum, compared to hospitals with lower compliance. Furthermore, when each of the Ten Steps was analyzed individually, having a written hospital policy in place was found to be the most important step associated with higher breastfeeding rates.³⁵ A study of maternity hospitals (N=145) in Switzerland found that the proportion of exclusively breastfed infants (birth to 5 months) was 42 percent for infants born in baby-friendly hospitals, compared to 34 percent for infants born elsewhere.³⁶ Findings from these types of studies suggest that hospitals with comprehensive breastfeeding policies are increasing the number of new mothers who initiate and sustain breastfeeding.

In 2007, the CDC Maternity Practices in Infant Nutrition and Care (mPINC) national survey assessed perinatal care in maternity hospitals and birth centers in the U.S. that provide maternity care services.³⁷ In North Carolina, 84 percent of the 85 eligible hospitals and birth centers participated in the mPINC survey. The results of the survey revealed that in North Carolina only 9 percent of facilities met the American Academy of Pediatrics Perinatal Care Guidelines against routine supplementation of formula for newborns, only 10 percent had comprehensive breastfeeding policies in place, and only 16 percent do not distribute formula company discharge packs. The mPINC state report for North Carolina outlines recommendations to improve breastfeeding practices and policies specific to the state.³⁸

State legislation, such as protecting a women's right to breastfeed in public, has also been shown to be an effective strategy for promoting breastfeeding. A recent study conducted by Kogan and colleagues³⁹ found that breastfeeding initiation rates were highest in states (predominantly in the west and northwest) that had enacted multiple pieces of legislation supportive of breastfeeding and lowest among states (predominantly southern) with minimal legislation. Washington state had the highest breastfeeding initiation rate (88%), and

North Carolina ranked 31st with an initiation rate of 63.5 percent. Currently, North Carolina has a single piece of legislation stating that a woman is allowed to breastfeed in any public or private location, and that she is not in violation of indecent exposure laws. In California, with the third highest rate of breastfeeding initiation (86.5%), several pieces of legislation have been enacted, including a law that requires the Department of Public Health to develop a training course about hospital policies and recommendations that promote exclusive breastfeeding and specify staff for whom this model training is appropriate.⁴⁰

Another key strategy for promoting breastfeeding involves educating employers on the health benefits of breastfeeding, and encouraging workplace policies and adaptations, such as private rooms for lactation, that would allow for new mothers to continue feeding their infant breast milk at work. Such policies have now garnered support in the new national health care bill. As part of the Patient Protection and Affordable Care Act signed by President Obama in March 2010, employers are now required to provide reasonable break time for one year for an employee who is subject to the Fair Labor Standards Act (paid hourly), to express breast milk for her nursing child, and provide a private room for this purpose.⁴¹ In North Carolina, the Office of State Personnel recently passed a lactation policy that provides space and break time for employees governed by the State Personnel Act,⁴² protecting salaried employees as well as hourly employees. Additional regulations went into effect on July 1, 2010, stating that all licensed child care facilities and family day care homes must provide accommodations for breastfeeding mothers, including seating and an electrical outlet in a private place other than a bathroom.⁴³ Recently, the North Carolina Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) awarded 57 local agency Breastfeeding Promotion and Support mini-grants in the amount of \$417,840 with roughly \$106,000 being spent on worksite lactation efforts and \$16,000 on training and lending libraries for child care facilities.

Peer support from the community with previous experience in breastfeeding their own children is also known to be effective in promoting breastfeeding. Peer supporters have been shown to be particularly helpful in working with low income populations, such as women in the WIC Program, which have traditionally low rates of breastfeeding initiation. A cross-sectional study of WIC mothers in Maryland (N=18,789) found that peer counseling was positively associated with breastfeeding

initiation.⁴⁴ It has also been found that peer supporters may provide additional benefits to new mothers, such as increased self-esteem, greater confidence, parenting skills, and improved family diet.⁴⁵ In addition, the use of community peer support programs is one of the recommendations for improving breastfeeding, as outlined in the White House Task Force Report on *Solving the Problem of Childhood Obesity Within a Generation*.⁷ The North Carolina WIC Program recently increased their peer counselor programs from 23 to 66 statewide, such that peer counselor programs are now available in all six perinatal regions of the state.

Creating a breastfeeding-friendly health care system, promoting legislation and policies that support breastfeeding, encouraging breastfeeding-friendly workplaces, and developing breastfeeding-friendly communities (e.g., local-based support groups) are some of the key recommendations outlined in North Carolina's state plan for breastfeeding, entitled "Promoting, Protecting and Supporting Breastfeeding: A North Carolina Blueprint for Action, 2006."⁴⁶ Additional recommendations include advocating for insurance coverage for breastfeeding care, involving media to promote breastfeeding public acceptance, and encouraging research and evaluation on breastfeeding outcomes. The action steps defined in the report are also nuanced to the needs of North Carolina, such as the North Carolina Division of Public Health developing the North Carolina Maternity Center Breastfeeding Friendly Designation (NC MCBFD). This initiative is supported by the North Carolina Hospital Association and other health professional organizations and is designed to assist hospitals in their efforts to begin implementing policies of the Baby-Friendly Hospital Initiative. The NC MCBFD awards one star for every two steps of the Ten Steps to Successful Breastfeeding that a facility has implemented. Further examination of action taken and programs instituted over the past four years is essential to determine the current status of breastfeeding in North Carolina and evaluate what progress the state has made since release of the blueprint for action in 2006.

Study Limitations

There are several limitations of this study. Breastfeeding is measured retrospectively in the CHAMP survey, i.e., mothers are asked to report on child's history of breastfeeding. Mothers with teenage children may be somewhat less reliable in recalling the specific duration of breastfeeding their adolescent (e.g., three months

vs. six months vs. nine months, etc.). We attempted to control for this recall bias, however, by categorizing long duration breastfeeding as the broad grouping of three or more months, thereby reducing the potential for misclassification. Although CHAMP also includes measures on formula feeding, breastfeeding exclusivity is not included in the current report since duration of exclusive breastfeeding was not assessed. Secondly, the child's height and weight were reported by proxy (maternal report) that can lead to inaccurate values, particularly for child height. To increase accuracy in parental reports of height and weight a callback survey was instituted in 2007 where updated height and/or weight measurements were obtained from parents who guessed or relied on the child's self-reporting of height and weight. Thirdly, the BRFSS and CHAMP are surveys of households with landline telephones. By not including households without telephone service or cell phone only households it is likely that some populations may be under-represented in the sample (e.g., low income). However, by including mother's education as proxy for socioeconomic status in the logistic regression model the effect of these factors on study results are controlled for to some extent. Lastly, an observational study such as this can only show an association between breastfeeding and child overweight—it cannot demonstrate cause and effect.

Conclusion

The results of this study suggest that breastfeeding is a protective factor against child overweight among children ages 2 to 17 in North Carolina. The American Academy of Pediatrics recommends that mothers breastfeed exclusively for at least six months, with continued breastfeeding for at least the first year of life, and beyond for as long as mutually desired by mother and child. Previous research offers several strategies that could be undertaken by the public health community to promote breastfeeding in North Carolina: (1) enacting recommendations specified by the CDC in the state report: *Maternity Practices in Infant Nutrition and Care in North Carolina*;³⁸ (2) increasing the number of breastfeeding peer supporters, or support programs, associated with county health departments; (3) ensuring that all new mothers in North Carolina receive information on the health benefits of breastfeeding for their infants; and (4) research and evaluation of strategies and objectives specified in the North Carolina's 2006 action plan for promoting breastfeeding.⁴⁶ Following these recommendations to promote breastfeeding could reduce the burden of childhood obesity in North Carolina.

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