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Why Aren't US Women Breastfeeding? An Examination of Barriers to Breastfeeding Associated with Pre-Pregnancy Health

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An abstract of
a thesis submitted to the Faculty of the Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of Master of Public Health in Global Health-Public Nutrition
2014

Abstract

Why Aren't US Women Breastfeeding? An Examination of Barriers to Breastfeeding Associated with Pre-Pregnancy Health

By Erikka L. Gilliam

Objective: To examine the association between pre-pregnancy health and breastfeeding outcomes and to investigate breastfeeding barriers among a racially and economically diverse population in 4 PRAMS sites in the United States.

Methods: Data were obtained from the Pregnancy Risk Assessment Monitoring Survey (PRAMS). Participants included women who had live births between 2004 and 2008 and who resided in Georgia, North Carolina, South Carolina and Illinois. Multinomial logistic regression was conducted to determine the association between pre-pregnancy hypertension and diabetes and breastfeeding duration. A descriptive analysis of reasons for breastfeeding non-initiation stratified by maternal health status was conducted. Simple logistic regression modeling was used to examine the relationship between pre-pregnancy health status and breastfeeding non-initiation due to maternal illness or medication use.

Results: Our analyses show that having pre-pregnancy hypertension has no significant correlation with short term breastfeeding duration. However, among hypertensive women, the odds of breastfeeding for more than 4 weeks was 21% less likely than their odds of not breastfeeding at all (AOR=0.79, 95% CI 0.67-0.94). Diabetes was not found to be independently associated with breastfeeding duration. Our studies found that pre-pregnancy hypertension correlated with mothers reporting reasons for non-initiation because of maternal illness (AOR: 2.1; 95% CI 1.66-2.65). Pre-pregnancy diabetes was also significantly associated with not initiating breastfeeding due to maternal illness (AOR: 2.6; 95% CI 1.41-4.60).

Conclusion: Our study was one of few that aimed to examine the specific barriers women face when deciding whether to breastfeed in a large and diverse population. In the midst of many limitations, these data gives a broad overview of the effect of pre-pregnancy chronic disease status and future breastfeeding practices.

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Acknowledgements

All thanks are given up to God for all His many blessings.I would like to thank my Thesis Advisor, Dr. Aryeh Stein for his encouragement and guidance throughout my time at Rollins. I would also like to thank Dr. Theresa Chapple at the Georgia Department of Public Health for introducing me to the field of Public Health and affording me the opportunity to work alongside the MCH team at GaDPH. Lastly, I give my greatest thanks to my husband and son for their undying support for me throughout this journey. While spending many late nights in the basement of the Grace Crum Rollins building, the support from my Rollins family and my son's accommodating spirit helped me tremendously in pushing forward. While this journey has not been easy, I am blessed to have been a part of it.

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Chapter 1: Introduction

Breastfeeding is an important public health practice as it is the natural source of nutrition for all infants. There are well-documented short-term and long-term benefits to breastfeeding for both mother and child. The immediate benefits to breastfeeding for infants are a lower incidence of ear infections, gastrointestinal illnesses and lower respiratory infections(Gartner et al., 2005). Many studies have demonstrated that children fed breast milk during infancy have a reduced risk of obesity, childhood cancers and diabetes later in life (Gillman et al., 2001; Grummer-Strawn, Mei, Centers for Disease, & Prevention Pediatric Nutrition Surveillance, 2004; Oddy et al., 1999; Scariati, Grummer-Strawn, & Fein, 1997). Mothers who breastfeed have a decreased risk of postpartum disease, osteoporosis, type II diabetes, ovarian and breast cancer (Newcomb et al., 1994; Rosenblatt & Thomas, 1993).

In addition to its benefits to mother and child, breastfeeding is also beneficial at the population level by decreasing the cost of adverse health effects associated with sub-optimal breastfeeding. Previous research has shown that these adverse health effects cost the United States approximately $14.2 billion dollars each year in pediatric disease and child deaths (Bartick et al., 2013). In addition, the United States stands to incur an even larger cost in preventable maternal health issues such as diabetes and cardiovascular disease (Bartick et al., 2013).

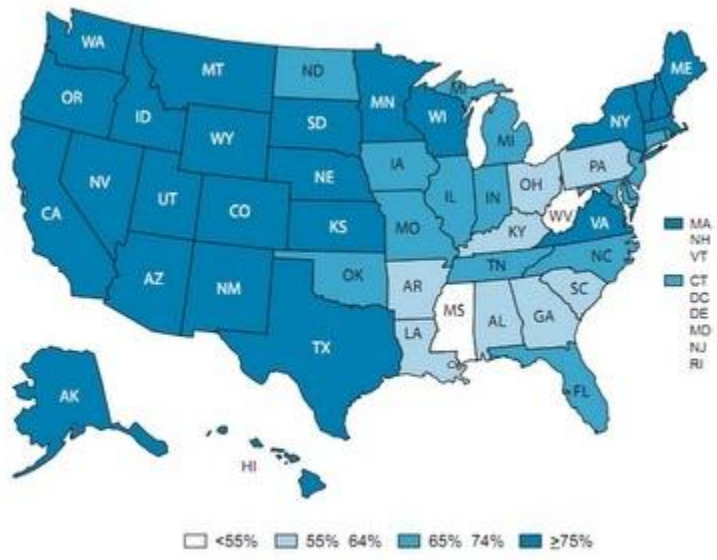
The strength of this evidence has led to the World Health Organization (WHO), American Academy of Pediatrics (AAP) and other health agencies recommending that infants be exclusively breastfed for the first 6 months of life and continue to be breastfed while supplementing with solid foods for at least one year. In the United States, breastfeeding initiation and duration rates have continued to increase over the years. According to CDC's 2013

Breastfeeding Report Card, infants who were ever breastfed increased to 76.5% among those born between 2009 and 2010, therefore meeting the Healthy People 2010 goal of at least 75% ever being breastfed. Furthermore, in 2010, 49% of infants were breastfeeding at 6 months old, a percentage just missing the national goal of 50%(Prevention, 2013). A growing body of research has focused on identifying the most influential risk factors for breastfeeding outcomes. Maternal age, race, education, returning to work and socioeconomic status continue to be some of the most predictive factors in breastfeeding initiation and duration. In addition, hospital care practices play an important role in a woman's intention to breastfeed as well as in her success in continuing to breastfeed. Previous research has also shown that maternal pre-pregnancy health can play a pivotal role in predicting breastfeeding outcomes. It is well documented that obesity is negatively associated with breastfeeding initiation and duration (Thulier & Mercer, 2009). Other maternal health issues that are strongly associated with body mass index such as diabetes and hypertension have also been suggested to be negatively correlated with breastfeeding (Finkelstein et al., 2013; Mulready-Ward & Sackoff, 2013). Research shows that barriers to breastfeeding vary among different populations, specifically with adolescents and in comparing different racial groups (Bentley, Dee, & Jensen, 2003; Cottrell & Detman, 2013; Spear, 2006; Tucker, Wilson, & Samandari, 2011).

The United States continues to have breastfeeding rates that fall well below the Healthy People 2020 goals set forth as a national initiative to improve the overall health of the nation(2011).While some states continue to progress in reaching the Healthy People 2020 goals, many continue to lag far behind in reaching these objectives(Prevention, 2013). Southeastern states have consistently ranked in the bottom half for breastfeeding rates (Figure 1). According to the most recent breastfeeding report card for infants born in 2010, North Carolina was the only

southeastern state that came close to meeting the Healthy People 2010 goals with 74.9% ever breastfed and 48.5% breastfed at 6 months(Prevention, 2013). Because many of these states have drastically failed in meeting the Healthy People 2010 goals, it makes it even more difficult for them to achieve the 2020 goals.

Figure 1: Percentage of Children Ever Breastfed among Children Born in 2007*



*Source: National Immunization Survey, Centers for Disease Control and Prevention, Department of Health and Human Services

There have been many studies which aimed to determine specific risk factors associated with breastfeeding practices among various populations. While many of these risk factors are well-established, there is still uncertainty about the barriers that hinder breastfeeding initiation and promote premature weaning. One such risk factor that is of particular interest is poor maternal health. Obesity is a proven risk factor for poor breastfeeding outcomes; however it is unclear which populations are at greater risk.

Many studies that have identified risk factors negatively associated with breastfeeding group populations together rather than investigating the potential association between regional differences as a potential confounder. The southeastern region of the United States has a long history of inhabiting some of the unhealthiest Americans so it is no surprise that it also has some of the lowest breastfeeding rates in the nation. While breastfeeding rates for most of these states remain far below the national average, there are some who have been steadily increasing their breastfeeding rates. In this study we will examine the relationship between pre-pregnancy health and breastfeeding behavior in four US states: Georgia, North Carolina, South Carolina and Illinois. We will also determine if this association varies by state.

While many studies concentrate on establishing a relationship between maternal health and breastfeeding behavior, there are few studies which attempt to examine the barriers that may be causing these groups to refrain from breastfeeding. We will examine the barriers to breastfeeding in women with poor pre-pregnancy health and determine whether differences exist in these populations compared to mothers who were healthy prior to pregnancy.

Research Objectives

The specific objectives for this study are:

1. To ascertain whether maternal pre-pregnancy health is associated with breastfeeding initiation and/or duration among women in Georgia, North Carolina, South Carolina and Illinois.
2. Determine whether breastfeeding barriers differ based on maternal health.

Hypotheses

Ho: There is no association between maternal health and breastfeeding behavior, controlling for other confounding factors.

Ha: There is no association between maternal health and breastfeeding behavior, controlling for other confounding factors.

Ho: There are no differences in breastfeeding barriers between mothers with poor pre-pregnancy health than those who were healthy prior to pregnancy, controlling for other confounding factors.

Ha2: There are differences in breastfeeding barriers between mothers with poor pre-pregnancy health than those who were healthy prior to pregnancy, controlling for other confounding factors.

Chapter II: Literature Review

To investigate the factors that influence maternal breastfeeding practices, we will discuss its relationship with three chronic maternal health conditions: obesity, hypertension and diabetes.

Obesity during Pregnancy

Obesity has become an important public health concern because of its association with multiple adverse health outcomes such as cardiovascular disease and diabetes. The overall prevalence of obesity, described as a body mass index of 30 or greater, has dramatically increased in the United States since the late 20th century. Based on national survey data, the prevalence of obesity showed little change from 1960 through 1980; however obesity prevalence had its first significant increase between 1976 and 1980 (Flegal, Carroll, Ogden, & Johnson, 2002). A similar increase occurred between 1988-1994 and 1999-2000. While there were less dramatic increases between 2000-2008, suggesting that the rate has slowed down or in some cases stopped, there have been no significant decreases documented to date (Flegal, Carroll, Kit, & Ogden, 2012). According to the most recent report from the National Health and Nutrition Survey, nearly a third of women of reproductive age are obese, nearly triple the amount from the 1970's (Ogden, Carroll, Kit, & Flegal, 2013). The greatest increase in obesity rates are among non-Hispanic African-American women (56%) compared to non-Hispanic white women (27%) (Ogden et al., 2013).

Being overweight or obese is of great concern among reproductive aged women because of its negative effects on both mother and child. More women are entering pregnancy overweight or obese, posing significant risks to both themselves and their child. It is estimated that approximately 60% of women of childbearing age are overweight or obese (2009). Overweight

and obese women are at greater risk of pregnancy complications such as gestational diabetes, pregnancy-induced hypertension and preeclampsia (Garrison, 2013). Obese women are also at greater risk of having difficulties with spontaneous onset of labor, putting them at greater risk of requiring medical induction of labor. Once in labor, these women oftentimes progress slowly, leading to a prolonged labor (Ramos & Caughey, 2005). These complications put women with a higher BMI at greater risk of requiring cesarean delivery and having difficulties with anesthesia management during delivery (Ramos & Caughey, 2005).

Being overweight or obese also negatively affect the postpartum period in that many studies have reported that excessive weight is associated with delayed lacto-genesis and postpartum weight retention (Matias, Dewey, Quesenberry, & Gunderson, 2014; Wojcicki, 2011). One prospective cohort study followed women who had been diagnosed with gestational diabetes from six to nine weeks postpartum until two years postpartum to determine whether diabetes was associated with delayed lacto-genesis. They found that women who were obese prior to pregnancy were nearly 60% more likely to have delayed lacto-genesis. Furthermore, they found that while diabetes alone was not independently associated with delayed lacto-genesis, women who were managing their diabetes with insulin rather than diet modification were three times more likely to experience delayed lacto-genesis (Matias et al., 2014).

In addition to effecting mother and baby during pregnancy and the postpartum period, excessive weight has long-term consequences on both mother and child. It is well documented that obesity increases the risk of many chronic diseases such as stroke, heart disease, diabetes, and certain cancers (Flegal et al., 2002; Weisberg, 2002). Children born to overweight or obese mothers are at increased risk of congenital birth defects, macrosomia, shoulder dystocia, pre-term birth and NICU admission (Galtier-Dereure, Boegner, & Bringer, 2000; Ramos & Caughey,

2005; Rosenberg, Garbers, Lipkind, & Chiasson, 2005). In addition to its short-term consequences, maternal obesity can have a lasting effect on the child. Children of obese mothers are at greater risk of being obese themselves during childhood and into adulthood (Hillier et al., 2007).

Breastfeeding and Obesity

Pregnancy complications and certain chronic diseases can negatively affect breastfeeding practices. A qualitative study examining the relationship between pregnancy complications and breastfeeding outcomes found that because of the pain and longer recovery time associated with cesarean deliveries, women who underwent this procedure were less likely to initiate breastfeeding in the hospital. Those who did initiate had shorter durations of breastfeeding than women who had vaginal deliveries (Finkelstein et al., 2013). Because infants of obese mothers are more likely to be admitted into the NICU, this causes more cases of prolonged separation between mother and child, further decreasing the odds of initiating breastfeeding. Breastfeeding immediately after birth has been shown to be the critical time to initiate proper milk let down. Separating the child for an extensive period of time either because of NICU admission or because the mother is recovering from surgery, can jeopardize her breastfeeding success (Finkelstein et al., 2013).

Interestingly, many studies have found that the risk factors that plague many obese women and their offspring are reduced in women who breastfeed. Studies show that breastfed children have a reduced risk of diabetes, obesity and otitis media (Ip et al., 2007). Women who breastfeed are able to return to their pre-pregnancy weight more often than those who do not breastfeed (Dewey, Heinig, & Nommsen, 1993). In a study that measured triceps skin-fold thickness one to nine months postpartum, they showed that women who had breastfed lost nearly

twice as much weight as those who formula fed. This was especially apparent in women who breastfed for 3-6 months(Dewey et al., 1993).

Pre-pregnancy Hypertension and Diabetes

As obesity rates increase in the US among reproductive aged women, so has the prevalence of diabetes and chronic hypertension. According to the 2009 Behavioral Risk Factor Surveillance System (BRFSS), the estimated prevalence of hypertension and diabetes among reproductive aged women is 10.1% and 1.5%, respectively (Hayes, Fan, Smith, & Bombard, 2011). Hypertension and diabetes is associated with many of the same risk factors for pregnancy complications as obesity including cesarean, macrosomic infants, congenital malformations, and preterm births (Deak & Moskovitz, 2012; El Mallah, Narchi, Kulaylat, & Shaban, 1997; Moore, Singer, Bradlee, Rothman, & Milunsky, 2000; Ray, Vermeulen, Shapiro, & Kenshole, 2001). Additionally, diabetic women have an increased risk of the child being hypoglycemic at birth which could require medical intervention to restore energy balance (Chertok, Raz, Shoham, Haddad, & Wiznitzer, 2009). However, a prospective study of infants born to mothers with gestational diabetes found that babies who were breastfed soon after delivery were nearly 50% less likely to be hypoglycemic than babies who received formula as their first feed(Chertok et al., 2009).

Hypertension, Diabetes and Breastfeeding

Similarly to its benefits to obese women, breastfeeding can be beneficial to diabetic women and their offspring. A longitudinal diabetes study conducted with the Pima Indians of Arizona found that breastfeeding decreases the risk of the child developing diabetes regardless of the mother's diabetes status (Pettitt, Forman, Hanson, Knowler, & Bennett, 1997). Although maternal diabetes is a positive predictor of diabetes in offspring, breastfed babies had an overall

reduced risk compared to formula fed babies (Pettitt et al., 1997). Furthermore, several reports suggest that women with diabetes should breastfeed their babies to assist the baby in reaching energy balance. This is achieved because breast milk has ketones which act as an alternative energy source that can aid in relieving hypoglycemia. Additionally, hypoglycemia can also occur as a result of hyperthermia, which can be alleviated with skin to skin contact between mother and child soon after delivery (Eidelman, 2001). While many investigators support this recommendation, others believe that the composition in the milk of diabetic mothers has adverse effects on the baby. One group studied offspring from diabetic mothers who were either given breast milk from their mothers or donor milk from healthy mothers. They found that while donor milk was beneficial, their mother's milk had no additional benefits than formula. While the majority of the studies conducted on this matter agree that breast milk is the preferred nutritional supplement for infants born to diabetic mothers, who the breast milk should come from warrants further research(Plagemann & Harder, 2005).

Similar to the disparities in obesity prevalence, hypertension and diabetes are most prevalent in African-Americans followed by Hispanic populations (Rosenberg et al., 2005; Tanaka et al., 2007). While there are similarities in the prevalence of obesity, diabetes and hypertension among racial groups, the relationship between these diseases and breastfeeding outcomes vary. Whereas many researchers agree that obesity is negatively associated with breastfeeding initiation and duration among White women and Hispanic women, there are few studies who have found a correlation between maternal weight and breastfeeding behavior among African American women. A cross-sectional study of more than 6,000 women who participated in the Pregnancy Risk Assessment Monitoring (PRAMS) study of in South Carolina found that very obese White women (BMI>35) were 37% less likely to initiate breastfeeding and

1.69 times more likely to discontinue breastfeeding in the first six months compared to women of normal BMI. However, African American women showed no correlation between breastfeeding behavior and BMI (Liu, Smith, Dobre, & Ferguson, 2010). These disparities also exist in pregnancy complications and birth outcomes. The Ramos group established that maternal hypertension and diabetes puts a child at risk of being born macrosomic, however African-American women do not show this same correlation (Ramos & Caughey, 2005).

Explaining the Reasons for Low Breastfeeding Rates

There are many studies that focus on the prevalence of breastfeeding and have done a detailed descriptive analysis, but few studies have examined the potential reasons why certain populations have poor breastfeeding behaviors. It is well-documented in the CDC Breastfeeding Report Card that African-American women have the lowest rates of breastfeeding initiation and duration, however, one qualitative study aimed to determine whether African-American women's intention to breastfeed differed from their actual initiation rate. They interviewed 10 low-income African-American women and found that while breastfeeding intention was high, initiation was low (Corbett, 2000). Differences in intention also differ among diabetic women. A large study in Ontario found that not only were diabetic women less likely to intend to breastfeed, the degree of difference was dependent on the type of diabetes treatment the women were undergoing (Finkelstein et al., 2013). Insulin-treated women were least likely to initiate breastfeeding than non-insulin treated women, suggesting that breastfeeding likelihood was inversely related to the severity of the disease. They also observed that women who were not insulin-treated had similar breastfeeding rates than women who were not diabetic suggesting that milder forms of diabetes had less of an effect on breastfeeding practices.

The majority of qualitative studies that have tried to provide an explanation for low breastfeeding rates in select populations have focused on more homogenous populations that are not ethnically diverse. Since African-American and Hispanic women are least likely to breastfeed, a qualitative study would give insight into the specific barriers to breastfeeding that these racial groups faced. One such study interviewed 253 African-American women from Florida to identify the key barriers women faced when initiating breastfeeding and of those who breastfed, their reasons for cessation (Cottrell & Detman, 2013). This study found that the fear of potential pain associated with breastfeeding prevented them from breastfeeding. Many also felt the time constraints and returning to work or school was also a major hindrance. Others felt uncomfortable about the idea of breastfeeding while some perceived that their health habits such as smoking, drinking or diet would prevent them from breastfeeding. Reasons for early cessation included poor latch, pain, perceiving that child wasn't eating enough or medical complications from mother or child (Cottrell & Detman, 2013).

Using PRAMS to Study Breastfeeding Behavior

There are many surveillance systems implemented in the United States to survey national breastfeeding practices. One useful database that is widely used is the Pregnancy Risk Assessment Monitoring System (PRAMS) implemented by the Centers for Disease Control and Prevention. This particular survey system is useful in examining key health behaviors and conditions that may exist before, during and after pregnancy. In order to study the association between maternal health and breastfeeding practices, this survey can be used. All states have a set of the same core questions while each individual state can choose a set of supplemental questions based on their interests. One set of supplemental questions address the barriers women

may have faced when deciding whether to initiate breastfeeding and others that address reasons for early cessation.

In studying the relationship between maternal health and breastfeeding, a growing number of researchers are using PRAMS data to analyze this relationship. A study was conducted using PRAMS data from 6 states and New York City to examine the factors associated with premature breastfeeding cessation in preterm infants (Mulready-Ward & Sackoff, 2013). Using breastfeeding for less than 8 weeks as their outcome variable, logistic regression was used to identify correlations in short breastfeeding duration. The authors found that young age, low birth weight, maternal smoking, maternal obesity and hypertension were all risk factors for short breastfeeding duration. They did not find an association between diabetes and breastfeeding duration, however, they included all forms of diabetes (gestational, type I and type II). Another group in Ontario has shown that women with gestational diabetes are more likely to breastfeed longer than women with other forms of diabetes (Finkelstein et al., 2013), therefore if this group would have stratified by diabetes type, they may have found a significant correlation.

To date, there is only one published article that examined the reasons women reported for early breastfeeding cessation using PRAMS data. This group did a retrospective analysis on data collected among women from 10 PRAMS sites (Ahluwalia, Morrow, & Hsia, 2005). When stratifying reasons for cessation by length of time that infants were breastfed, they found that the majority of reasons for cessation in the first week pertained to establishing good breastfeeding practices such as proper latch while reasons for cessation after the first week were more heterogeneous. While this study was one of the first to attempt to quantify these explanations for short breastfeeding intervals, there were no attempts to make a comparison between maternal

health characteristics. Furthermore, this study only focused on breastfeeding duration but did not address women's reasons for not initiating breastfeeding.

As the literature on population-specific barriers to breastfeeding remains scarce, the purpose of this study was to investigate breastfeeding barriers among a racially and economically diverse population in 4 PRAMS sites in the United States.

Chapter III: Methodology

Study Design

The overarching goal of this study was to better understand the factors which influence breastfeeding behavior among women with poor maternal health. For this cross-sectional study, data were obtained from the Pregnancy Risk Assessment Monitoring Survey (PRAMS), a survey administered by the Centers for Disease Control and Prevention (CDC). This survey collects surveillance data from women who had live births in a given year. Questions include those about maternal characteristics just prior to pregnancy, throughout pregnancy and during the post-partum period. The survey uses two different sampling methods, requiring samples to be weighted to control for this sampling method, for non-coverage and for non-response. This will allow for analysis of a sample which will more accurately represent the total population. PRAMS data is linked to birth certificate records so select demographic data were obtained from birth certificate records. Maternal health status, our exposure variable, and our outcome variables, breastfeeding initiation and duration rates were abstracted from the PRAMS survey data. All statistical analyses were performed using SAS-Callable SUDAAN.

Sample population

Subjects were restricted to mothers who had live births between 2004 and 2008 who were residents of Georgia, North Carolina, South Carolina, or Illinois. To reduce the introduction of additional factors that may negatively affect breastfeeding behavior, only subjects who had singleton or twin births were included while other multiples were excluded from the study. Other inclusion criteria included women with known breastfeeding status. After these criteria were met, there were a total of 24,892 women who were included in the study.

Measures

Exposure variables

To measure maternal health before pregnancy, the PRAMS dataset had questions about whether the mother had been told by a physician that she had diabetes or high blood pressure. To assess overweight or obesity, we used the pre-pregnancy weight and the height to calculate BMI. A BMI of 25.0-29.9 was categorized as overweight while 30 and above was considered obese according to WHO guidelines.

Outcome Variables

To measure breastfeeding initiation, we used the PRAMS variable that measured frequency of ever breastfeeding (yes/no). We chose to look at breastfeeding duration by assessing prevalence up to 4 weeks since literature states that the steepest decline in breastfeeding is within the first month. We chose 4 weeks or more as our long-term breastfeeding outcome and less than 4 weeks as our measure of short-term breastfeeding outcome. Women who did not answer whether they ever breastfed were excluded from the study. We assessed various barriers to breastfeeding by using the question on the PRAMS survey that asked women what were the reasons for not initiating breastfeeding. Women were allowed to give multiple reasons using the given options as well as adding any additional reasons as an open-ended response. Open-ended responses were categorized into common themes.

Covariates

We collected information about other potential covariates that may also correlate with breastfeeding practices. Various maternal and child characteristics were included in the analyses.

Data Analysis

Univariate Analysis

Initially, we conducted a descriptive analysis of our sample population which included our exposure and outcome variables as well as other maternal and infant characteristics. To measure maternal exposure to overweight or obesity, we used BMI while also measuring maternal pre-pregnancy hypertension and diabetes. Because we are measuring pre-pregnancy health, we did not include gestational diabetes exposure. To assess the association between these maternal health issues and breastfeeding initiation and breastfeeding at 4 weeks, chi-square tests were performed for these categorical variables. To examine barriers to breastfeeding, we performed a descriptive analysis of reasons women gave for not initiating breastfeeding by pre-pregnancy health status.

Multivariate Analysis

To assess the effect of maternal health on breastfeeding behavior, we used multinomial logistic regression. When building the model, maternal health variables along with potentially confounding variables were selected for the model by stepwise backward elimination. Relationships between pre-pregnancy health status, our exposure variable, and breastfeeding behavior, our outcome variable were established by model building. Simple logistic regression was conducted to assess the crude relationships between potential confounders or effect modifiers and our outcome variable (breastfeeding duration) and our exposure variable (pre-pregnancy diabetes or hypertension). Based on the results of the crude odds ratios and previous literature, we included maternal age, race, BMI, smoking, parity, birth weight, maternal education, and state of residence as potential confounders and/or effect modifiers. We developed a gold standard full model that consisted of all possible confounders that were previously identified during bivariate analyses. We dropped potential confounders one at a time, then

assessed whether the reduced model produced an odds ratio within 10% of the full model's odds ratio. Covariates that reduced the odds ratio by more than 10% were left in the model while those that did not meet this criterion were dropped from the model. Two models were built to assess the relationship between pre-pregnancy health and breastfeeding behavior: one assessing pre-pregnancy hypertension's relationship and the other assessing diabetes' relationship with breastfeeding behavior. To examine the relationship of pre-pregnancy hypertension and diabetes on specific reasons for breastfeeding non-initiation, we used simple logistic regression using a similar selection process for covariates in the model.

Chapter IV: Results

Descriptive Characteristics

Descriptive characteristics of women and their children by state of residence are presented in Table 1. Of the 24,892 women in our sample, 53.0% were White, 23.2% were African-American and 18.9% were Hispanic. The majority of the population had at least a high school education with 28.2% earning a high school diploma or GED, 22.2% having some college and 28.6% having a college degree. Sixty percent of the women recruited into the study were married and 48.1% received WIC services during pregnancy. Four states were represented in this study population: 31.3% from Georgia, 39.3% from Illinois, 20.6% from North Carolina and 8.9% from South Carolina. When assessing the health status of the women in the sample, 50.6% had a normal body mass index (BMI), 12.5% were underweight, 13.46% were overweight and 23.4% were considered obese. Approximately 2% of the population was diagnosed with diabetes prior to pregnancy, while 12.6% of women were diagnosed with hypertension prior to pregnancy. An examination of the infant characteristics revealed that the majority (69.4%) of deliveries occurred vaginally and 9.3% of infants were born less than 37 completed weeks gestation. Over 98% of the births were singletons and 40.9% of the births were firstborns.

Each state had some variation in demographic characteristics. Illinois had a slightly older population with the majority of the women being between the ages of 25-34, while all others ranged from 20-29. Georgia had a more ethnically diverse population, with minorities representing more than 50% of the sample. South Carolina had the highest pre-pregnancy hypertension (16.6%), Illinois had the lowest prevalence of preterm birth (8.6%) and low birth weight (6.7%), South Carolina had the highest prevalence of preterm birth and low birth weight at 10.2% and 8.5%, respectively.

When comparing these demographics between women who ever breastfed and those who never breastfed, we saw many variations (Table 2). Compared to women who have ever breastfed, those who did not breastfeed were more likely to be younger in age, less educated, are unmarried and have participated in the WIC program during pregnancy. Additionally, while the largest percentage of women represented are of White race, the gap between White and African American women decreases among women who did not initiate breastfeeding. An investigation into the health status of these women found that women who did not breastfeed had a higher prevalence of pre-pregnancy obesity, hypertension and diabetes. Furthermore, babies born to these women were more likely to be delivered preterm and have low birth weight. Lastly, women who did not breastfeed were more likely to have 2 or more other children, a factor that has been shown to negatively affect breastfeeding behavior.

The prevalence of breastfeeding was assessed by state in Table 3. We found that Illinois had the highest prevalence of women who initiated breastfeeding (76%) and subsequently the highest prevalence of long-term breastfeeding, defined as breastfeeding for 10 or more weeks. South Carolina represented the state with the lowest breastfeeding rate with nearly 36% of women who did not initiate breastfeeding and only 36% women breastfeeding for at least 10 weeks.

To assess the relationship between pre-pregnancy health status and breastfeeding duration, Table 4 shows the prevalence of breastfeeding by pre-pregnancy health status. Having either hypertension, diabetes, obesity or a combination of the three negatively affects the prevalence of breastfeeding initiation and duration. Having hypertension and diabetes in the presence or absence of obesity had the greatest impact on breastfeeding behavior, with 48% of the sample not initiating at all and only 24.3% breastfeeding for at least 10 weeks.

Association between Breastfeeding and Pre-pregnancy Health

Multivariate logistic regression was used to compare the odds of breastfeeding for a short duration or never breastfeeding utilizing two models: 1) women with pre-pregnancy diabetes and 2) women with pre-pregnancy hypertension. We used the odds of breastfeeding for a long duration of time (at least 4 weeks) as the reference group for both models (Table 5). After assessing confounding and interaction, we adjusted the model for maternal age, education, race, marital status, tobacco use, mode of delivery, BMI, birth weight, infant in ICU, state of birth, pre-pregnancy diabetes, pre-pregnancy hypertension and sampling design. Although eliminating smoking or infant being in the intensive care unit from the model did not change the odds of breastfeeding by at least 10%, we left these in the model because other literature has shown a significant relationship between these covariates and breastfeeding duration. The interaction between maternal race and hypertension and between age and pre-pregnancy diabetes were adjusted for in respective models. Our analyses showed that having pre-pregnancy hypertension had no significant correlation with short term breastfeeding duration (least 4 weeks), however, the odds of breastfeeding for more than 4 weeks is reduced by 21% (OR=0.79, 95% CI 0.67-0.94) in women who had pre-pregnancy hypertension. While we initially saw some association between diabetes and breastfeeding for more than 4 weeks, after adjusting for confounders, we saw no significant relationship for any duration.

Barriers to Breastfeeding Initiation

Our previous analyses show that having hypertension and diabetes prior to becoming pregnant is a risk factor for poor breastfeeding practices. Our next objective was to examine the

specific reasons for breastfeeding non-initiation by pre-pregnancy health status (Table 6). Women who stated that they never breastfed their baby were asked to state their reasons for non-initiation and were allowed to choose more than one reason. Pre-defined barriers included not wanting to be tied down or wanting one's body back. Other reasons focused on health issues such as mother or baby being sick. Having other household responsibilities or other children was also included. Fear of breastfeeding either because of past experience or from what one had been told from others was not listed as a pre-defined reason but was a theme that was developed from additional comments participants listed. Reasons that were non-predefined were categorized as other reason. Select reasons included having breast augmentation, wanting to smoke, not wanting to maintain a healthy diet and wanting the father or other family member to help. The dominant reason for non-initiation regardless of health status was due to not liking breastfeeding.

Compared to women who were neither obese, hypertensive nor diabetic prior to pregnancy, mother being sick or on medication was the most prevalent reason for non-initiation among women diagnosed with one of these conditions. Women who were both hypertensive and diabetic stated that the infant being sick or in intensive care was a major barrier to breastfeeding. Interestingly, women who were obese but were neither hypertensive nor diabetic reported the highest prevalence of non-initiation due to having other children or other responsibilities.

Our next objective was to determine if pre-pregnancy health was associated with a specific reason for early breastfeeding cessation. In table 6, we show that the mother being sick or on medication was one of the most predominant reasons for non-initiation among women who had pre-pregnancy diabetes or hypertension. We chose to build a model to determine the relationship between pre-pregnancy diabetes and hypertension diagnoses and not breastfeeding due to maternal illness among women who stated that they did not breastfeed their baby. We

conducted simple logistic regression while adjusting for potential confounders and effect modifiers (Table 7). Based on these results, we decided to include maternal age, race, BMI and state of birth in the model while also adjusting for the complex sampling design for both models for pre-pregnancy health indicators. We found that 25% of women who stated that at least one of their reasons for not breastfeeding was due to illness or taking medication were hypertensive and 8.5% were diabetic prior to pregnancy (Table 7). Of the women who were hypertensive, 21.9% stated that their illness or medication use contributed to their decision not to breastfeed compared with those who were not hypertensive (11.4%). Furthermore, 34.1% of women who were diabetic prior to pregnancy listed this reason as a major factor in their decision not to breastfeed. Our data show that women who have pre-pregnancy hypertension are 2.1 (1.66-2.65) times more likely to fail to initiate breastfeeding because of illness or medication use compared with women who did not have hypertension. We found that women with pre-pregnancy diabetes had 2.6 (1.41-4.60) times' greater odds of failing to initiate breastfeeding because of illness or medication use compared with women who did not have diabetes.

Chapter V: Discussion

Our findings indicate that having hypertension prior to pregnancy is negatively associated with breastfeeding initiation and duration. Compared to women who did not have either of these conditions prior to pregnancy, the estimated risk of not breastfeeding for at least 4 weeks is increased by 21% in women with hypertension. On the contrary, having pre-pregnancy diabetes was not significantly correlated with breastfeeding initiation or duration. However, the association was nearly significant (OR=0.77 95% CI= 0.66-1.07), suggesting that having a larger sample size of women with diabetes may have strengthened the power of this association.

When examining specific explanations for breastfeeding non-initiation, both hypertension and diabetes were significantly associated with specific reasons for not breastfeeding. Among women who did not breastfeed, those who were hypertensive and/or diabetic were more likely to report that their illness or use of medication was a major reason for non-initiation (Range 20.8%-34.3%).

Strengths and Limitations

A major strength of this study is that the PRAMS survey allowed us to examine the relationship between pre-pregnancy morbidities and breastfeeding behavior in an ethnically and economically diverse population of women across the United States which better represents the general population. Because the survey is nationally represented, our sample size was quite high (N=24,892) allowing for greater precision of the estimated risks. This large sample size was due in part to our ability to obtain survey data over several years. Furthermore, a strength of this study was that it had the capability to adjust for many potential confounders including maternal race, age, education and various infant characteristics. Furthermore, we were able to gather information from the PRAMS survey as well as birth and demographic information from state

vital records. Lastly, since the PRAMS survey is conducted by phone and mail, women may have been more likely to report more truthfully with sensitive topics in the self-administered surveys.

One of the major limitations of this study was the inability to examine the relationship between diabetes treatment and breastfeeding behavior. As previously mentioned, other studies have shown that diabetes itself is not an independent risk factor for poor breastfeeding behavior but disease treatment (insulin versus diet) is. Also, we were unable to decipher between women with type I and type II diabetes. We would propose that someone diagnosed with type I diabetes would have a different outlook on breastfeeding than those who were type II especially since type I diabetes management requires medication while type II diabetes management differs depending on severity of the disease. Additionally, we were unable to determine time of diagnosis of diabetes or hypertension so there was no way of knowing if the length of time since diagnosis had an effect on their breastfeeding choices. The degree of either of the conditions would determine the medication regime and may contribute to some women not wanting to breastfeed because of the various medications they were prescribed.

Our biggest concern with the data was in analyzing the barriers women encountered when deciding whether to breastfeed. We were unable to obtain the code definitions for the pre-defined reasons for non-initiation so it is unclear how each code was developed. For instance, "Did not like breastfeeding" is a vague statement and does not tell us the reason for this statement. Did these women not like breastfeeding because it was inconvenient or that they had difficulty with technique? When respondents state that they were embarrassed, were they embarrassed about breastfeeding in public or felt that breastfeeding would be sexually stimulating? These are some of the questions that were left unanswered in this study.

Furthermore, women who submitted a questionnaire by mail were not supplied with a code definition so their interpretation of the codes may differ from that of the telephone interviewer. We also do not know if these code definitions were used exactly the same for each state and therefore may not be representative of the true statements made by each participant.

Our study revealed that one of the leading reasons for non-initiation of breastfeeding among women with hypertension and/or diabetes was due to maternal illness or medication use. Unfortunately, we were unable to examine whether this held true for women with other morbidities prior to pregnancy. Furthermore, we do not know if these illness or medication were associated with their chronic disease or with some other illness. We also don't know why their illness or medication use prevented them from breastfeeding. Were they physically unable to breastfeed or were they afraid that the medication they were taking would be toxic to their baby? One of the open-ended responses implies that some women may have this fear. A participant stated, "I was afraid I would make him sick." These questions can only be addressed with a qualitative analysis through in-depth interviewing of women in this category.

Lastly, many of the responses given for non-initiation implies that participants had in fact began breastfeeding but quit after a short time which may lead to underreporting of initiation. For example, many respondents reported a major barrier to initiation of breastfeeding was their perception of insufficient milk supply. One could only come to this conclusion if they actually tried to breastfeed. This question may need to be explained better in the questionnaire to improve respondents' understanding of what initiation is defined as.

Public Health Implications and Recommendations

While this study was able demonstrate that both pre-pregnancy diabetes and hypertension had some association breastfeeding behavior, we see that the majority of the differences in

breastfeeding rates occur in initiation and breastfeeding beyond 10 weeks. Further studies need to be done to examine pre-pregnancy chronic conditions and its influence on long-term breastfeeding. Furthermore, a qualitative study of women who did not breastfeed to gain insight on women's perceptions concerning breastfeeding is necessary. The PRAMS questionnaire asks respondents to state their reasons for not breastfeeding but we recommend that they add an additional question that requests that the respondents first state their main reason for not breastfeeding then allow them to list additional reasons. This information would allow researchers to determine which barriers are of most concern in the population.

Our study was one of few that aimed to examine the specific barriers women face when deciding whether to breastfeed in a large and diverse population. In the midst of many limitations, these data gives a broad overview of the effect of pre-pregnancy chronic disease status and future breastfeeding practices.

Appendices: Tables

Table 1: Population characteristics of mothers and infants, four PRAMS sites 2004-2008

	Total N=24,892		Illinois N=8,291		Georgia N=6,717		North Carolina N=5,308		South Carolina N=4,576	
Characteristic	%[a]	SE	%[a]	SE	%[a]	SE	%[a]	SE	%[a]	SE
Maternal Age										
Under 18	3.8	0.2	3.8	0.2	4.0	0.4	3.3	0.3	4.5	0.5
18-19	7.4	0.2	6.4	0.3	8.0	0.6	7.8	0.5	9.0	0.7
20-24	24.8	0.4	21.2	0.5	27.4	0.9	25.7	0.7	29.3	1.1
25-29	27.8	0.4	29.2	0.5	26.9	0.9	27.3	0.7	26.5	1.0
30-34	22.8	0.4	24.6	0.5	21.3	0.8	22.9	0.7	20.2	0.9
35-39	11.1	0.3	12.4	0.4	10.5	0.6	10.6	0.5	8.6	0.6
40+	2.3	0.1	2.4	0.2	2.1	0.3	2.4	0.2	2.1	0.3
Race/Ethnicity										
Non-Hispanic White	53.0	0.4	52.7	0.6	46.5	1.1	58.1	0.8	57.1	1.1
Non-Hispanic Black	23.2	0.4	17.5	0.5	32.0	0.9	21.9	0.7	31.1	1.1
Hispanic, any race	18.9	0.3	25.1	0.5	14.1	0.9	15.8	0.6	9.2	0.7
Other	5.0	0.2	4.8	0.2	7.5	0.7	4.2	0.3	2.6	0.4
Education										
Less than 9 years	5.4	0.2	6.5	0.3	4.0	0.4	6.2	0.4	3.7	0.5
9-11 years	15.6	0.3	14.3	0.4	15.9	0.8	16.0	0.6	19.6	1.0
12 years	28.2	0.4	25.3	0.5	32.9	1.0	27.9	0.8	25.5	1.0
13-15 years	22.2	0.4	21.0	0.5	22.3	0.8	21.5	0.7	29.3	1.0
More than 15 years	28.6	0.4	33.0	0.6	24.8	0.8	28.4	0.7	21.9	0.9
Married	60.0	0.4	61.6	0.6	58.3	1.0	60.4	0.8	57.5	1.1
WIC Participation	48.1	0.4	44.4	0.6	52.3	1.0	46.8	0.8	53.4	1.1
BMI										
<19.8	12.5	0.3	12.1	0.4	12.4	0.7	13.3	0.6	12.5	0.8
19.8-26	50.6	0.5	52.3	0.6	49.9	1.0	49.8	0.9	48.4	1.2
>26-29	13.5	0.3	13.4	0.4	13.6	0.7	13.7	0.6	13.0	0.8

30 or above	23.4	0.4	22.3	0.5	24.1	0.9	23.3	0.7	26.1	1.0
Pre-pregnancy Diabetes	2.2	0.1	1.8	0.16	2.5	0.3	2.6	0.3	2.4	0.4
Pre-pregnancy Hypertension	12.6	0.3	11.2	0.4	12.8	0.6	13.1	0.5	16.6	0.8
Smoking	8.1	0.2	7.4	0.3	5.9	0.5	10.9	0.5	12.3	0.8
Vaginal Delivery	69.4	0.4	69.5	0.5	69.5	0.9	69.3	0.8	68.4	1.0
Pre-term	9.3	0.2	8.6	0.3	9.9	0.4	9.4	0.4	10.2	0.5
Birth Weight										
<2500g	7.5	0	6.7	0.1	8.1	0.1	7.6	0.1	8.5	0.1
2500g-4500g	91.2	0.1	92.0	0.2	90.4	0.3	91.0	0.2	90.7	0.2
> 4500g	1.3	0.1	1.2	0.1	1.5	0.3	1.4	0.2	0.81	0.2
Plurality										
Singleton	98.3	0.1	98.3	0.1	98.3	0.2	98.4	0.1	98.4	0.2
Twin	1.7	0.1	1.7	0.1	1.7	0.2	1.6	0.1	1.6	0.2
Parity										
0	40.9	0.4	40.2	0.6	40.1	1.0	43.0	0.8	42.0	1.1
1	32.3	0.4	32.5	0.6	32.2	0.9	31.6	0.8	33.2	1.1
2	17.1	0.3	16.6	0.4	18.3	0.8	16.3	0.6	16.7	0.9
3-5	9.2	0.3	10.1	0.4	8.8	0.6	8.5	0.5	7.8	0.6
6+	0.6	0.1	0.6	0.1	0.6	0.2	0.6	0.1	0.3	0.1

[a] Percentages are weighted

Table 2: Population characteristics of mothers and infants, four PRAMS sites 2004-2008					
	Ever Breastfed N=17,903		Never Breastfed N=6,988		
Characteristic	**% [a]**	**SE**	**% [a]**	**SE**	***P value***
Maternal Age					*<0.0001*
Under 18	2.7	0.2	6.7	0.4	
18-19	6.0	0.3	11.0	0.5	
20-24	22.4	0.4	31.1	0.8	
25-29	28.8	0.5	25.3	0.8	
30-34	25.2	0.4	16.6	0.6	
35-39	12.3	0.3	8.0	0.4	
40+	2.6	0.2	1.3	0.2	
Race/Ethnicity					*<0.0001*
Non-Hispanic White	53.0	0.4	49.1	0.9	
Non-Hispanic Black	23.2	0.4	37.9	0.8	
Hispanic, any race	18.9	0.3	9.9	0.5	
Other	5.0	0.2	3.1	0.4	
Education					*<0.0001*
Less than 9 years	6.0	0.3	3.8	0.3	
9-11 years	12.0	0.4	25.1	0.7	
12 years	24.4	0.5	38.0	0.8	
13-15 years	23.0	0.4	20.2	0.7	
More than 15 years	34.5	0.5	12.9	0.6	
Marital Status					*<0.0001*
Married	67.0	0.5	41.7	0.8	
WIC Participation	42.1	0.5	63.8	0.8	*<0.0001*
BMI					*<0.0001*
<19.8	12.2	0.4	13.1	0.6	
19.8-26	53.1	0.5	44.2	0.9	
>26-29	13.0	0.4	14.8	0.6	
30 or above	21.7	0.4	28.0	0.8	

Pre-pregnancy Diabetes	1.9	0.1	3.2	0.3	*0.0001*
Pre-pregnancy Hypertension	11.7	0.3	14.9	0.6	*<0.0001*
Vaginal Delivery	69.3	0.5	69.4	0.8	*0.9356*
Pre-term	8.8	0.2	10.5	0.4	*<0.0001*
Birth Weight					*<0.0001*
Low	7.0	0.1	8.7	0.2	
Normal	91.5	90.2	90.4	0.3	
High	1.5	0.1	0.9	0.2	
Plurality					*0.3777*
singleton	98.4	0.1	98.2	0.2	
twin	1.6	0.1	1.8	0.2	
Parity					*<0.0001*
0	42.8	0.5	36.0	0.8	
1	32.0	0.5	33.0	0.8	
2	16.3	0.4	19.3	0.7	
3-5	8.5	0.3	10.9	0.5	
6+	0.4	0.1	0.9	0.1	

[a] Percentages are weighted

Table 3: Breastfeeding Prevalence by State, PRAMS 2004-2008				
	Illinois N=8,174	Georgia N=6,624	North Carolina N=5,254	South Carolina N=4,483
Duration	%(SE)	%(SE)	%(SE)	%(SE)
Never Breastfed	24.2 (0.5)	31.2 (0.9)	27.2(0.8)	35.8(1.1)
Less than 1 week	3.7(0.2)	3.9(0.4)	3.4(0.3)	3.1(0.4)
1-4 weeks	14.5(0.4)	13.7(0.7)	13.7(0.6)	15.3(0.8)
5-9 weeks	10.7(0.4)	11.0(0.6)	11.4(0.5)	10.2(0.7)
10 or more weeks	46.9(0.6)	40.2(1.0)	44.4(0.8)	35.6(1.1)

Table 4: Breastfeeding Duration by Pre-Pregnancy Health Status from Four PRAMS Sites, 2004-2008					
	Pre-pregnancy Hypertension no Diabetes [a] N=4,332	Pre-Pregnancy Diabetes no Hypertension [a] N=350	Hypertension and Diabetes [a] N=267	Obese only N=3,596	All Others N=14,298
Duration	%(SE)	%(SE)	%(SE)	%(SE)	%(SE)
Never Breastfed	32.4 (1.1)	38.0 (3.9)	48.0(5.5)	33.1(1.1)	26.0 (0.5)
Less than 1 week	5.9(0.7)	2.3(1.0)	3.9(1.7)	4.5(0.5)	3.2(0.2)
1-4 weeks	16.1(0.9)	15.0(2.9)	16.6(4.5)	15.6(0.8)	13.4(0.4)
5-9 weeks	13.0(1.5)	12.5(0.1)	7.3(2.0)	11.4(0.7)	7.4(0.2)
10 or more weeks	34.0(1.2)	36.9(3.6)	24.3(4.5)	35.5(1.1)	31.5(0.4)

[a] In the presence or absence of obesity

[a] Percentages are weighted

Table 5: Association Between Pre-Pregnancy Health and Breastfeeding Initiation and Duration from Four PRAMS Sites, 2004-2008

	No breastfeeding N=6,893	≤4 Weeks N=4,546	>4 Weeks N=12,785	Breastfeeding ≤4 Weeks	Breastfeeding >4 Weeks
	% (SE)	% (SE)	% (SE)	OR(95% CI)	OR(95% CI)
Pre-pregnancy hypertension					
Yes	33.2(1.1)	22.0(1.0)	44.9(1.2)	1.05[a] (0.86-1.28)	0.79[a] (0.67-0.94)
No	27.3(0.43)	17.2(0.35)	55.6(0.5)		
Pre-pregnancy diabetes					
Yes	40.5(3.1)	18.5(2.5)	41.0(3.0)	1.0[b] (0.64-1.55)	0.77[b] (0.55-1.07)
No	27.7(0.4)	17.8(0.34)	54.5(0.44)		

[a] Adjusting for maternal age, race, smoking, BMI, marital status, state of birth, maternal education, infant in ICU, pre-pregnancy diabetes, and sampling design

[b] Adjusting for maternal age, race, smoking, BMI, marital status, state of birth, maternal education, infant in ICU, pre-pregnancy hypertension and sampling design

[a] Percentages are weighted

Table 6: Reasons for Breastfeeding Non-Initiation from four PRAMS sites, 2004-2008

	Pre-pregnancy Hypertension no Diabetes [ab] N=1,328	Pre-pregnancy Diabetes no Hypertension [ab] N=123	Hypertension and Diabetes [ab] N=127	Obese only N=1,164	All Others N=3,803
Barriers [a]	%(SE)	%(SE)	%(SE)	%(SE)	%(SE)
Baby sick/NICU	3.9(0.6)	3.6(1.9)	11.5(4.9)	1.9(0.4)	2.4(0.3)
Mother sick/medication	20.8(1.6)	34.3(6.6)	33.8(7.2)	13.5(1.4)	10.1(0.7)
Fear/Past Difficulties	2.5(0.6)	1.0(0.9)	0(0)	2.4(0.6)	2.5(0.3)
Difficulties with technique	16.1(3.1)	12.0(7.4)	0(0)	17.2(3.5)	14.8(1.7)
Other children	17.8(1.6)	11.6(3.3)	6.7(3.3)	25.4(1.7)	19.2(0.8)
Other responsibilities	21.5(1.7)	17.0(5.1)	12.4(4.7)	28.4(1.7)	22.7(0.9)
Didn't like breastfeeding	53.4(2.1)	31.6(5.6)	38.5(8.0)	53.3(2.0)	57.1(1.1)
Tied Down	8.5(1.1)	2.4(1.3)	3.9(2.7)	8.8(1.0)	8.9(0.6)
Embarrassed/Uncomfortable	6.1(0.9)	8.5(5.0)	5.0(2.4)	6.7(0.9)	7.3(0.6)
Want body to self	9.6(1.1)	5.5(2.4)	9.4(4.1)	9.7(1.1)	9.2(0.6)
Work/School	22.6(1.8)	6.4(2.2)	6.4(3.5)	21.5(1.5)	21.3(0.9)
Other	3.9(0.7)	5.2(2.3)	3.8(2.3)	5.3(1.0)	4.7(0.5)

[a] Participants were allowed to choose more than one barrier so percentages may not add to 100%.
[b] With or without obesity

Table 7: Breastfeeding Non-Initiation Due to Maternal Illness or Medication Use Among Women who did not Breastfeed by Pre-Pregnancy Health Status, PRAMS 2004-2008 N=1,191

		Distribution	Prevalence	Odds
		% [c] (SE)	%[c] (SE)	OR(95% CI)
Pre-pregnancy hypertension				
	Yes	25.2 (1.8)	21.9(1.58)	2.10[a] (1.66-2.65)
	No	74.9 (1.8)	11.4(0.6)	1.00
Pre-pregnancy diabetes				
	Yes	8.5(1.4)	34.1(5.0)	2.60[b] (1.41-4.60)
	No	91.5(1.4)	12.2(0.5)	1.00

[a] Adjusting for maternal age, race, BMI, state of birth and sampling design
b Adjusting for maternal age, race, BMI, state of birth and sampling design
c Percentages are weighted

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