THE ASSOCIATION BETWEEN PRECONCEPTION CARE RECEIPT AND THE TIMELINESS AND ADEQUACY OF PRENATAL CARE: AN EXAMINATION OF MULTISTATE DATA FROM PREGNANCY RISK ASSESSMENT MONITORING SYSTEM (PRAMS) 2009-2011

by

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ABSTRACT

MEGHAN KUSPER WALLY. The association between preconception care receipt and the timeliness and adequacy of prenatal care: An examination of multistate data from the Pregnancy Risk Assessment Monitoring System (PRAMS) 2009-2011. (Under the direction of DR. LARISSA R. BRUNNER HUBER).

Prenatal care (PNC) is a critical preventive health service for pregnant women and infants. Also, preconception care is recommended for all women of reproductive age. This study aimed to examine preconception care and its association with timeliness and adequacy of PNC. This retrospective cohort study used data from a large sample of U.S. first-time mothers (n=13,509) who participated in the 2009-2011 Pregnancy Risk Assessment Monitoring System in 10 states. Logistic regression was used to calculate odds ratios and 95% confidence intervals to model the association between preconception care receipt and the two PNC outcomes, as well as the association between preconception advice regarding folic acid, weight, smoking, and drinking, and the PNC outcomes. Women who received preconception care had statistically significant increased odds of timely (OR=1.30, 95% CI: 1.08, 1.57) and adequate PNC (OR=1.26, 95% CI: 1.05, 1.52) as compared to women who did not receive preconception care after adjustment for confounders. Preconception advice regarding specific topics was not associated with timely/adequate PNC. Given that untimely and inadequate PNC are associated with adverse birth outcomes, the observed associations provide further justification for implementing preconception care in all women of reproductive age. Future studies should investigate how specific components of preconception care are associated with PNC timeliness/adequacy, health behaviors during pregnancy, and birth outcomes.

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CHAPTER 1: INTRODUCTION

Prenatal care (PNC) is a critical preventive health service for pregnant women and their infants. PNC allows for correct dating of the pregnancy, detecting abnormal lab results, screening for infections, advising on diet and health behaviors, and assessing pregnancy history and risks (Kirkham, Harris, & Grzybowski, 2005). Pregnant women are strongly recommended to begin PNC during the first trimester (i.e., the first 12 weeks of pregnancy) in order to fully receive adequate medical services (Centers for Disease Control and Prevention [CDC], 2000). However, in 2007, only 70.8% of women who delivered a live birth received PNC during the first trimester (U.S. Department of Health and Human Services, 2013). Women who begin PNC after 12 weeks are at increased risk for having undetected pregnancy complications that can result in poor outcomes for the mother and neonate, including maternal and infant mortality (CDC, 2000).

Although PNC, especially during the first trimester, has reduced low birth weight, prematurity, and infant mortality rates, these improvements have slowed since 1996 (Johnson et al., 2006). The slowed reduction in these outcomes seems to be due to inconsistencies in implementing interventions, such as weight management, chronic disease management, smoking cessation, vitamin supplementation, and sexually transmitted disease (STD) screenings prior to pregnancy. Care provided before pregnancy is called preconception care, the goal of which is to "provide health promotion, screening, and interventions for women of reproductive age to reduce risk factors that might affect

future pregnancies" (Johnson et al., 2006). In fact, only 32.4% of women in the United States report receiving preconception care (Williams, Zapata, D'Angelo, Harrison, & Morrow, 2012). Preconception care interventions are effective in preventing adverse pregnancy outcomes because the basis for many of these outcomes occurs 17 to 56 days after conception. Some women remain unaware of their pregnancy during this time; therefore, it is important to address health conditions and behaviors that can affect a pregnancy before a woman even becomes pregnant (Moos, 2003). While both PNC and preconception care can greatly reduce adverse maternal and infant outcomes, some research findings also suggest that receiving preconception care is associated with timely initiation of PNC (Williams, Zapata, D'Angelo, Harrison, & Morrow, 2012). One Healthy People 2020 goal is to have a 10% improvement in the percentage of women receiving timely PNC. Thus, improving preconception care could be a step toward reaching this goal (U.S. Department of Health & Human Services, 2013).

To date, only one study has found an association between preconception care and timely initiation of PNC (Williams, Zapata, D'Angelo, Harrison, & Morrow, 2012). Several studies have found an association between having any source of health care prior to pregnancy (i.e. not necessarily preconception care) and timely PNC initiation (Braveman, Marchi, Egerter, Pearl & Neuhaus, 2000; Liu, Liu, Ye, & Li, 2006; and Beeckman, Louckx, & Putnam, 2011). Specifically, one study suggests that having a regular obstetrician prior to pregnancy is a factor related to earlier onset of PNC since it removes barriers to care, such as difficulty scheduling an appointment (Beeckman, Louckx, & Putman, 2011).

Additionally, some factors associated with untimely PNC could be addressed in preconception care. For example, having an unwanted/unplanned pregnancy is associated with untimely PNC, yet effective family planning during the preconception period could reduce the number of unwanted/unplanned pregnancies, leading to increased timely PNC in the general population (Braveman, Marchi, Egerter, Pearl, & Neuhaus, 2000). Women who do not know that PNC should begin in the first trimester are also at risk for untimely care, but preconception education could improve knowledge about timing of PNC (Braveman, Marchi, Egerter, Pearl, & Neuhaus, 2000). Overall, preconception counseling can improve women's knowledge regarding pregnancy risk factors, as well as their health behaviors prior to pregnancy (Williams, Zapata, D'Angelo, Harrison, & Morrow, 2012).

Preconception care is recommended for all women of reproductive age, regardless of pregnancy intention, since about half of pregnancies are unintended (Johnson et al., 2006). However, very few women actually receive preconception care. Receipt of preconception care is especially low among women in poverty, women with cardiovascular risk, women with unhealthy behaviors, and women with unplanned pregnancies who may be at increased risk for adverse pregnancy outcomes (Curtis, Abelman, Schulkin, Williams, & Fassett, 2006; Hillemeier, Weisman, Chase, Dyer, & Shaffer, 2008). If an association exists between preconception care and timely PNC, it is only benefitting a small proportion of women. Clearly the expansion of preconception care to all women of childbearing age, regardless of pregnancy intention, is of great public health importance.

This study examined whether an association exists between receipt of preconception care and timeliness and/or adequacy of prenatal care among a large,

population-based sample of women who have recently delivered a liveborn infant. Additionally, the study explored whether specific components of preconception care are associated with timeliness and/or adequacy of prenatal care. Finding an association between receipt of preconception care and timeliness and/or adequacy of prenatal care would provide further support to improve implementation of preconception care to all women in order to further reduce maternal and child morbidity and infant mortality rates.

CHAPTER 2: LITERATURE REVIEW

PNC is associated with healthy maternal and infant outcomes, and it is recommended that it begin in the first trimester of pregnancy. Preconception care also is essential to prevent negative outcomes that occur before a woman is aware she is pregnant. Furthermore, preconception care is associated with timely PNC initiation. However, it is unknown which aspects of preconception care are involved in this association. This literature examines the association between preconception care and timely PNC, the implementation of preconception care in the United States, and the effectiveness of preconception care on effecting maternal behavior change.

2.1 Prenatal Care

Prenatal care ideally should begin during the first trimester (i.e., the first 12 weeks of pregnancy). This first visit is important to determine the estimated date of delivery. In addition, since organogenesis is taking place during this early stage in pregnancy leaving the fetus vulnerable to teratogens, the first visit is also when counseling about behaviors that can affect the pregnancy, including air travel, diet/weight status, folic acid and/or iron supplementation, exercise, hair treatments, hot tubs, medications (both prescription and over-the-counter), sex, substance use (including alcohol, tobacco, and illicit drugs), domestic violence, and working conditions, should be addressed. Women, especially first-time mothers, also are taught about the changes that will occur during pregnancy and how to prepare for delivery. During the first visit blood is typed and the pregnant woman

is offered screenings for genetic conditions according to risk. Usually, an ultrasound will be performed as well (Kirkham, Harris, & Grzybowski, 2005).

In addition to beginning PNC during the first trimester, women also should continue to have subsequent, regularly scheduled PNC visits. Typically, women have visits once each month during weeks 4 through 28, twice each month during weeks 28 through 36, and weekly for weeks 36 until birth (U.S. Department of Health and Human Services, 2010). High-risk pregnancies, including pregnancies to women with chronic diseases, multiple births, very young maternal age, maternal age greater than 35, or previous adverse pregnancy outcomes may require more frequent visits (U.S. Department of Health and Human Services, 2010). These subsequent PNC visits for all women may involve tests for various conditions, including: anemia, infections (STIs, HIV, toxoplasmosis, streptococcus), gestational diabetes, and rubella and chicken pox immunity (U.S. Department of Health and Human Services, 2010).

2.2 Preconception Care

The goal of preconception care is to optimize the health of women before conception of a first or subsequent pregnancy. All women of childbearing age (i.e., 15-44 years) are recommended to receive preconception care, defined as being more than a single visit to a healthcare provider, but less than well-woman care, which encompasses all primary and preventive visits a woman receives during the periods of time she is not pregnant (Johnson et al., 2006). Preconception care should be integrated with primary care by including counseling on appropriate medical care and behavior to optimize pregnancy outcomes at each health encounter with a woman of reproductive age (Johnson et al., 2006). Preconception care involves health promotion, screening, and interventions

to reduce risk factors that might affect a pregnancy in the future. These risk factors include: isotretinoin use (medication commonly known as Accutane, used primarily to treat acne), alcohol misuse, anti-epileptic drug use, diabetes, folic acid deficiency, hepatitis B vaccination, HIV/AIDS, hypothyroidism, maternal phenylketonuria, rubella vaccination, obesity, oral anticoagulant use, STDs, smoking, and others (Johnson et al., 2006). While the Centers for Disease Control and Prevention provide an evidence-based list of preconception clinical content that should be addressed, categorized by heath promotion, personal history, nutrition, immunizations, infectious diseases, and medical conditions (CDC, 2014), a method for implementing preconception care clinically has not been defined. However, preconception care should be part of routine health care, tailored to meet the needs of the individual woman, and provided across the lifespan (Johnson et al., 2006). While the preconception care topics are very similar to the topics addressed during prenatal care, the basis for many adverse pregnancy outcomes is established 17 to 56 days after conception. Since some women remain unaware of their pregnancy during this time, addressing issues that can affect a pregnancy before a woman even becomes pregnant is important (Moos, 2003).

2.3 Implementation of Preconception Care

While an association exists between preconception care and timely PNC initiation, preconception care should be implemented universally to achieve a greater percentage of women with timely PNC. Hillemeier et al. (2008) conducted a cross-sectional survey of 1,335 women in Pennsylvania to assess how the health status of women is associated with health services use. They found that women with cardiovascular risk factors had reduced odds of seeing an obstetrician/gynecologist

(OR=0.91, 95% CI: 0.84, 0.99). Women in poverty (income below federal poverty level) also had reduced the odds of receiving pregnancy planning counseling, including discussion of birth control methods (OR=0.64, 95% CI: 0.36, 0.70). Particularly relevant to this study is that only 50% of women reported receiving pregnancy planning counseling, and receipt of medical advice was not associated with some important health needs, such as tobacco, alcohol, and drug use. Therefore, women at higher risk for adverse pregnancy outcomes (due to poverty, cardiovascular risk, or unhealthy behaviors) were not more likely to receive pregnancy planning counseling. Limitations of this study included the lack of temporal sequence due to the cross-sectional study design, as well as limited generalizability since the sample only included women from rural regions of Central Pennsylvania.

A recent study in the United States using 2004-2008 Pregnancy Risk Assessment Monitoring System data from four states (Maine, New Jersey, Utah, and Vermont) found that only 32.4% of the 30,481 women in the Pregnancy Risk Assessment Monitoring System had preconceptional counseling, and very few women with unintended pregnancies or without health insurance prior to pregnancy reported preconception counseling receipt (13.5% and 13.7%, respectively) (Williams, Zapata, D'Angelo, Harrison, & Morrow, 2012).

2.4 Association between Preconception Care and Timely PNC Initiation

The literature suggests an association between preconception care and timely PNC, however, the study populations, measures of preconception care receipt, and study designs are varied. Beekman, Louckx, and Putnam (2011) conducted a prospective cohort study of Belgian women (n = 333) recruited through clinical centers to study factors

influencing PNC initiation. This study did not measure preconception care receipt directly, but the authors found that not having a regular obstetrician was associated with an increased odds of late initiation of PNC (OR=1.79, 95% CI: 1.15, 2.79). However, the association might be due to preconception counseling or simply the utilization of health services, since the content of the health care visit was not analyzed. Additionally, the study excluded women who received preconception care from a source other than an obstetrician. Since this study was conducted in Belgium, rather than the United States, results may not be generalizable to United States women or the health care system in the United States. Finally, the sample size was small, and did not include women who did not receive any PNC, which may limit generalizability to all pregnant women (Beekman, Louckx, & Putnam, 2011).

A prospective cohort study in China found similar results to the study conducted in Belgium (Liu, Liu, Ye, & Li, 2006). The study included 195,796 women included in China's population-based Perinatal Health Care Surveillance System database, which includes data on gestational age at first PNC visit, as well as whether or not the woman had a physical exam or counseling by health care professionals prior to pregnancy. After controlling for maternal residence, age, educational attainment, occupation, parity, preconception medical disorders, and high-risk medical experiences during the first trimester, women with preconception health care utilization were 2.7 (95% CI: 2.6, 2.8) times more likely to have timely PNC than were women with no preconception care. Again, this measure of preconception care may not be accurate since it was defined as the woman having a physical exam or counseling by health professionals prior to pregnancy. The woman may have received a physical or counseling, but topics may not have been

discussed in the context of protecting a future pregnancy, or the visit may not have included important preconception care topics. Therefore, this study was unable to identify which preconception services are associated with timely PNC. Another limitation is the exclusion of women who were under the age of 20 or unmarried, meaning that the results may not be generalizable to the entire population. The authors also considered timely PNC initiation as prior to 15 weeks, rather than 12 weeks; so, it is difficult to compare this study to those conducted according to United States recommendations of beginning PNC during the first 12 weeks of pregnancy. However, their definition of timely PNC would provide a conservative estimate of the association, since the 15-week timeline is more lenient. Finally, results may not be generalizable to United States women since the Chinese healthcare system may differ from that of the United States (Liu, Liu, Ye, & Li, 2006).

Studies in the United States have found similar results. Braveman, Marchi, Egerter, Pearl, and Neuhaus (2000) studied noninsurance barriers to timely PNC using a cross-sectional survey of post-partum, low-income women from California (n = 3,071) with insurance coverage prior to and during pregnancy. Women were identified from a statewide, representative survey conducted from 1994-1995. Among women who were aware of their pregnancy during the first trimester, risk of untimely PNC was increased for grand multiparous women (5 or more births), women who did not know care should begin during the first trimester, and women with unplanned or unwanted pregnancies. Additionally, women who lacked regular prepregnancy care were at increased odds of untimely PNC (OR=1.37, 95% CI: 1.04, 1.80). These data demonstrated that prepregnancy care is associated with timely PNC. Similarly to the aforementioned studies

(Liu, Liu, Ye, & Li, 2006; Beekman, Louckx, & Putnam, 2011), the association between prepregnancy care and timely PNC might be due to preconception care or exposure to the health care system, which could reduce the time needed to identify and access a provider, since the content of the health care visits was not analyzed. Generalizability could be limited, as this study included low-income California residents (Braveman, Marchi, Egerter, Pearl, and Neuhaus, 2000). Additionally, this study was conducted prior to the 2006 CDC recommendations for preconception care (Johnson et al., 2006); so, the inclusion of preconception care in routine medical care may not have been as prevalent as it is now.

A recent study in the United States analyzed the association between preconceptional care and PNC using 2004-2008 Pregnancy Risk Assessment Monitoring Survey data from four states (Maine, New Jersey, Utah, and Vermont; n = 30,481) that included a question regarding preconceptional counseling receipt (Williams, Zapata, D'Angelo, Harrison, & Morrow, 2012). Preconception counseling receipt was measured with the question, "Before you got pregnant with your new baby, did you talk with a doctor, nurse, or other health care worker to prepare for a healthy pregnancy and baby?" Among women with intended pregnancies, preconception care was statistically significantly associated with timely PNC (OR=2.05, 95% CI: 1.77, 2.38). However, this association was not significant for women with unintended pregnancies (OR=1.17, 95% CI: 0.96, 1.43). This study improved upon previous studies by including a direct measure of preconception care receipt, rather than a proxy measure such as having a regular obstetrician, having had a physical, or having regular prepregnancy care. However, the question used in this study provides no data on the content, depth, or timing of

counseling. The question also may be biased toward only women with intended pregnancies answering affirmatively since it discusses preparing for pregnancy. Finally, the analysis lacked information on use of general health care prior to pregnancy, meaning the association could be due to health care utilization rather than preconception care (Williams, Zapata, D'Angelo, Harrison, & Morrow, 2012).

Overall, these studies have found an association between receiving care before pregnancy and starting PNC during the first trimester. However, two studies were conducted in other countries and may not be generalizable to the United States. A common limitation to these studies is the measure of preconception care being very broad and typically measuring only the use of medical care in general prior to pregnancy. One study did use a more direct measure of preconception care receipt by asking if the woman talked to a health care worker about preparing for pregnancy. However, this study only found an association with timely PNC for women with intended pregnancies.

2.5 Effectiveness of Preconception Care on Effecting Behavior Change

An association exists between preconception care and timely PNC initiation; however, preconception care is not offered to the majority of women (Hillemeier, Weisman, Chase, Dyer, & Shaffer, 2008; Williams, Zapata, D'Angelo, Harrison, & Morrow, 2012). To support expanding preconception care, it is critical that it changes maternal behaviors. Elsinga et al. (2008) completed a randomized controlled trial assessing the impact of a preconception care program called "Parents to Be" on knowledge of pregnancy risk factors and preventive measures and maternal behaviors. Women were recruited through general practitioners, and the study only included women contemplating pregnancy within one year (n = 211 intervention, n = 422 control).

Knowledge about timing of conception, infectious diseases, folic acid need, and exposure to harmful substances was assessed through a test and women who received preconception care scored 4.6% higher on the test than women who did not receive preconception care (95% CI: 2.6%, 6.6%). A statistically significant association was found between preconception care and using folic acid before pregnancy (OR=4.93, 95% CI: 2.81, 8.66) and abstaining from alcohol in the first trimester (OR=1.79, 95% CI: 1.08, 2.97) as compared to women receiving standard care. These data demonstrated that preconception care increased knowledge about healthy pregnancies and increased healthy behaviors before and during pregnancy. Therefore, it is possible that preconception care could lead to timely PNC due to increased knowledge. However, this study had low participation and was conducted in the Netherlands, rather than the United States. The aforementioned study by Williams, Zapata, D'Angelo, Harrison, and Morrow (2012) that used PRAMS data from 4 states also found that receipt of preconception care was significantly associated with daily consumption of multivitamins (OR=4.35, 95% CI: 4.00, 4.73) as well as cessation of drinking during prior to pregnancy (OR=1.34, 95% CI: 1.16, 1.54).

Since preconception care increases awareness of behaviors that can affect a pregnancy, women who receive preconception care might be more knowledgeable about recommendations for prenatal care or more likely to recognize the importance of prenatal care. Therefore, the link between receipt of preconception care and timely initiation/adequacy of prenatal care is plausible.

2.6 Conceptual Model

The Behavioral Model of Health Services Use was developed to explain patterns of utilization of health services. The model categorizes factors that contribute to using or seeking health services into three groups: predisposing factors, enabling factors, and need (Andersen, 1995). This model was used to create a conceptual model of prenatal care utilization (Figure 1). The model also shows the relationship among variables related to PNC utilization. While this study specifically assessed the relationship between receipt of preconception care and timeliness and adequacy of PNC, it is possible that preconception care could also be related to other variables in the model, such as beliefs about PNC, knowledge about PNC and healthy pregnancies, and formation of a preexisting relationship with a healthcare provider. . Lifestyle advice given by a health professional is a significant contributor to subsequent behavior change (Brobeck, Bergh, Odencrants, & Hildingh, 2015); therefore, advice regarding the specific topics of folic acid, weight, smoking, and drinking, could lead to behavior change.

2.7 Concluding Remarks

The literature suggests an association between preconception care and timely PNC. However, in most studies, the measure of preconception care receipt was very broad (Braveman, Marchi, Egerter, Pearl, & Neuhaus, 2000; Liu, Liu, Ye, & Li, 2006; Beekman, Louckx, & Putnam, 2011). The most specific measure was the PRAMS question “Before you got pregnant with your new baby, did you talk with a doctor, nurse, or other health care worker to prepare for a healthy pregnancy and baby?” (Williams, Zapata, D’Angelo, Harrison, & Morrow, 2012). The generalizability of prior studies has also been limited since some studies were conducted internationally (Liu, Liu, Ye, & Li,

2006; Beekman, Louckx, & Putnam, 2011), and the healthcare systems may vary across countries. Those studies done in the United States were limited to certain states (Braveman, Marchi, Egerter, Pearl, & Neuhaus, 2000; Williams, Zapata, D'Angelo, Harrison, & Morrow, 2012). The current study used a large, population-based sample of women to examine the preconception care and PNC initiation association in greater detail. Also, this study used more recent data (i.e., 2009-2011) that allows for the analysis of preconception care since the 2006 CDC preconception care recommendations were released. The current study also considered specific topics that were discussed in preconception care and their association with prenatal care outcomes. Specifically, preconception care discussion about folic acid, weight, smoking, and drinking were included in the analysis, since these are preconception health objectives included in Healthy People 2020 (United States Department of Health and Human Services (2013). The receipt of preconception advice on these four specific topics was included to assess preconception care in a more precise manner. This detailed question also assists in determining which topics are most important to address during preconception care.

In addition, the association between preconception care and adequacy of prenatal care was considered, and this potential association has not yet been researched. A positive association between receipt of preconception care and timeliness and/or adequacy of prenatal care would support initiatives to improve implementation of preconception care to all women in order to further reduce maternal and child morbidity and mortality rates.

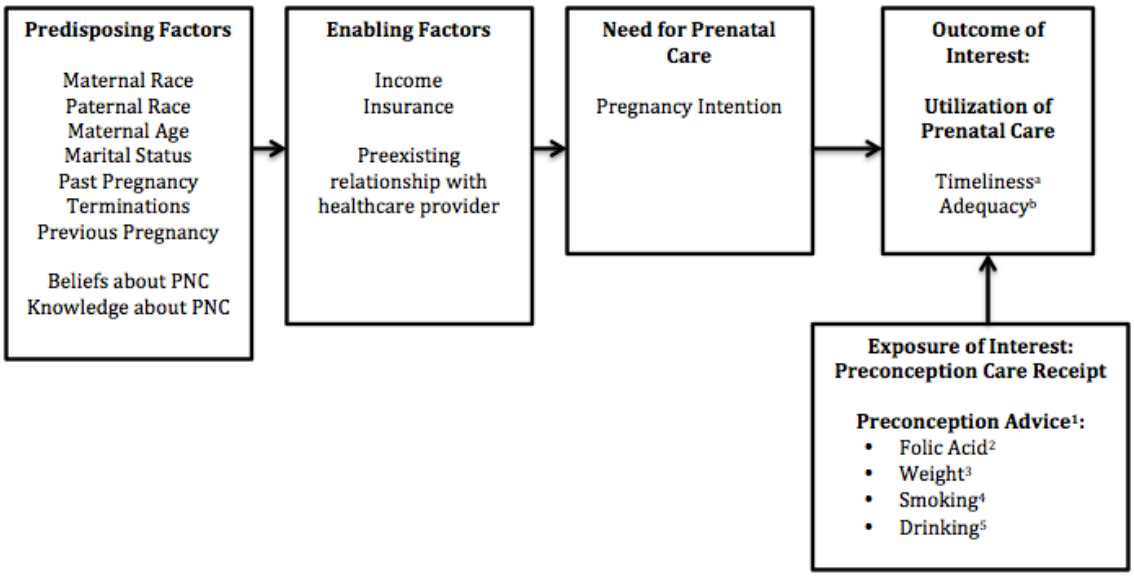

Figure 1: Conceptual model of the association between preconception care and PNC timeliness and adequacy, based on the Behavioral Model of Health Services Use. Superscripts refer to the exposures (1-5) and outcomes (a-b) as indicated in the following hypotheses.

CHAPTER 3: HYPOTHESES

This study examined the association between receipt of preconception care and initiation of prenatal care during the first trimester of pregnancy, as well as the adequacy of prenatal care, using data from the 2009-2011 Pregnancy Risk Assessment Monitoring System (PRAMS). In addition, this study also examined whether specific components of preconception care are associated with timely initiation of prenatal care and/or adequacy of prenatal care.

The specific hypotheses were:

1a. Women who receive preconception care have increased odds of starting prenatal care during the first trimester of pregnancy as compared to women who do not receive preconception care.

1b. Women who receive preconception care have increased odds of receiving adequate prenatal care as compared to women who do not receive preconception care.

2a. Women who receive preconception advice about taking vitamins with folic acid have increased odds of receiving timely prenatal care as compared to women who do not receive preconception advice about taking vitamins with folic acid before pregnancy.

2b. Women who receive preconception advice about taking vitamins with folic acid have increased odds of receiving adequate prenatal care as compared to women who do not receive preconception advice about taking vitamins with folic acid before pregnancy.

3a. Women who receive preconception advice regarding having a healthy weight have increased odds of receiving timely prenatal care as compared to women who do not receive preconception advice about having a healthy weight before pregnancy.

3b. Women who receive preconception advice regarding having a healthy weight have increased odds of receiving adequate prenatal care as compared to women who do not receive preconception advice about having a healthy weight before pregnancy.

4a. Women who receive preconception advice regarding not smoking have increased odds of receiving timely prenatal care as compared to women who do not receive preconception advice about not smoking before pregnancy.

4b. Women who receive preconception advice regarding not smoking have increased odds of receiving adequate prenatal care as compared to women who do not receive preconception advice about not smoking before pregnancy.

5a. Women who receive preconception advice regarding not drinking alcohol have increased odds of receiving timely prenatal care as compared to women who do not receive preconception advice about not drinking alcohol before pregnancy.

5b. Women who receive preconception advice regarding not drinking alcohol have increased odds of receiving adequate prenatal care as compared to women who do not receive preconception advice about not drinking alcohol before pregnancy.

CHAPTER 4: METHODS

4.1 Study Design and Population

This retrospective cohort study used data from the 2009-2011 Pregnancy Risk Assessment Monitoring System (PRAMS). PRAMS is an ongoing, annual, state specific, population-based surveillance system conducted by the Centers for Disease Control and Prevention (CDC) and state health departments. PRAMS is designed to monitor and collect data on maternal behaviors, attitudes, and experiences that occur before, during, and shortly after pregnancy (CDC, 2014b).

PRAMS uses a multi-stage, complex sampling strategy. Each month, the state draws a stratified systematic sample of 100 to 250 new mothers from a sampling frame of eligible, live-born birth certificates from the past 2-4 months (CDC, 2014). Women from certain groups are sampled at a higher rate to ensure sufficient data are available in small but high-risk groups. The selected women first receive an introductory letter. After 3 to 7 days, the initial self-administered mail questionnaire is sent. After 7 to 10 days, a "tickler" is sent as a thank you and reminder. The women who have not responded between 7 to 14 days after the "tickler" receive a second questionnaire packet. A third packet is sent to all nonrespondents 7 to 14 days after the second packet. Finally, a telephone follow-up is initiated for all mail nonrespondents 7 to 14 days after the third questionnaire. A total of 1,300 to 3,400 women are sampled from each state annually. In

addition to the questionnaire data, the birth certificate records are also available for analysis (CDC, 2014).

This study used data from the 2009-2011 PRAMS cycle for ten states: Maryland, Michigan, New Jersey, Hawaii, Maine, Minnesota, Utah, Ohio, Tennessee, and West Virginia. While a set of core PRAMS questions is asked nationwide, states can ask state-specific questions on the self-administered questionnaire in addition to these core questions. As the hypotheses of this study sought to examine the association between preconception care receipt and prenatal care initiation and adequacy, having data on the receipt of preconception care was imperative. These ten states were the only states that asked about preconception care and had data available for analysis. Only primiparous women, ages 18-39 years old who answered the specific preconception care question on the PRAMS questionnaire and had complete information on preconception care, PNC initiation, and PNC adequacy were included in this study. Additionally, this age group was chosen to reflect most women of reproductive age who would be the intended recipients of preconception care. This analysis was restricted to primiparous women since women who have previously had a live birth would likely be aware of appropriate behaviors to have a healthy pregnancy, including PNC guidelines. However, multiparous women are more likely to underutilize PNC than primiparous women (St. Clair, Smeriglio, Alexander, Connell, & Niebyl, 1990). Women who had a previous healthy pregnancy and infant may be less likely to seek timely and adequate PNC, regardless of preconception care receipt before their current pregnancy.

A total of 38,468 women participated in the 2009-2011 PRAMS for selected states. Sample sizes from each state ranged from 266 in Tennessee to 1,863 in West

Virginia. Women were excluded from this study for the following reasons: not between the ages of 18 to 39 (n=2,392), not a first-time mother (n=21,542), did not answer the preconception care question (n=148), had missing adequacy of PNC data (n=492), or had missing timeliness of PNC data (n=190). In addition, women missing information on the following covariates were excluded: race/ethnicity (n=84), maternal education (n=94), marital status (n=6), or past pregnancy termination (n=12). Thus, 13,509 women were available for analysis.

4.2 Exposure Assessment

The main exposure in this study was preconception care receipt. In the PRAMS questionnaire, preconception care receipt was measured by the following question: "Before you got pregnant with your new baby, did a doctor, nurse, or other health care worker talk to you about how to prepare for a healthy pregnancy and baby?". Participants who answered "Yes" to this question were considered to be exposed as it pertains to Hypotheses 1a and 1b..

Women who answered "Yes" to the first question were asked the follow-up question: "*Before* you got pregnant with your new baby, did a doctor, nurse, or other health care worker talk with you about any of the things listed below? Please count only discussions, not reading materials or videos.

a. Taking vitamins with folic acid before pregnancy
b. Being a healthy weight before pregnancy
c. Getting my vaccines updated before pregnancy
d. Visiting a dentist or dental hygienist before pregnancy
e. Getting counseling for any genetic diseases that run in my family

f. Controlling any medical conditions such as diabetes and high blood pressure
g. Getting counseling or treatment for depression or anxiety
h. The safety of using prescription or over-the-counter medicines during pregnancy
i. How smoking during pregnancy can affect a baby
j. How drinking alcohol during pregnancy can affect a baby
k. How using illegal drugs during pregnancy can affect a baby

Participants were able to answer "Yes" or "No" to each item.

Women who answered yes to the question about folic acid (a), were considered exposed for Hypotheses 2a and 2b. Women who answered yes to the question about weight status (b), were considered exposed for Hypotheses 3a and 3b. Women who answered yes to the question about smoking (i), were considered exposed for Hypotheses 4a and 4b. Women who answered yes to the question about drinking (j) were considered exposed for Hypotheses 5a and 5b.

4.3 Outcome Assessment

The main outcomes of interest were initiation and adequacy of prenatal care. Information on PNC initiation was collected in the birth certificate records. It was labeled as "Start PNC 1st Trimester?". Women who started PNC during the first trimester were considered to have the outcome. Information on adequacy of PNC was also collected in the birth certificate records. Specifically, adequacy of PNC was classified by the Adequacy of Prenatal Care Utilization (Kotelchuck) index as being adequate plus, adequate, intermediate, or inadequate. The Adequacy of Prenatal Care Utilization index measures adequacy of PNC based on adequacy of initiation of PNC and adequacy of

received services once PNC begins. The expected number of visits is based on American Congress of Obstetricians and Gynecologists (ACOG) PNC standards for uncomplicated pregnancy, adjusted for gestational age at initiation of PNC and gestational age at delivery (Kotelchuck, 1994). Those women classified as having adequate or adequate plus PNC were considered to have adequate PNC (Krueger & Scholl, 2000; Bryson, Iannou, Rulyak, & Critchlow 2003).

4.4 Covariate Assessment

Information on demographic, lifestyle, and pregnancy characteristics collected through PRAMS were considered as potential confounding factors. Based upon the literature, the confounders considered included: pregnancy intention, maternal education, maternal race/ethnicity, maternal age, marital status, paternal education, paternal race/ethnicity, method of payment, income, and past pregnancy terminations (Braveman, Marchi, Egerter, Pearl, & Neuhaus, 2000; Hulsey, 2001; Chandler, 2002; Kupek, Petrou, Vause, & Maresh, 2003; Potter, Pereyra, Lampe, Rivero, Danner, Cohen, et al., 2009; Bengiamin, Capitman, & Ruwe, 2010; Beeckman, Louckx, & Putman, 2011). All of these covariates were included in birth certificate data, with the exception of method of payment, pregnancy intention, and income, which were self-reported by women on the PRAMS questionnaire.

4.5 Data Analysis

Univariate Analysis

The frequencies and percentages for all demographic, lifestyle, and pregnancy characteristics were calculated for the participants in the study.

Bivariate Analysis

Logistic regression was used to calculate odds ratios and 95% confidence intervals to provide a crude association between preconception care receipt (and specific components of care) and timely prenatal care as well as preconception care receipt (and specific components of care) and adequacy of prenatal care. In addition, other factors associated with the two outcomes (i.e., timely prenatal care and adequate prenatal care) were identified.

Multivariate Analysis

Multivariate logistic regression was used to calculate adjusted odds ratios and 95% confidence intervals to model the association between preconception care (and specific components of care) and timely prenatal care as well as preconception care (and specific components of care) and adequacy of prenatal care while controlling for confounders. The adjusted model included variables that changed the magnitude of the exposure-outcome relationship by at least 10% (Maldonado & Greenland, 1993). Since PRAMS uses a complex sampling design, SAS-callable SUDAAN was used in all analyses.

4.6 Power and Sample Size

A total of 13,509 women were available for analysis. The ratio of unexposed (women who do not receive preconception care) to exposed (women who receive preconception care) was 1.80:1. The frequency of timely prenatal care in the unexposed was 82.44%. Thus, setting alpha at 0.05 and power at 80%, the smallest detectable OR for the preconception care-timely PNC association was approximately 1.15. The frequency of adequate PNC among the unexposed was 77.93%. Thus, the smallest

detectable OR for the preconception care-adequate PNC association was approximately 1.14.

4.7 Human Subject Protection

Since this study was a secondary data analysis, no contact was made with the participants of this study. PRAMS participants gave informed consent to participate in the study before filling out the survey. The information in the dataset did not include any identifying information and was kept confidential.

4.8 Permission to Access Data

The multistate PRAMS dataset was obtained through a data sharing agreement with the Centers for Disease Control and Prevention. UNC Charlotte's College of Health and Human Services IT Data Security Office, along with the researchers, established a data security plan. The de-identified data were placed on a private shared drive accessible only to student investigator Meghan Kusper Wally and Dr. Larissa Huber. This drive was protected by username and password. Data were stored on the network server only, and not transferred to portable devices. When the researchers were not physically on campus, the dataset was securely accessed remotely.

CHAPTER 5: RESULTS

5.1 Univariate Results

The majority of women were between the ages of 25-34 (51.28%), non-Hispanic white (68.0%), and had more than a high school education (66.03%) (Table 1). Most women were married (57.99%), had intended the pregnancy (59.53%), and had no previous pregnancy terminations (79.18%). Income was fairly equally distributed: 38.03% earned more than $50,000, 23.90% earned between $20,000 and $49,999, and 32.34% earned less than $20,000. Data regarding method of payment were missing for a large percentage of the sample (64.32%); however, the most common method reported was employer-provided insurance (20.79%).

About one-third of the women reported receiving preconception care (35.4%). The most reported preconception topics discussed were vitamins (n=1,681), drinking (n=1,266), weight (n=1,251), and smoking (n=1,238). The least reported preconception topics discussed were mental health (n=443), genetic counseling (n=647), medical conditions (n=664), and dentist (n=764). The majority of women had PNC that began during the first trimester (85.37%) and adequate PNC (77.58%).

5.2 Bivariate Results

Timeliness of PNC Outcome

Women who were between the ages of 18-24 years had 0.25 times the odds of having timely PNC as compared to women between the ages of 35-39 (95% CI: 0.17,

0.38). There was no strong association between women in the 25-34 age group and timely PNC (OR=0.84, 95% CI: 0.55, 1.27) (Table 2). Women who were non-Hispanic black, Hispanic, or "other" race/ethnicity had statistically significant decreased odds of having timely PNC as compared to non-Hispanic white women (OR=0.32, 95% CI: 0.27, 0.39; OR=0.30, 95% CI: 0.24, 0.38; and OR=0.62, 95% CI: 0.50, 0.78, respectively). Minority paternal races also had statistically significant decreased odds of timely PNC as compared to non-Hispanic white paternal race (non-Hispanic black: OR=0.49, 95% CI: 0.31, 0.79; Hispanic: OR=0.29, 95% CI: 0.18, 0.48; and Other: OR=0.31, 95% CI: 0.19, 0.51).

Women without a high school degree had 82% decreased odds of timely PNC (95% CI: 0.14, 0.22) and women with only a high school degree had 68% decreased odds of having timely PNC (95% CI: 0.27, 0.38) as compared to mothers with more than a high school education. Fathers without a high school degree and fathers with only a high school degree also had decreased odds of having timely PNC as compared to fathers with more than a high school education (OR=0.22, 95% CI: 0.17, 0.28; OR=0.45, 95% CI: 0.37, 0.54, respectively).

As income decreased, odds of timely PNC also decreased (less than $20,000 vs. $\geq$$50,000: OR=0.10, 95% CI: 0.08, 0.13; $20,000-$49,999 vs. $\geq$$50,000: OR=0.27, 95% CI: 0.21, 0.34). Unmarried women had decreased odds of having timely PNC as compared to married women (OR=0.24, 95% CI: 0.21, 0.28). Women with pregnancies that were mistimed or unintended had also decreased odds of timely PNC as compared to women with intended pregnancies (OR=0.34, 95% CI: 0.29, 0.40 and OR=0.20, 95% CI: 0.15, 0.26, respectively). Women with Medicaid had 78% decreased odds of timely PNC

(95% CI: 0.16, 0.30), and women with other insurance had 68% decreased odds of timely PNC (95% CI: 0.19, 0.52) as compared to women with employer-provided insurance.

Women who received preconception care had 2.22 times the odds of having timely PNC as compared to women who did not receive preconception care; this result was statistically significant (95% CI: 1.87, 2.63). With respect to the specific preconception care topics, the associations varied. Women who received preconception advice about folic acid had statistically significant increased odds of timely PNC (OR=5.36, 95% CI: 3.50, 8.22), while women who received preconception advice about smoking or drinking had statistically significant decreased odds of timely PNC (OR=0.25, 95% CI: 0.15, 0.41; OR=0.28, 95% CI: 0.17, 0.46, respectively). Receiving preconception advice about weight was not associated with timeliness of PNC (OR=0.79, 95% CI: 0.52, 1.21).

Adequacy of PNC Outcome

Women who were between the ages of 18-24 years had 0.63 times the odds of having adequate PNC as compared to women between the ages of 35-39 years (95% CI: 0.49, 0.81) while maternal age between the 25-34 years was not associated with adequate PNC (OR=0.99, 95% CI: 0.77, 1.27) (Table 3). Women of minority races had statistically significant decreased odds of having adequate PNC as compared to non-Hispanic white women (non-Hispanic black: OR=0.46, 95% CI: 0.40, 0.54; Hispanic: OR=0.61, 95% CI: 0.50, 0.74; and Other: OR=0.75, 95% CI: 0.63, 0.89). Non-Hispanic black fathers had statistically significant decreased odds of adequate PNC as compared to non-Hispanic white fathers (OR=0.66, 95% CI: 0.45, 0.96), yet paternal race of Hispanic or other race

was not associated with adequate PNC (OR=0.88, 95% CI: 0.55, 1.42; OR=0.85, 95% CI: 0.52, 1.40, respectively).

Women without a high school degree had 49% decreased odds of adequate PNC (95% CI: 0.41, 0.96), and women with only a high school degree had 27% decreased odds of having adequate PNC as compared to mothers with more than a high school education (95% CI: 0.64, 0.84). Paternal education had similar associations with adequate PNC (no high school degree: OR=0.62, 95% CI: 0.49, 0.78 and only high school degree: OR=0.76, 95% CI: 0.65, 0.88, respectively). Women earning less than $20,000 had statistically significant decreased odds of adequate PNC as compared to women earning $50,000 or more (OR=0.54, 95% CI:0.47, 0.63). However, income of $20,000-49,999 was not statistically associated with adequate PNC (OR=0.85, 95% CI: 0.71, 1.01).

Unmarried women had statistically significant decreased odds of having adequate PNC as compared to married women (OR=0.57, 95% CI: 0.51, 0.65). Women with pregnancies that were mistimed or unintended had statistically significant decreased odds of adequate PNC as compared to women with intended pregnancies (OR=0.66, 95% CI: 0.58, 0.75 and OR=0.50, 95% CI: 0.39, 0.64, respectively). Women with Medicaid or other insurance had statistically significant decreased odds of adequate PNC as compared to women with employer-provided insurance (OR=0.56; 95% CI: 0.43, 0.73; OR=0.56, 95% CI: 0.38, 0.84; OR=0.78, 95% CI: 0.65, 0.93, respectively).

Women who received preconception care had 1.32 times the odds of having adequate PNC as compared to women who did not receive preconception care (95% CI: 1.15, 1.50). Regarding the specific preconception care components, only preconception care advice about folic acid had a statistically significant association with adequate PNC.

Specifically, women who received preconception advice about folic acid had statistically significant increased odds of adequate PNC (OR=1.60, 95% CI: 1.12, 2.29). Receiving preconception advice about weight, smoking, or drinking was not statistically associated with adequacy of PNC (OR=1.00, 95% CI: 0.76, 1.33; OR=0.80, 95% CI: 0.60, 1.07; and OR=0.83, 95% CI: 0.62, 1.10, respectively).

5.3 Multivariate Results

Timeliness of PNC as Outcome

After adjusting for maternal age, paternal education, maternal education, income, marital status, and pregnancy intention, the association between preconception care and timely PNC was attenuated, but remained statistically significant. Specifically, women who received preconception care had 30% increased odds of having timely PNC (95% CI: 1.08, 1.57) (Table 4). After adjusting for confounders, the association between preconception advice on folic acid and timeliness of PNC was attenuated and no longer statistically significant (OR=1.49, 95% CI: 0.87, 2.54). After adjustment, the associations between preconception advice on weight, smoking and drinking remained largely unchanged and statistically insignificant (OR=1.17, 95% CI: 0.72, 1.89; OR=0.68, 95% CI: 0.39, 1.18; and OR=0.80, 95% CI: 0.46, 1.39, respectively).

Adequacy of PNC as Outcome

After adjusting for maternal age, paternal education, marital status, income, and pregnancy intention, the association between preconception care and adequate PNC remained largely unchanged. Specifically, women who received preconception care had 26% increased odds of having adequate PNC as compared to women who did not receive preconception care (95% CI: 1.05, 1.52) (Table 5). The unadjusted model was retained

for the preconception advice regarding weight-adequacy of PNC association since no variables met the definition of confounding for this association. After adjustment for confounders, there continued to be no strong associations between preconception advice regarding smoking and drinking (OR=1.11, 95% CI: 0.82, 1.51 and OR=1.13, 95% CI: 0.83, 1.54, respectively). However, after adjustment, the preconception advice on folic acid-adequacy of PNC association reversed direction and was no longer statistically significant (OR=0.87, 95% CI: 0.58, 1.32).

CHAPTER 6: DISCUSSION

6.1 Summary of Main Findings

In the unadjusted models, preconception care was statistically significantly associated with increased odds of both timeliness and adequacy of PNC (OR=2.22, 95% CI: 1.87, 2.63 and OR=1.32, 95% CI: 1.15, 1.50, respectively). After adjustment for maternal age, paternal education, maternal education, income, marital status, and pregnancy intention, the association between preconception care and timeliness of PNC was attenuated but remained statistically significant (OR=1.30, 95% CI: 1.08, 1.57). Similarly, after adjustment for maternal age, paternal education, marital status, income, and pregnancy intention the association between preconception care and adequate PNC was attenuated but remained statistically significant (OR=1.26, 95% CI: 1.05, 1.52). After adjustment, preconception care advice regarding specific topics such as folic acid, weight, smoking, or drinking was not statistically associated with either PNC outcome.

6.2 Consistency of Findings with Literature

This study's findings on the association between preconception care and both timeliness of PNC is consistent with prior literature.(Braveman, Marchi, Egerter, Pearl, & Neuhaus, 2000; Liu, Liu, Ye, & Li, 2006; Beekman, Louckx, & Putnam, 2011). Beekman, Louckx, and Putnam (2011) conducted a prospective cohort study of Belgian women and found that not having a regular obstetrician was associated with increased odds of late PNC (OR=1.79, 95% CI: 1.15, 2.79). Braveman, Marchi, Egerter, Pearl, and

Neuhaus (2000) conducted a cross-sectional survey of low-income California women and found that women who lacked regular prepregnancy care were at increased odds of untimely PNC (OR=1.37, 95% CI: 1.04, 1.80). Both of these studies suggest an association between prepregnancy health care and timely PNC, which is consistent with the findings of the present study.

Two past studies have investigated the association between preconception care specifically and timeliness of PNC and found similar associations as this study. Liu, Liu, Ye, & Li (2006) conducted a prospective cohort study in China and found that women with preconception health care, defined as a physical exam or counseling prior to pregnancy, had increased odds of timely PNC (OR=2.7, 95% CI: 2.6, 2.8). A retrospective study that also used PRAMS multistate data from 2004-2008 and the same measure of preconception care receipt as the present study found an association between preconception care and timely PNC only among women with intended pregnancies (OR=2.05, 95% CI: 1.77, 2.38) (Williams, Zapata, D'Angelo, Harrison, & Morrow, 2012). However, the present study found an association among all first-time mothers, indicating either that preconception care is particularly relevant for primiparous women, or that preconception care is being more effectively delivered since the CDC preconception care recommendations were released in 2006. The unadjusted odds ratio was more similar to that found by Williams, Zapata, D'Angelo, Harrison, & Morrow.

This study's findings on the association between preconception care and adequate PNC are important since this association had not previously been studied. Additionally, the findings on the insignificant associations between preconception care advice on folic acid, weight, smoking, or drinking and PNC timeliness and adequacy are important as

these specific topics have not yet been evaluated. The lack of a statistically significant association between these specific preconception care topics and the PNC outcomes could be due to the relatively small sample sizes within those subanalyses since most women did not answer the question about specific preconception care topics. Alternatively, it could be that comprehensive preconception care, or simply having care prior to pregnancy, is the important part of preconception care as it relates to PNC timeliness and adequacy, rather than the specific individual topics.

The conceptual model used in the present study illustrates the relationships between factors involved in the association between preconception care receipt and timeliness/adequacy of PNC (Figure 1). Preconception care may alter a woman's beliefs or knowledge about PNC, leading her to utilize PNC as recommended. Additionally, preconception care may play a role in developing a relationship with a healthcare provider, making it easier or more enjoyable for the woman to seek and continue PNC. This model is supported by this study, studies that have found an association between having healthcare prior to pregnancy and timely PNC (Braveman, Marchi, Egerter, Pearl, & Neuhaus, 2000; Liu, Liu, Ye, & Li, 2006; Beekman, Louckx, & Putnam, 2011), and a study that found preconception care increases knowledge about pregnancy topics (Elsinga et al., 2008).

6.3 Strengths and Limitations

Nondifferential Misclassification

The outcome variables, timely initiation of PNC and adequacy of PNC, were obtained from birth certificate records, thus reducing the possibility for nondifferential misclassification of the outcome. Additionally, the use of the Kotelchuck index to

measure adequacy of PNC was preferable, since it has been demonstrated to be more accurate and meaningful than the Kessner index (Kotelchuck, 1994).

Nondifferential misclassification of the exposure variable, receipt of preconception care (and specific components) was possible. The exposure variable was self-reported and was not confirmed by medical records. For example, women may have confused preconception care with PNC, or women may have recalled discussing reaching a healthy weight, but it was not discussed in the context of a future pregnancy. If nondifferential misclassification of the exposure or outcome occurred, it would have biased results toward the null.

Selection Bias/Representativeness

Selection bias was unlikely due to the high response rate of PRAMS. Response rates must be at least 65% for data to be released for analysis (CDC, 2014). However, it is possible that non-participants could have been different from participants. PRAMS response rates are typically higher for women who are older, white, married, more educated, first-time mothers, received early PNC, and had a normal birthweight infant (Shulman, Gilbert, & Lansky, 2006). If participation were related both to preconception care receipt and PNC initiation/adequacy, the results would be biased away from the null.

Information Bias

The fact that information on the timing and adequacy of PNC came from birth certificates reduced information bias. Recall bias could have occurred if women who had early and adequate PNC confused the timing of their medical advice on health behaviors related to pregnancy, since they had many visits. These women may have recalled advice being given prior to pregnancy (preconception care), when in fact, the advice was given

during their first PNC visit very early in pregnancy. If this type of bias occurred, it most likely would have biased the results away from the null.

Confounding

Potential confounders known to be related to both the exposure and outcome were considered including: pregnancy intention, method of payment, maternal education, maternal race/ethnicity, maternal age, marital status, paternal education, paternal race/ethnicity, method of payment, income, and past pregnancy terminations (Braveman, Marchi, Egerter, Pearl, & Neuhaus, 2000; Hulsey, 2001; Chandler, 2002; Kupek, Petrou, Vause, & Maresh, 2003; Potter, Pereyra, Lampe, Rivero, Danner, Cohen, et al., 2009; Bengiamin, Capitman, & Ruwe, 2010; Beeckman, Louckx, & Putman, 2011). However, confounders were limited by what was included in the PRAMS dataset. It is possible that another variable was related to both the exposure and disease and not on the causal pathway. Not controlling for an unknown confounder could have resulted in an inaccurate estimate of the association between preconception care receipt (and specific components) and PNC initiation/adequacy. For example, it is possible that lack of transportation or childcare was a confounder in these relationships (Kalmuss, 1990), but data on these variables are not in the dataset. Additionally, healthier women are more likely to seek preventive care (Hofer & Katz, 1996); therefore, health prior to pregnancy could be associated with both preconception care and PNC.

Generalizability

The complex sampling design of PRAMS ensures that results from each state are generalizable to that state. State-specific analyses found that results were of similar magnitude and had overlapping confidence intervals; thus, while it is possible that the

states that asked the preconception care question differ from other states, state-specific analyses found the results likely can be generalized to other women in the United States.

Strengths

The current study has a number of strengths. Compared to some other studies, this study had a large sample size and controlled for a number of confounders. This study also analyzed the relationship between preconception care and timeliness and adequacy of PNC among first-time mothers, which has not previously been assessed. This study also was the first to evaluate individual components of preconception care. Due to the complex sampling strategy and multistate nature of PRAMS, the sample was also generalizable to U.S. women.

6.4 Significance

This study examined the association between preconception care receipt and timeliness and adequacy of PNC among first-time mothers. Previous studies of preconception care receipt as a predictor of timely PNC initiation were limited and inconclusive, and there were no studies on adequacy of PNC. Additionally, no evidence regarding specific components of preconception care or how preconception care (and specific topics) is associated with adequacy of PNC was available. This study further investigated whether an association exists between preconception care (and specific components) and PNC initiation/adequacy. Studies suggest an association between late initiation/inadequate PNC and adverse birth outcomes (CDC, 2000), and recently the prevalence of adverse birth outcomes has remained stagnant in the United States (Johnson et al., 2006). Therefore, it was important to further investigate possible

predictors of timely PNC initiation and adequacy of PNC, including preconception care (and specific components).

The association between preconception care and PNC timeliness and adequacy found in this study justifies more universal implementation of preconception care recommendations. An effort to increase implementation of preconception care recommendations is critical, since only about one-third of women in this sample reported receiving preconception care, even after the CDC recommendations. For example, healthcare providers could discuss the implications of current behaviors or medical conditions on a future pregnancy with women, regardless of current pregnancy intention. These discussions could be incorporated relatively easily into discussions about birth control methods with general practitioners. Alternatively, public health programs could incorporate preconception care topics into other interventions. For example, anti-smoking campaigns can highlight what smoking can do to a fetus; weight management programs can incorporate messages about how being at an unhealthy weight would affect a pregnancy. Incorporating preconception messages into other programs in this way has the potential to reach more women, as well as men who may become fathers. Implementation of this type of care and advice may lead to less adverse birth outcomes due to timely/adequate PNC and women becoming healthier prior to pregnancy.

While this study found no significant associations between preconception advice regarding folic acid, weight, smoking, or drinking, and timeliness or adequacy of PNC, future studies should assess the role of these specific topics further, as they relate to PNC outcomes, as well as other pregnancy outcomes. This study had a relatively small sample size for these subanalyses, due to nonresponse. These associations also should be

analyzed with maternal behavior as an effect modifier. For example, if maternal smoking status was examined as an effect modifier between preconception care advice on smoking and PNC, it could be that women who smoke feel more susceptible to problems after hearing this advice, and therefore start PNC early once they become pregnant, while similar advice would not have as strong of an effect on a nonsmoker. Future studies also should continue investigating the association between preconception care and other pregnancy outcomes, including maternal behaviors during pregnancy and health outcomes of both the mother and the infant.

REFERENCES

Andersen, R. M. (1995). Revisiting the behavioral model and access to medical care: Does it matter? *Journal of Health and Social Behavior, 36*(1), 1-10.

Beeckman, K., Louckx, F., & Putman, K. (2011). Predisposing, enabling and pregnancy-related determinants of late initiation of prenatal care. *Maternal and Child Health Journal, 15,* 1067-1075.

Bengiamin, M. I., Capitman, J. A., & Ruwe, M. B. (2010). Disparities in initiation and adherence to prenatal care: Impact of insurance, race-ethnicity and nativity. *Maternal and Child Health Journal, 14*(4), 618-624.

Braveman, P., Marchi, K., Egerter, S., Pearl, M., & Neuhaus, J. (2000). Barriers to timely prenatal care among women with insurance: The importance of prepregnancy factors. *Obstetrics & Gynecology, 95*(6), 874-880.

Brobeck, E., Bergh, H., Odencrants, S., & Hildingh, C. (2015). Lifestyle advice and lifestyle change: To what degree does lifestyle advice of healthcare professionals reach the population, focusing on gender, age, and education? *Scandinavian Journal of Caring Sciences, 29*(1), 118-125.

Bryson, C. L., Ioannou, G. N., Rulyak, S. J., & Critchlow, C. (2003). Association between gestational diabetes and pregnancy-induced hypertension. *American Journal of Epidemiology, 158,* 1148-1153.

Centers for Disease Control and Prevention [CDC]. 2000. Entry into prenatal care—United States, 1989-1997. *Morbidity and Mortality Weekly Report*, *49*(18): 393-398.

Centers for Disease Control and Prevention [CDC]. 2014. *Preconception health and health care: Content of care for women.* Retrieved from: http://www.cdc.gov/preconception/careforwomen/index.html

Centers for Disease Control and Prevention [CDC]. 2014b. *Pregnancy Risk Assessment Monitoring System*. Retrieved from http://www.cdc.gov/prams/

Chandler, D. (2002). Late entry into prenatal care in a rural setting. *The Journal of Midwifery & Women's Health, 47*(1), 28-34.

Curtis, M., Abelman, S., Schulkin, J., Williams, J. L., & Fassett, E. M. (2006). Do we practice what we preach? A review of actual clinical practice with regards to preconception care guidelines. *Maternal and Child Health Journal, 10,* S53-S58.

Elsinga, J., de Jong-Potjer, L. C., van der Pal-de Bruin, K. M., le Cessie, S., Assendelft, W. J. J., & Buitendijk, S. E. (2008). The effect of preconception counseling on lifestyle and other behaviour before and during pregnancy. *Women's Health Issues, 18*, S117-125.

Hillemeier, M. M., Weisman, C. S., Chase, G. A., Dyer, A., & Shaffer, M. L. (2008). Women's preconceptional health and use of health services: Implications for preconception care. *HSR: Heatlh Services Research, 43*(1), 54-75.

Hulsey, T. M. (2001). Association between early prenatal care and mother's intention of and desire for the pregnancy. *Journal of Obstetric, Gynecologic, and Neonatal Nursing, 30*(3), 275-282.

Hofer, T. P. & Katz, S. J. (1996). Healthy behaviors among women in the United States and Ontario: The effect on use of preventive care. *American Journal of Public Health, 86*(12), 1755-1759.

Johnson, K., Posner, S., Biermann, J., Cordero, J., Atrash, H., Parker, C., Boulet, S., & Curtis, M. G. (2006). Recommendations to improve preconception health and health care—United States. *Morbidity and Mortality Weekly Report, 55*(RR-6), 1-23.

Kalmuss, D. (1990). Barriers to prenatal care among low-income women in New York City. *Family Planning Perspectives, 22*(5), 215-218.

Kirkham, C., Harris, S., & Grzybowski, S. (2005). Evidence-based prenatal care: Part I. General prenatal care and counseling issues. *American Family Physician, 71*, 1307-1316.

Kotelchuck, M. (1994). An evaluation of the Kessner adequacy of prenatal care index and a proposed adequacy of prenatal care utilization index. *American Journal of Public Health, 84*(9), 1414-1420.

Krueger, P. M. & Sholl, T. O. (2000). Adequacy of prenatal care and pregnancy outcome. *The Journal of American Osteopathic Association, 100*(8), 485-92.

Kupek, E., Petrou, S., Vause, S., & Maresh, M. (2003). Clinical, provider, and sociodemographic predictors of late initiation of antenatal care in England and Wales. *An International Journal of Obstetrics & Gynaecology, 109*(3), 265-273.

Liu, Y., Liu, J., Ye, R., & Li, Z. (2006). Association of preconceptional health care utilization and early initiation of prenatal care. *Journal of Perinatology, 26,* 409-413.

Maldonado, G. & Greenland, S. (1993). Simulation study of confounder-selection strategies. *American Journal of Epidemiology, 138*(11), 923-36.

Moos, M. K. (2004). Preconceptional health promotion: Progress in changing a prevention paradigm. *Journal of Perinatal and Neonatal Nursing, 18,* 2-13.

Potter, J. E., Pereyra, M. L., Rivero, Y., Danner, S. P., Cohen, M. H., Bradley-Byers, A., Webber, M. P., Nesheim, S. R., O'Sullivan, M. J., & Jamieson, D. J. (2009). Factors associated with prenatal care use among peripartum women in the Mother-Infant rapid intervention at delivery study. *Journal of Obstetric, Gynecologic, & Neonatal Nursing, 38*(5), 534-543.

Shulman, H. B., Gilbert, B. C., & Lansky, A. (2006). The pregnancy risk assessment monitoring system (PRAMS): Current methods and evaluation of 2001 response rates. *Public Health Reports, 121*(1), 74-83.

St. Clair, P. A., Smerigio, V. L., Alexander, C. S., Connell, F. A., & Niebyl, J. R. (1990). Situational and financial barriers to prenatal care in a sample of low-income, inner-city women. *Public Health Reports, 105*(3), 264-267.

U.S. Department of Health and Human Services. Office of Disease Prevention and Health Promotion. Healthy People 2020. Washington, DC. Available at http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=26#376462. Accessed November 17, 2013.

U.S. Department of Health and Human Services. Office on Women's Health. (2010). *Pregnancy: Prenatal care and tests.* Retrieved from http://womenshealth.gov/pregnancy/you-are-pregnant/prenatal-care-tests.html#babyActivity

Williams, L., Zapata, L. B., D'Angelo, D. V., Harrison, L., & Morrow, B. (2012). Associations between preconception counseling and maternal behaviors before and during pregnancy. *Maternal and Child Health Journal, 16,* 1854-1861.

Table 1: Characteristics of analytic sample from multistate 2009-2011 PRAMS

	Number	Weighted Percent
Variables	**N**	**(%)**
Preconception Care General		
Yes	4,832	35.4
No	8,677	64.6
Prenatal Care 1st Trimester		
Yes	11,541	85.37
No/No PNC	1,968	14.63
Adequacy of PNC		
Adequate/Adequate Plus	10,718	77.58
Inadequate/Intermediate	2,791	22.42
Maternal Age		
18-24	5,928	42.04
25-34	6,388	51.28
35-39	1,193	6.68
Maternal Race/ethnicity		
Non-Hispanic White	8,572	68.0
Non-Hispanic Black	1,871	13.22
Hispanic	1,080	9.51
Other Race	1,986	9.27
Paternal Race/ethnicity		
Non-Hispanic White	2,230	25.17
Non-Hispanic Black	395	3.32
Hispanic	279	2.15
Other Race	211	1.79
Missing	10,394	67.57
Maternal Education		
Less than HS graduate	1,194	9.21
HS graduate	3,863	24.76
More than HS	8,452	66.03
Paternal Education		
Less than HS graduate	1,149	8.36
HS graduate	3,816	25.16
More than HS	6,693	53.48
Missing	1,851	13.01
Marital Status		
Married	7,530	57.99
Other	5,979	42.01
Income		
<$20,000	4,697	32.34
$20,000-$49,999	3,236	23.90
≥$50,000	4,770	38.03
Missing	806	5.73

Table 1: Characteristics of analytic sample from multistate 2009-2011 PRAMS (continued)

	Number	Weighted Percent
Variables	**N**	**(%)**
Pregnancy Intention		
Intended	8,080	59.53
Mistimed	4,516	33.92
Unintended	773	5.54
Method of Payment		
Employer-provided	2,088	20.79
Medicaid	1,064	11.56
Other	309	3.34
Missing	10,048	64.32
Past pregnancy terminations		
No	10,590	79.18
Yes	2,919	20.82

Table 2: Unadjusted odds ratios and 95% confidence intervals for the association between demographic and medical characteristics and timeliness of PNC, 2009-2011 PRAMS

	OR	**95% CI**
Variables		
Preconception Care General		
Yes	2.22	1.87, 2.63
No	**1.00**	**Referent**
Preconception Care Specific-Folic Acid		
Yes	5.36	3.50, 8.22
No	**1.00**	**Referent**
Preconception Care Specific-Weight		
Yes	0.79	0.52, 1.21
No	**1.00**	**Referent**
Preconception Care Specific-Smoking		
Yes	0.25	0.15, 0.41
No	**1.00**	**Referent**
Preconception Care Specific-Drinking		
Yes	0.28	0.17, 0.46
No	**1.00**	**Referent**
Maternal Age		
18-24	0.25	0.17, 0.38
25-34	0.84	0.55, 1.27
35-39	**1.00**	**Referent**
Maternal Race/ethnicity		
Non-Hispanic White	**1.00**	**Referent**
Non-Hispanic Black	0.32	0.27, 0.39
Hispanic	0.30	0.24, 0.38
Other Race	0.62	0.50, 0.78
Paternal Race/ethnicity		
Non-Hispanic White	**1.00**	**Referent**
Non-Hispanic Black	0.49	0.31, 0.79
Hispanic	0.29	0.18, 0.48
Other Race	0.31	0.19, 0.51
Missing	0.56	0.44, 0.70
Maternal Education		
Less than HS graduate	0.18	0.14, 0.22
HS graduate	0.32	0.27, 0.38
More than HS	**1.00**	**Referent**

Table 2: Unadjusted odds ratios and 95% confidence intervals for the association between demographic and medical characteristics and timeliness of PNC, 2009-2011 PRAMS (continued)

	OR	95% CI
Variables		
Paternal Education		
Less than HS graduate	0.22	0.17, 0.28
HS graduate	0.45	0.37, 0.54
More than HS	**1.00**	**Referent**
Marital Status		
Married	**1.00**	**Referent**
Other	0.24	0.21, 0.28
Income		
<$20,000	0.10	0.08, 0.13
$20,000-$49,999	0.27	0.21, 0.34
≥$50,000	**1.00**	**Referent**
Missing	0.11	0.08, 0.13
Pregnancy Intention		
Intended	**1.00**	**Referent**
Mistimed	0.34	0.29, 0.40
Unintended	0.20	0.15, 0.26
Method of Payment		
Employer-provided	**1.00**	**Referent**
Medicaid	0.22	0.16, 0.30
Other	0.32	0.19, 0.52
Missing	0.43	0.34, 0.55
Past pregnancy terminations		
No	**1.00**	**Referent**
Yes	1.09	0.91, 1.31

Table 3: Unadjusted odds ratios and 95% confidence intervals for the association between demographic and medical characteristics and adequacy of PNC, 2009-2011 PRAMS

	OR	**95% CI**
Variables		
Preconception Care General		
Yes	1.32	1.15, 1.50
No	**1.00**	**Referent**
Preconception Care Specific-Folic Acid		
Yes	1.60	1.12, 2.29
No	**1.00**	**Referent**
Preconception Care Specific-Weight		
Yes	1.00	0.76, 1.33
No	**1.00**	**Referent**
Preconception Care Specific-Smoking		
Yes	0.80	0.60, 1.07
No	**1.00**	**Referent**
Preconception Care Specific-Drinking		
Yes	0.83	0.62, 1.10
No	**1.00**	**Referent**
Maternal Age		
18-24	0.63	0.49, 0.81
25-34	0.99	0.77, 1.27
35-39	**1.00**	**Referent**
Maternal Race/ethnicity		
Non-Hispanic White	**1.00**	**Referent**
Non-Hispanic Black	0.46	0.40, 0.54
Hispanic	0.61	0.50, 0.74
Other Race	0.75	0.63, 0.89
Paternal Race/ethnicity		
Non-Hispanic White	**1.00**	**Referent**
Non-Hispanic Black	0.66	0.45, 0.96
Hispanic	0.88	0.55, 1.42
Other Race	0.85	0.52, 1.40
Missing	0.83	0.70, 0.98

Table 3: Unadjusted odds ratios and 95% confidence intervals for the association between demographic and medical characteristics and adequacy of PNC, 2009-2011 PRAMS (continued)

	OR	**95% CI**
Maternal Education		
Less than HS graduate	0.51	0.41, 0.96
HS graduate	0.73	0.64, 0.84
More than HS	**1.00**	**Referent**
Paternal Education		
Less than HS graduate	0.62	0.49, 0.78
HS graduate	0.76	0.65, 0.88
More than HS	**1.00**	**Referent**
Marital Status		
Married	**1.00**	**Referent**
Other	0.57	0.51, 0.65
Income		
<$20,000	0.54	0.47, 0.63
$20,000-$49,999	0.85	0.71, 1.01
≥$50,000	**1.00**	**Referent**
Missing	0.43	0.34, 0.56
Pregnancy Intention		
Intended	**1.00**	**Referent**
Mistimed	0.66	0.58, 0.75
Unintended	0.50	0.39, 0.64
Method of Payment		
Employer-provided	**1.00**	**Referent**
Medicaid	0.56	0.43, 0.73
Other	0.56	0.38, 0.84
Missing	0.78	0.65, 0.93
Past pregnancy terminations		
No	**1.00**	**Referent**
Yes	0.89	0.77, 1.03

Table 4: Adjusted odds ratios and 95% confidence intervals for the association between preconception care and timeliness of PNC, 2009-2011 PRAMS

	OR	**95% CI**
Variables		
Preconception Care General[a]		
Yes	1.30	1.08, 1.57
No	**1.00**	**Referent**
Preconception Care Specific-Folic Acid[b]		
Yes	1.49	0.87, 2.54
No	**1.00**	**Referent**
Preconception Care Specific-Weight Status[c]		
Yes	1.17	0.72, 1.89
No	**1.00**	**Referent**
Preconception Care Specific - Smoking[d]		
Yes	0.68	0.39, 1.18
No	**1.00**	**Referent**
Preconception Care Specific-Drinking[e]		
Yes	0.80	0.46, 1.39
No	**1.00**	**Referent**

[a] Preconception Care General model adjusted for maternal age, maternal education, paternal education, income, marital status, and pregnancy intention.
[b] Folic acid model adjusted for maternal age, maternal race, maternal education, paternal race, paternal education, marital status, income, pregnancy intention, and method of payment.
[c] Weight status model adjusted for maternal age, maternal race, income, and pregnancy intention.
[d] Smoking model adjusted for maternal age, maternal race, maternal education, paternal education, marital status, income, and pregnancy intention.
[e] Drinking model adjusted for maternal age, maternal race, maternal education, paternal education, marital status, income, pregnancy intention, and method of payment.

Table 5: Adjusted odds ratios and 95% confidence intervals for the association between preconception care and adequacy of PNC, 2009-2011 PRAMS

	OR	**95% CI**
Variables		
Preconception Care General[a]		
Yes	1.26	1.05, 1.52
No	**1.00**	**Referent**
Preconception Care Specific-Folic Acid[b]		
Yes	0.87	0.58, 1.32
No	**1.00**	**Referent**
Preconception Care Specific-Weight Status[c]		
Yes	1.00	0.76, 1.33
No	**1.00**	**Referent**
Preconception Care Specific –Smoking[d]		
Yes	1.11	0.82, 1.51
No	**1.00**	**Referent**
Preconception Care Specific-Drinking[e]		
Yes	1.13	0.83, 1.54
No	**1.00**	**Referent**

[a] Preconception Care General model adjusted for maternal age, paternal education, marital status, income, and pregnancy intention

[b] Folic acid model adjusted for maternal age, maternal race, maternal education, paternal education, marital status, income, pregnancy intention, and method of payment.

[c] Unadjusted model retained.

[d] Smoking model adjusted for maternal age, maternal race, maternal education, paternal education, marital status, income, and pregnancy intention.

[e] Drinking model adjusted for maternal age, maternal race, maternal education, paternal education, marital status, income, and pregnancy intention.