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The Effect of Preconception Counseling on Health Behaviors in the Preconception and Pregnancy Period

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Abstract

The Effect of Preconception Counseling on Health Behaviors in the Preconception and Pregnancy Period

By
Gabriel Blake Rodriguez

BACKGROUND: The mechanisms for how preconception care can be influence the risk of preterm births is relatively poorly understood. One of the potential pathways for preconception counseling to affect preterm births is through the modifying of health behaviors before and during pregnancy. This study investigates the relationship between preconception counseling health behaviors in the preconception and pregnancy period.

METHODS: Using PRAMS data from 2012 and 2013, women from 31 states and NYC were included in the study. To account for selection bias between women who did and did not receive preconception counseling, propensity score matching using 1:1 matching was used. Preconception behaviors analyzed were diabetes screening, high blood pressure screening, and depression screening, having a healthy BMI, and multivitamin/folic acid intake. Pregnancy behaviors investigated were starting prenatal care in the first trimester, experiencing appropriate gestational weight gain, and smoking cessation.

RESULTS: Reception of preconception counseling was positively associated with screening for diabetes, high blood pressure, and depression, as well as taking multi-vitamin/folic acid supplements every day compared to none. Reception was negatively associated with having a healthy BMI before pregnancy. The only pregnancy period behavior that had a statistically significant result was starting prenatal care in the first trimester.

CONCLUSIONS: Preconception counseling potentially has a large influence on the health behaviors of women before and during pregnancy. To maximize the reach and impact of preconception counseling, more health care workers should be trained to give preconception counseling at all levels of the health care system to increase the likelihood of reception. Medicaid insurance should be expanded to include women who would be eligible for coverage if they were pregnant to improve access and affordability of preconception counseling. Ultimately, this study shows the potential of preconception counseling's influence on health behaviors and provides a foundation for future research.

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Introduction

Preterm births, infants born before completion of the 37th week of the pregnancy, are the leading cause of infant mortality and major contributor of pediatric morbidity and disability in the United States of America (Callaghan, MacDorman, Rasmussen, Qin, & Lackritz, 2006; Loggins & Andrade, 2014; Russell et al., 2007). Approximately 1 in 10 infants in the United States are born preterm, but they make up nearly half of the total cost of hospitalization after birth (Russell et al., 2007). Preterm births carry a higher cost of care not only in the period immediately after birth but also into adulthood, as they have a higher risk of developing asthma and other chronic conditions (Callaghan et al., 2006; Dean et al., 2013). With the large cost of preterm birth, the Center for Disease Control (CDC), and clinicians across the US have worked to reduce the risk of preterm births occurring (Dean et al., 2013; Denney, Culhane, & Goldenberg, 2008; Johnson, Posner, Biermann, & Cordero, 2006; Russell et al., 2007).

The first strategy to reduce the risk of preterm birth that was pursued on a large scale was prenatal care, which is preventative healthcare during pregnancy (Kotelchuck, 1994). The goal of prenatal care is to screen for and prevent health complications during a women's pregnancy through checkups and promotion of healthy behaviors (Bloch, Dawley, & Suplee, 2009; Loggins & Andrade, 2014). The hope was that with these interventions during pregnancy, the rate of preterm births would fall. However, the preterm birth rate in the US remained stable during the last decade and there was little supporting evidence for prenatal care's effectiveness on lowering preterm birth rates (Dean et al., 2013; Loggins & Andrade, 2014). With the reality of the limitations of prenatal care becoming more evident to clinicians and policy makers a new effort has taken place to address this issue. The focus for interventions has moved from the time of

pregnancy to the period before pregnancy occurs (Beckmann, Widmer, & Bolton, 2014; Johnson et al., 2006).

Preconception care is defined as, a set of interventions with the purpose of identifying biomedical, behavioral, and medical risk factors to a women's health before pregnancy and modifying them (Batra, Higgins, & Chao, 2015; Johnson et al., 2006). Women who are of reproductive age, whether they are or not intending to become pregnant, are considered to be in the preconception period (Committee on Obstetric Practice, 2002). The period before pregnancy, for the purposes of this study, is the year before a pregnancy. Preconception care is seen as being potentially effective due to its ability address issues that can have significant impacts on the health of the infant (Fuehrer, Buckler, Bowman, & Gregory, 2015). Studies have shown that preconception care does have a positive impact on maternal health behaviors in certain instances, such folic acid intake, weight change, BMI change, influenza vaccination, and reception of specialist preconception counseling (Beckmann et al., 2014; Johnson, Atrash, & Johnson, 2008). While many studies have looked at the individual factors that affect the risk of preterm birth, our understanding of the magnitude of the impact it has on maternal health behaviors remains limited.

The current literature on the subject of preconception care's impact on maternal behaviors is limited by the scope of what is covered. The common behaviors that are analyzed are smoking and alcohol use, diet and exercise, and multi-vitamin use. While these are important, there are other behaviors, such as chronic conditions and mental health, which preconception care seeks to alter that have not been researched. By looking at these areas, we can expand upon our understanding of the scope of preconception care's impact on maternal health behaviors which have an effect on the risk of preterm births.

Literature Review

PRETERM BIRTHS

Preterm births is the leading cause of infant mortality, and are identified as a preventable condition (Callaghan et al., 2006). The risk of death for a preterm birth when compared to infants of normal gestational ages and equivalent weights are 15 times greater, and as high as 75 times greater for the very preterm infant, born between 28 to 32 weeks (Batra et al., 2015; Callaghan et al., 2006; Russell et al., 2007). The cost of a preterm birth also is significantly higher; the initial hospitalization cost after birth for preterm infant versus normal term infant is $15,000 and $600 respectively (Russell et al., 2007). With such high cost and risk of death, it has been the goal of researchers to determine the most effective way to reduce the rate of preterm births.

PRECONCEPTION CARE

The first preconception care guidelines were published in 1983 by the American Academy of Pediatricians (AAP) and the American College of Obstetricians and Gynecologists (ACOG) with the Guidelines for Perinatal Care (Johnson et al., 2006). These guidelines have been continually updated to the present day and are the bases of both the CDC's and HealthyPeople 2020 recommendations (Johnson et al., 2006). Despite this early acknowledgement of the utility of preconception care, prenatal care occupied attentions of policy-makers and clinicians for the next twenty years. What was concluded during this time was that not only did prenatal care not reduce the rate of preterm births, the disparity in perinatal mortality actually became even larger (Loggins & Andrade, 2014; Wheatley, Kelley, Peacock, & Delgado, 2008). Healy et al. found that "prenatal care, although unequivocally helpful and necessary, remains insufficient in its present form for minority women."(2006)

The AAP and ACOG's perinatal guidelines divide the main aspects of preconception care intervention into four categories: physical assessment, risk screening, vaccinations, and

counseling. Risk screening is of interest in this study as it element which encompasses maternal health behaviors which preconception care counseling seeks to influence. Risk screening is comprised of eight parts: reproductive awareness, environmental toxins and teratogens, nutrition and folic acid, genetics, substance use, medical conditions and medications, infectious diseases and vaccinations, and psychosocial concerns (Johnson et al., 2006). These intervention areas have been shown to have some effect on the health of the mother or on the infant birth outcomes, but how effective preconception care is at changing health behaviors is not uniformly understood.

Oza-Frank et al. (2015) was interested in the effect of specific interventions on the probability of the targeted behavior occurring. Using data from the Pregnancy Risk Assessment Monitoring Survey (PRAMS) for the years 2009 and 2010, they looked at interventions for smoking, alcohol, diet, exercise, and folic acid/multivitamin intake. What they found was that there was a strong positive change only for folic acid/multivitamin intake, the other interventions had no association with their respective behaviors before or during pregnancy (Oza-Frank, Gilson, Keim, Lynch, & Klebanoff, 2014). These results, while concerning, do not necessarily point to preconception care's ineffectiveness to influence maternal health behaviors as other studies have found there to be an effect.

Williams et al (2011), following a similar model, looked into prenatal care, smoking and alcohol use, folic acid/multivitamin use. In contrast to Oza-Frank et al (2015), they found positive associations for all categories they looked into for preconception care. However, they also found that preconception care was particularly low among women with unintended pregnancies, with only 13.5% receiving any compared to 42.9% among intended pregnancies

(Williams, Zapata, D'Angelo, Harrison, & Morrow, 2012). This highlights the positive potential selection bias that may be involved in the women who receive preconception care.

The current literature on preconception care's impact on maternal health behaviors has not fully explored all the issues which relate to preconception care, with most research focusing on smoking and alcohol use, diet, exercise, prenatal care and multi-vitamin use. This left the intervention areas of depression and anxiety, diabetes, and hypertension/high blood pressure (HBP) relatively untouched when analyzing maternal behaviors. This study fills in the current gap in the literature for the preconception care's effect on maternal health behaviors related to mental health, chronic conditions, and appropriate weight gain during pregnancy, in addition to revisiting previously investigated behaviors.

Table 1. PRAMS Sequence of Contacts
Pre-letter. This letter introduces PRAMS to the mother and informs her that a questionnaire will soon arrive.
Initial Mail Questionnaire Packet. This packet is sent to all sampled mothers 3 to 7 days after the pre-letter.
Tickler. The tickler serves as a thank you and a reminder note. It is sent 7 to 10 days after the initial mail packet.
Second Mail Questionnaire Packet. This packet is sent to all sampled mothers who have not yet responded 7 to 14 days after the tickler has been sent.
Third Mail Questionnaire Packet. This third packet is sent to all remaining non-respondents 7 to 14 days after the second questionnaire.
Telephone Follow-up. Telephone follow-up is initiated for all mail non-respondents 7 to 14 days after mailing the last questionnaire.

Methods

Sample

The Pregnancy Risk Assessment Monitoring System (PRAMS) was developed in 1987 to reduce infant morbidity and mortality by influencing maternal behaviors before, during, and immediately after pregnancy. It is the only surveillance system that provides data about pregnancy and the first few months after birth. PRAMS is an ongoing, state specific, population-based surveillance system designed to identify groups of women and infants

at high risk for health problems, to monitor changes in health status, and to measure progress towards goals in improving the health of mothers and infants. PRAMS was designed to supplement vital records data by providing state-specific data on maternal behaviors and experiences to be used for planning and assessing perinatal health programs. In addition, because PRAMS use standardized data collection methods, it allows data to be compared among states.

PRAMS is a mixed mode survey, utilizing mail and telephone surveys in order to reduce non-response rates and bias. PRAMS send surveys to women who had given birth to a live child within two (2) to six (6) months after the delivery. PRAMS has multiple contacts with the women surveyed in order to assure higher response and completion rates first by three mail questionnaire packets and then a telephone follow-up, the steps are detailed in Table 1. The data collection cycle last approximately 95 days from pre-letter to telephone. Each participating state draws a stratified systematic sample of 100 to 300 new mothers every month from eligible birth certificates, with many states oversampling low weight births. Surveys are linked to birth certificate data for analysis, providing a great deal of demographic and medical information to be paired with the survey answers.

The study population consist of women who do not have missing values for the receiving the intervention of interest, reception of corresponding screening, or gestational age of their infant at birth. If values for these indicators are missing, then the woman was be dropped from the study population. Using the data from Phase 7 of PRAMS for 2012 and 2013, the study sample is divided into two groups based on whether they received or did not receive preconception counseling. For the smoking and drinking regressions, only women who engaged in smoking or drinking in the three months before pregnancy, respectively, was be included for analysis. To control for selection, propensity score matching was used for all analytic samples.

Andersen Behavioral Model of Health Services Use Framework

This study followed the Andersen Behavioral Model of Health Services Use, which divides confounding factors at the individual level into categories of predisposing, enabling, and need. Predisposing factors are those which are outside the control of the individual to alter, influencing their likely of accessing healthcare services (Andersen & Davidson, 2005). Predisposing factors in the model are maternal age, maternal race/ethnicity, marital status, and maternal body mass index (BMI) category. Enabling factors are those that either assist or hinder the ability of the individual to access healthcare services. In this studies model the enabling factors are socio-economic status (SES), insurance status before pregnancy, and insurance status during pregnancy. Need factors are those that affect an individual's own perception of their general health and functional state and whether they are of sufficient importance and magnitude for them to seek professional help. Need factors in this model are tobacco use, alcohol use, chronic conditions, domestic abuse, and preconception stressors.

Table 2. Constructs and Measures

	Construct	**Measure**	**Hypothesized Relationship to the Dependent Variable(DV)**
Focal Relationship	Health Behaviors	Dichotomous Indicator Preconception: • Diabetes • High Blood Pressure • Depression/Anxiety • Healthy Weight before Pregnancy • Vitamin Intake During Pregnancy: • Prenatal Care in 1st Trimester • Appropriate Weight Gain During Pregnancy • Smoking Cessation • Drinking Cessation	Dependent Variable
	Preconception Counseling or Education 12 months before pregnancy	Dichotomous Indicator	Focal Independent
Predisposing	Maternal Age	Categorical • Less or equal to 17 [Control] • 18 to 19 • 20 to 24 • 25 to 29 • 30 to 34 • 35 to 39 • 40 or more	Positive as age increases
	Maternal Race	Categorical • Non-Hispanic White [Control] • Non-Hispanic Black • Non-Hispanic Other • Hispanic	Non-Hispanic Whites have higher birthweights compared to non-Hispanic Blacks, Blacks, and other.

	Maternal BMI Grouped	Maternal BMI Grouped • Underweight [Control] • Normal • Overweight • Obese	Positive compared to control
Enabling	SES	Categorical Variables • Total Household Income: o $0 to $15,000 o $15,001 to $19,000 o $19,001 to $22,000 o $22,001 to $26,000 o $26,001 to $29,000 o $29,001 to $37,000 o $37,001 to $44,000 o $44,001 to $52,000 o $52,001 to $56,000 o $56,001 to $67,000 o $67,001 to $79,000 o $79,001 or more • Maternal Education o Less than 8 o 9 to 11 o 12 o 13 to 15 o 16 or more o Unknown • Marital Status o Married o Other	Positively associated
	Insurance Status Pre-Pregnancy	Survey – How insurance was paid for. • Insurance Status o Private o Public o Other o None	Positively associated with birthweight
	Multi-Vitamin/Folic Acid Intake 1 Month Before Pregnancy	Categorical • None [Control] • 1-3 times/week • 4-6 times/week • Every day/week	Positive compared to control
	Prenatal Care	Kotelchuck Index • Adequate Plus • Adequate • Intermediate • Inadequate [Control]	Negative compared to control

Need	Previous Live Birth	Dichotomous Indicator	Positive
	Experienced Domestic Violence 12 Months Before Pregnancy	Dichotomous Indicator	Negative
	Stressors	Grouped sum of indicators variables for stress inducing events that occurred twelve (12) months before given birth • A close family member was very sick and had to go into the hospital • I got separated or divorced from my husband or partner • I was homeless • My husband or partner lost his job • I lost my job even though I wanted to go on working • I argued with my husband or partner more than usual • I had a lot of bills I couldn't pay • I was in a physical fight • My husband or partner went to jail • Someone very close to me died	A higher score group would have a negative relationship with the Dependent Variable
	Smoked 3 months before and last 3 months of pregnancy	Dichotomous Indicator	Negative/Positive
	Drank 3 months before and last 3 months of pregnancy	Dichotomous Indicator	Negative/Positive
	Abuse before Pregnancy	Dichotomous Indicator	Negative association with DV
	Pre-existing Diabetes	Dichotomous Indicator	Positive
	Pre-existing Hypertension/High Blood Pressure	Dichotomous Indicator	Positive

	Pre-existing Depression	Dichotomous Indicator	Positive

Predisposing Measurements

Maternal age is an important factor as it has a larger influence on the likelihood of the infant to be born premature, as age increases the receptiveness of counseling increases (Williams et al., 2012). Maternal race/ethnicity is a strong predictor of the likelihood of the infant being born preterm, minorities and Hispanics are less likely to seek care and be receptive to counseling (Chuang, Hillemeier, Dyer, & Weisman, 2011; Williams et al., 2012). Maternal BMI category has been found to be associated with preterm birth (Sven Cnattingius, 2013).

Enabling Measurements

SES is a complex concept that has broad influences on the health of the individual. Often SES is conceptualized by combining financial, occupational, and educational influences. For the purposes of this study, SES is comprised of total household income, maternal education, and marital status. Marital status is also a strong indicator of the risk of preterm birth, with single mothers having a higher risk when compared to married mothers (Loggins & Andrade, 2014). When prenatal care is started does not affect the focal relationship directly, but may be an indicator of motivation. Prenatal care is measured using the Kotelchuck index, which takes into account what trimester prenatal care was started and the proportion of visits recommended by the American College of Obstetricians and Gynecologist (Kotelchuck, 1994). The potential scores being the following: adequate plus, prenatal care started in the 1st or 2nd month and >= 110% of recommended visits; adequate, prenatal care started 3rd or 4th month and 80-109% of recommended visits completed; intermediate, prenatal care started 5th or 6th month and 50-79% of recommended visits completed; and inadequate, prenatal care started 7th month or later and <50% of recommended visits completed (Kotelchuck, 1994). Insurance status before pregnancy is important as women with insurance are far more likely to receive any preconception care

compared to women without (Williams et al., 2012). Multi-vitamin/folic acid intake has been found to be associated with positive health behaviors (Oza-Frank et al., 2014).

Need Measurements

Alcohol use, tobacco use, and experience of domestic abuse before pregnancy are important to take account of as studies have shown that they share a negative relationship with reception of preconception care (D'Angelo et al., 2007; Williams et al., 2012). Preconception maternal stressor also shared a negative relationship with reception of preconception care (Class, Khashan, Lichtenstein, Långström, & D'Onofrio, 2013). Chronic conditions have a mixed and complicated relationship with preconception care. Women with chronic conditions are more likely to interact with a health care worker and to seek health care services, but are not necessarily more likely to seek preconception care directly (Lassi, Imam, Dean, & Bhutta, 2014; Steel, Lucke, & Adams, 2015). The health care services which they seek may look at or treat the same concerns which preconception care have, but not with the direct intent of improving the health of the mother before pregnancy. Women who have experienced a previous live birth are less likely to report receiving preconception care compared to women who have never have a previous live birth (Oza-Frank, Kachoria, Keim, & Klebanoff, 2015). Women who experienced domestic abuse before pregnancy are more likely to not engage in prenatal care, thus it can be assumed that they are less likely to receive preconception education or counseling (Cha & Masho, 2014).

Hypothesis

The hypothesized relationship between the focal variables is that preconception counseling will have a positive impact on the likelihood of engaging in positive healthy behaviors. The counter acting effect of having a raised awareness to the risk will not be strong enough to weaken the relationship significantly.

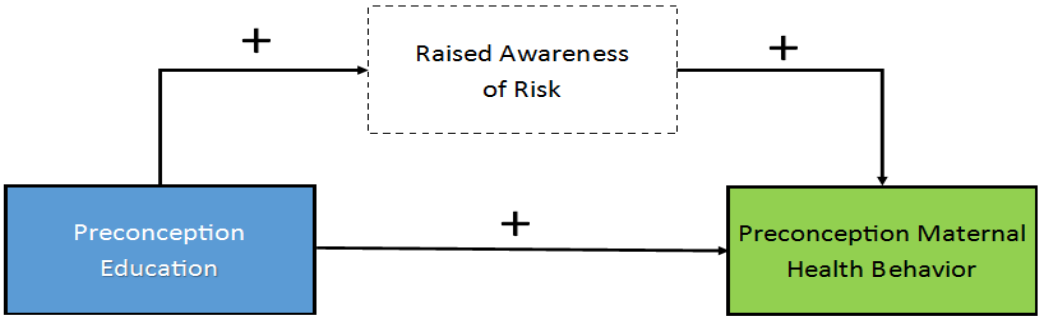

Figure 1. Hypothesized Focal Relationship

Data Analysis

The analytic sample was comprised of all the women in the PRAMS data sets without missing data. To determine whether women who received preconception counseling are more likely to engage in healthy behaviors a logistic regression was used. The regression model:

$$P(\text{Engage in Specific Health Behavior} = 1) = B_0 + B_1X_{PCE} + B_2X_C + E,$$

In this model, X_{PCE} represents the dichotomous measure of reception of preconception counseling, and X_C represents all control variables. Chi-squared test were done to determine whether selection bias was present in the group of women who received preconception counseling compared to those who had not received any preconception counseling. The dataset was propensity scored matched on a 1:1 match in order to control for the high amount of selection bias which was present in the data – even after applying survey weights. The marginal effects of the propensity score matched was interpreted as the average treatment effect on treated, and an effect size greater than zero would reject the null hypothesis.

Summary Statistics

Table 3. Before and After Propensity Scoring Preconception Period

	Before Propensity Score		After Propensity Score		Before Propensity Score		After Propensity Score	
	Unadjusted Entire Sample		Adjusted Entire Sample*		Unadjusted Smoke		Adjusted Smoke	
Received Preconception Counseling	No	Yes	No	Yes	No	Yes	No	Yes
Age		P = 0.000		P = 0.4778		P = 0.000		P = 0.64
17 or Younger	2.00%	1.49%	0.94%	0.85%	2.34%	2.10%	1.47%	1.47%
18-19	5.00%	2.98%	2.61%	2.41%	7.88%	6.84%	5.97%	6.17%
20-24	22.78%	14.86%	14.44%	13.78%	32.59%	26.85%	24.79%	25.91%
25-29	29.79%	30.16%	30.28%	31.25%	28.69%	28.74%	29.81%	30.12%
30-34	26.05%	31.64%	33.85%	32.69%	19.46%	24.39%	25.91%	25.19%
35-39	11.64%	15.10%	14.29%	15.15%	7.38%	8.88%	10.35%	9.03%
40 or More	2.76%	3.77%	3.60%	3.87%	1.66%	2.19%	1.71%	2.11%
Education		P = 0.000		P = 0.3701		P = 0.000		P = 0.961
0-8 Years	3.51%	2.80%	1.65%	1.48%	1.82%	1.92%	1.27%	1.15%
9-11 Years	10.85%	9.51%	7.28%	7.30%	18.38%	19.38%	16.55%	16.99%
12 Years	25.63%	18.49%	18.39%	17.07%	37.94%	32.36%	33.03%	32.67%
13-15 Years	29.08%	23.59%	24.05%	25.08%	31.72%	29.13%	31.72%	31.24%
16 or More Years	30.92%	45.61%	48.64%	49.08%	10.13%	17.22%	23.94%	21.22%
Trying to Become Pregnant		P = 0.000		P = 0.0517		P = 0. 000		P = 0.631
Yes	45.98%	71.61%	71.65%	73.33%	29.79%	50.88%	52.65%	51.97%
Previous -- live birth		P = 0.000		P = 0.0364		P = 0.564		P = 0.375
Yes	60.47%	50.69%	53.76%	51.77%	57.16%	56.60%	59.09%	57.86%
Race/Ethnicity		P = 0.0002		P = 0.6343		P = 0.000		P = 0.459
White, Non-Hispanic	62.65%	61.22%	67.40%	67.93%	63.53%	51.83%	55.11%	55.99%

Black, Non-Hispanic	13.12%	13.84%	10.90%	11.11%	14.16%	21.97%	19.34%	19.66%
Other, Non-Hispanic	9.47%	11.00%	10.47%	9.77%	14.43%	18.16%	19.06%	17.39%
Hispanic	14.75%	13.94%	11.23%	11.19%	7.87%	8.04%	6.49%	6.96%
Insurance Before Pregnancy		P = 0.000		P = 0.0612		P = 0.000		P = 0.978
Private	52.93%	65.63%	70.18%	70.40%	33.38%	38.78%	40.47%	40.63%
Public	20.85%	21.18%	17.41%	18.19%	35.33%	42.92%	41.46%	40.95%
Other	4.30%	4.34%	3.62%	3.94%	5.33%	6.34%	5.93%	6.13%
None	21.92%	8.85%	8.78%	7.47%	25.95%	11.96%	12.14%	12.30%
Insurance During Pregnancy		P = 0.000		P = 0.5419		P = 0.000		P = 0.26
Private	50.84%	64.44%	68.77%	69.23%	30.63%	36.96%	38.82%	38.68%
Public	41.85%	29.57%	26.42%	25.86%	63.63%	56.44%	56.31%	55.16%
Other	4.03%	4.03%	3.18%	3.50%	3.88%	5.11%	3.89%	4.90%
None	3.28%	1.96%	1.64%	1.41%	1.86%	1.49%	0.97%	1.26%
Stressors		P = 0.000		P = 0.574		P = 0.000		P = 0.994
None	29.10%	32.68%	33.71%	32.76%	14.37%	17.93%	18.23%	18.09%
1-2	40.02%	41.50%	42.04%	41.98%	34.18%	36.25%	36.39%	36.77%
3-5	24.30%	21.03%	19.82%	20.80%	35.84%	32.35%	32.01%	31.83%
6 or more	6.58%	4.79%	4.42%	4.46%	15.61%	13.47%	13.38%	13.31%
Kotelchuck Index		P = 0.000		P = 0.4938		P = 0.002		P = 0.825
Inadequate	12.23%	9.50%	8.71%	8.30%	15.73%	13.87%	13.62%	12.80%
Intermediate	12.64%	11.97%	11.99%	11.69%	11.61%	13.68%	13.04%	13.34%
Adequate	46.53%	46.37%	46.22%	47.67%	37.15%	36.77%	37.39%	37.16%
Adequate Plus	28.60%	32.15%	33.08%	32.34%	35.51%	35.68%	35.95%	36.71%
BMI Pre-pregnancy		P = 0.000		P = 0.9259		P = 0.000		P = 0.728
Underweight	4.23%	3.56%	3.47%	3.53%	6.28%	4.73%	4.58%	4.58%
Normal	50.72%	47.29%	49.25%	48.75%	45.56%	40.68%	41.50%	40.67%
Overweight	24.23%	24.48%	24.03%	24.54%	23.13%	23.73%	22.76%	24.11%
Obese	20.82%	24.68%	23.25%	23.18%	25.03%	30.86%	31.16%	30.64%

Smoked Before and During Pregnancy		P = 0.000		P = 0.7252		P = 0.000		
Yes	12.22%	9.37%	9.87%	10.08%	62.28%	55.65%		
Alcohol Before and During Pregnancy		P = 0.7314		P = 0.5159		P = 0.024		P = 0.689
Yes	48.38%	48.14%	51.70%	52.32%	7.18%	6.05%	58.46%	57.90%
Experienced Domestic Abuse before Pregnancy		P = 0.000		P = 0.0664		P = 0.000		P = 0.2
Yes	3.02%	1.99%	2.32%	1.80%	76.70%	43.68%	6.83%	5.94%
Vitamin Intake/Week		P = 0.000		P = 0.8266	6.29%	9.15%		P = 0.474
None	60.77%	25.49%	25.47%	25.01%	3.17%	6.68%	45.72%	45.44%
1-3 Days	7.40%	7.80%	8.09%	7.82%	13.83%	40.49%	9.19%	9.59%
4-6 Days	5.78%	8.20%	8.49%	8.82%		P = 0.000	6.17%	7.16%
Everyday	26.05%	58.51%	57.96%	58.35%	53.63%	47.88%	38.92%	37.80%
Household Income		P = 0.000		P = 0.2014	12.48%	10.63%		P = 0.853
$ 0 TO $19,000	33.10%	23.67%	21.95%	20.63%	10.07%	8.50%	47.91%	47.23%
$19,001 TO $26,000	10.54%	7.62%	7.17%	7.50%	8.45%	7.56%	9.87%	10.58%
$26,001 TO $37,000	10.31%	7.85%	7.72%	8.05%	5.03%	6.03%	8.20%	8.79%
$37,001 TO $52,000	10.67%	8.71%	9.71%	9.36%	10.34%	19.39%	8.64%	7.96%
$52,001 TO $67,000	7.86%	9.00%	8.44%	9.59%		P = 0.000	6.17%	6.21%
$67,001 or more	27.51%	43.16%	45.01%	44.88%	2.67%	5.93%	19.22%	19.22%
Pre-existing Diabetes		P = 0.000		P = 0.5431		P = 0.000		P = 0.543
Yes	2.08%	4.60%	3.45%	3.67%	5.66%	12.71%	4.38%	4.74%
Pre-existing HBP		P = 0.000		P = 0.9233		P = 0.005		P = 0.157
Yes	3.69%	7.54%	5.87%	5.91%	20.93%	23.15%	9.35%	10.55%
Pre-existing Depression		P = 0.0005		P = 0.7475		P = 0.000		P = 0.135
Yes	9.79%	11.20%	10.25%	10.43%	2.34%	2.10%	20.85%	22.59%

Observations	72,000	25,538	18,000	5,026

*****For a detailed breakdown among the different samples, please refer to the appendix for Table 8 and 9

Predisposing: AGE, RACE, BMI

Predisposing: General Population

In the non-propensity scored sample, age, race, and BMI were statistically different using a chi-squared test. Women who received preconception counseling were more likely to be older, Black or Hispanic, and be overweight or obese.

Predisposing: Smoking Population

In the non-propensity scored sample, age, race/ethnicity, and BMI were statistically different using a chi-squared test. Women who received preconception counseling were more likely to be older, a minority, and be obese.

ENABLING: EDUCATION, INTENTION, INSURNCE BEFORE PREGNANCY, INSURANCE DURING PREGNANCY, KOTELCHUCK, VITAMIN, INCOME

Enabling: General Population

In the non-propensity scored sample, maternal education, intention of pregnancy, insurance status before pregnancy, insurance status during pregnancy, Kotelchuck index, vitamin intake, and income was found to be statistically different using a chi-squared test. Women who received preconception counseling were more likely to be better educated, intend to become pregnant, more were insured, have a Kotelchuck index score, more likely to consume multivitamins/folic acid at a higher level, and have a greater household income.

Enabling: Smoking Population

In the non-propensity scored sample, maternal education, intention of pregnancy, insurance status before pregnancy, insurance status during pregnancy, Kotelchuck index, vitamin intake, and income was found to be statistically different using a chi-squared test. Women who had smoked 3 months before pregnancy and received preconception counseling were more likely

to be better educated, intend to become pregnant, to be insured, have a higher Kotelchuck index score, and have a greater household income.

NEED: PREVIOUS LIVE BIRTH, STRESSORS, SMOKING, ALCOHOL, ABUSE, DIABETES, HBP, DEPRESSION

Need: General Population

In the non-propensity scored sample, having previous live birth, stressors, smoking, experiencing domestic abuse, pre-existing diabetes, pre-existing high blood pressure, and pre-existing depression was found to be statistically different using a chi-squared test. Women who received preconception counseling were more likely to not have a previous live birth, experience less stressors, to not have smoked before and during pregnancy, to not have experienced domestic abuse before pregnancy, to have pre-existing diabetes, to have to have pre-existing high blood pressure, and to have pre-existing depression.

After applying propensity score matching, having a previous live birth among women who received and did not receive preconception counseling was still found to be statistically different.

Need: Smoking Population

In the non-propensity scored sample, stressors, having drank alcohol throughout pregnancy, experience domestic violence, pre-existing diabetes, pre-existing high blood pressure, and pre-existing depression was found to be statistically different using a chi-squared test. Women who received preconception counseling were more likely to experience less stressors, to not have experienced domestic abuse before pregnancy, to have pre-existing diabetes, to have to have pre-existing high blood pressure, and to have pre-existing depression.

Regressions

Table 4. Preconception Behaviors – Propensity Score Matched

	Diabetes Screening	High Blood Pressure Screening	Depression/Anxiety Screening	Health Weight before Pregnancy [A]
Before pregnancy: advise about improving health	0.140*	0.165*	0.090*	-0.076*
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	25089	25105	25112	25438

p-values in parentheses

* $p < 0.05$

Controls were age, education, intention of pregnancy, having a previous live birth, race/ethnicity, insurance status before pregnancy, # of stressors before pregnancy, multi-vitamin/folic acid intake before pregnancy, BMI before pregnancy, smoked before and during pregnancy, consumed alcohol before and during pregnancy, experienced domestic abuse, pre-existing diabetes, pre-existing HBP, pre-existing depression, and state of residence.

[A] Did not include BMI as a control

Preconception Period

Diabetes

Women who were advised about improving health were 14 percentage points more likely to be screened for diabetes before pregnancy. When compared to women with 8 or less years of education, women with 12 years of education were 13.7 percentage points less likely, 13 to 15 years of education were 16.2 percentage points less likely, and 16 or more years of education were 17.9 percentage points less likely to be screened for diabetes before pregnancy. When compared to Non-Hispanic Whites, Non-Hispanic Black women were 8.4 percentage points more likely, Non-Hispanic Other were 5.8 percentage points more likely, and Hispanics were 8.5 percentage points more likely to be screened for diabetes before pregnancy. When compared to women with private insurance, women with public insurance before pregnancy were 3.4 percentage points more likely, and women with no insurance before pregnancy 5.9 percentage points less likely to be screened for diabetes before pregnancy. When compared to women with no stressors one year before pregnancy, women with 3-5 stressors were 4.0 percentage points more likely, and women with 6 or more stressors were 6.1 percentage points more likely to be screened for diabetes before pregnancy. When compared to women who took no multi-vitamins

or folic acid supplements one month before pregnancy, women who took multi-vitamins/folic acid 4-6 times/week were 3.3 percentage points more likely, and women who took multi-vitamins/folic acid everyday/week were 6.1 percentage points more likely to be screened for diabetes. When compared to underweight women, overweight women were 5.0 percentage points more likely, and obese women were 11.2 percentage points more likely to be screened for diabetes. Women who drank before and during pregnancy were 3.3 percentage points less likely to be screened for diabetes. Women who had pre-existing diabetes were 21.6 percentage points more likely to be screened for diabetes. Women who had pre-existing depression were 3.5 percentage points more likely to be screened for diabetes.

High Blood Pressure

Women who were advised about improving health were 16.5 percentage points more likely to be screened for high blood pressure before pregnancy. When compared to women 17 or younger, women 35 to 39 years of age were 12.8 percentage points more likely, and women 40 or older were 13.1 percentage points more likely to be screened for high blood pressure before pregnancy. When compared to women with 8 or less years of education, women with 12 years of education were 15.5 percentage points less likely, 13 to 15 years of education were 16.5 percentage points less likely, and 16 or more years of education were 17.9 percentage points less likely to be screened for high blood pressure before pregnancy. Women who had a previous live birth were 2.2 percentage points less likely to be screened for high blood pressure before pregnancy. When compared to Non-Hispanic Whites, Non-Hispanic Black women were 9.7 percentage points more likely, and Hispanics were 5.4 percentage points more likely to be screened for high blood pressure before pregnancy. When compared to women with private insurance, women with no insurance before pregnancy were 9.1 percentage points less likely to be screened for high blood pressure before pregnancy. When compared to women with no

stressors one year before pregnancy, women with 3-5 stressors were 5.4 percentage points more likely, and women with 6 or more stressors were 7.2 percentage points more likely to be screened for high blood pressure before pregnancy. When compared to women who took no multi-vitamins or folic acid supplements one month before pregnancy, women who took multi-vitamins/folic acid 1-3 times/week were 3.7 percentage points more likely, women who took multi-vitamins/folic acid 4-6 times/week were 5.5 percentage points more likely, and women who took multi-vitamins/folic acid everyday/week were 7.2 percentage points more likely to be screened for high blood pressure. When compared to underweight women, overweight women were 6.9 percentage points more likely, and obese women were 13.0 percentage points more likely to be screened for high blood pressure. Women who had experienced domestic violence did not have a statistically significant effect. Women who had pre-existing diabetes were 8.3 percentage points less likely to be screened for high blood pressure. Women who had pre-existing high blood pressure were 40.1 percentage points more likely to be screened for high blood pressure. Women who had pre-existing diabetes were 4.6 percentage points more likely to be screened for high blood pressure.

Depression/Anxiety

Women who were advised about improving health were 9.0 percentage points more likely to be screened for depression before pregnancy. When compared to women with 8 or less years of education, women with 12 years of education were 10.4 percentage points less likely, 13 to 15 years of education were 10.7 percentage points less likely, and 16 or more years of education were 13.7 percentage points less likely to be screened for depression before pregnancy. When compared to Non-Hispanic Whites, Non-Hispanic Other were 2.5 percentage points less likely to be screened for depression before pregnancy. When compared to women with private insurance, women with public insurance before pregnancy were 4.2 percentage

points more likely, and women with no insurance before pregnancy 3.6 percentage points less likely to be screened for depression before pregnancy. When compared to women with no stressors one year before pregnancy, women with 1-2 stressors were 1.9 percentage points more likely, women with 3-5 stressors were 6.3 percentage points more likely, and women with 6 or more stressors were 8.3 percentage points more likely to be screened for depression before pregnancy. BMI before pregnancy did not have a statistically significant effect. Women who had pre-existing diabetes were 12.2 percentage points less likely to be screened for depression. Women who had pre-existing diabetes were 39.4 percentage points more likely to be screened for depression.

Healthy BMI before Pregnancy

Women who were advised about improving health were 7.6 percentage points less likely to have a healthy BMI before pregnancy. When compared to women 17 or younger, women 25 to 29 years of age were 12.3 percentage points less likely, women 30 to 34 years of age were 16.0 percentage points less likely, women 35 to 39 years of age were 18.6 percentage points less likely, and women 40 or older were 16.7 percentage points less likely to have a healthy BMI before pregnancy. When compared to women with 8 or less years of education, 13 to 15 years of education were 10.1 percentage points less likely to have a healthy BMI before pregnancy. Women who had a previous live birth were 2.9 percentage points less likely to be screened for high blood pressure before pregnancy. When compared to Non-Hispanic Whites, Non-Hispanic Black women were 14.0 percentage points less likely, Non-Hispanic Other women were 3.1 percentage points more likely, and Hispanics were 10.3 percentage points more likely to have a healthy BMI before pregnancy. Insurance before pregnancy was not found to be statistically significant for any type. When compared to women with no stressors one year before pregnancy, women with 1-2 stressors were 2.8 percentage points less likely, and women with 3-5 stressors

were 5.2 percentage points less likely to have a healthy BMI before pregnancy. When compared to women who took no multi-vitamins or folic acid supplements one month before pregnancy, women who took multi-vitamins/folic acid 1-3 times/week were 5.4 percentage points more likely, women who took multi-vitamins/folic acid 4-6 times/week were 8.7 percentage points more likely, and women who took multi-vitamins/folic acid everyday/week were 5.8 percentage points more likely to have a healthy BMI before pregnancy. Women who had pre-existing high blood pressure were 17.7 percentage points less likely to have a healthy BMI before pregnancy.

Table 5. Preconception Behaviors, Multivitamin/Folic Acid intake/week –Propensity Score Matched

	1-3 times/week	4-6 times/week	Every day/week
Before pregnancy: advise about improving health	0.001	0.008	0.218*
	(0.905)	(0.098)	(0.000)
Observations	26606	26606	26606

p-values in parentheses
* $p < 0.05$
Controls were age, education, intention of pregnancy, having a previous live birth, race/ethnicity, insurance status before pregnancy, insurance status after pregnancy, # of stressors before pregnancy, Kotelchuck index score, BMI before pregnancy, smoked before and during pregnancy, consumed alcohol before and during pregnancy, experienced domestic abuse, pre-existing diabetes, pre-existing HBP, pre-existing depression, and state of residence.

Multivitamin/Folic Acid Intake Everyday

Women who were advised about improving health were 21.8 percentage points more likely to take multivitamins/folic acid supplements every day, compared to women who took no multivitamin/folic acid supplents. When compared to women 17 or younger, women 35 to 39 years of age were 10.1 percentage points more likely, and women 40 or older were 11.6 percentage points more likely to take multivitamins/folic acid supplements every day. Women who intended to become pregnant were 14.7 percentage points more likely to take multivitamins/folic acid supplements every day. Women who had a previous live birth were 8.8 percentage points less likely to take multivitamins/folic acid supplements every day. When compared to Non-Hispanic Whites, Non-Hispanic Black women were 8.3 percentage points less

likely, Non-Hispanic Other women were 7.6 percentage points less likely, and Hispanics were 4.1 percentage points less likely to take multivitamins/folic acid supplements every day. Compared to women with private insurance one month before pregnancy, women with no insurance were 10.0 percentage points less likely to take multivitamins/folic acid supplements every day. When compared to women with no stressors one year before pregnancy, women with 1-2 stressors were 3.6 percentage points less likely, women with 3-5 stressors were 7.6 percentage points less likely, and women with 6 or more stressors were 6.2 percentage points less likely to take multivitamins/folic acid supplements every day. Women who smoked before and during pregnancy were 9.3 percentage points less likely to take multivitamins/folic acid supplements every day. Women who had pre-existing high blood pressure were 4.5 percentage points more likely to take multivitamins/folic acid supplements every day.

Table 6. Pregnancy Behaviors – Propensity Score Matched

	PNC Started 1st Trimester[A]	Appropriate Gestational Weight Gain	Smoking Cessation[B]
Before pregnancy: advise about improving health	0.012*	-0.005	0.002
	(0.002)	(0.609)	(0.922)
Observations	25452	24896	13557

p-values in parentheses
* $p < 0.05$
Controls were age, education, intention of pregnancy, having a previous live birth, race/ethnicity, insurance status before pregnancy, insurance status after pregnancy, # of stressors before pregnancy, multi-vitamin/folic acid intake before pregnancy, Kotelchuck index score, BMI before pregnancy, smoked before and during pregnancy, consumed alcohol before and during pregnancy, experienced domestic abuse, pre-existing diabetes, pre-existing HBP, pre-existing depression, and state of residence.
[A] Did not include Kotelchuck index score as a control
[B] Did not include smoking before and during pregnancy as a control

Pregnancy Period

Prenatal Care in the 1st Trimester

Women who were advised about improving health were 1.2 percentage points more likely to start prenatal care in the first trimester. Age was not found to have a statistically significant effect. When compared to women with 8 or less years of education, 9 to 11 years of

education were 6.4 percentage points more likely, 12 years of education were 7.1 percentage points more likely, 13 to 15 years of education were 7.5 percentage points more likely, and 16 or more years of education were 9.2 percentage points more likely to start prenatal care in the first trimester. Women who intended to become pregnant were 3.5 percentage more likely to start prenatal care in the first trimester. Women who had a previous live birth were 1.2 percentage points less likely to start prenatal care in the first trimester. When compared to Non-Hispanic Whites, Non-Hispanic Black women were 1.9 percentage points less likely, and Non-Hispanic Other women were 1.8 percentage points less likely to start prenatal care in the first trimester. Compared to women with private insurance one month before pregnancy, women with no insurance were 2.8 percentage points less likely to start prenatal care in the first trimester. Compared to women with private insurance one month during pregnancy, women with no insurance were 6.2 percentage points less likely to start prenatal care in the first trimester. Women who drank before and during pregnancy were 1.0 percentage points more likely to start prenatal care in the first trimester. Experiencing domestic violence were 1.9 percentage points less likely to start prenatal care in the first trimester.

Non-Statistically Significant Regressions

The focal variables of interest which had no statistically significant relationship with preconception counseling were: multi-vitamin/folic acid intake 1-3 and 4-6 times/week, appropriate weight gain during pregnancy, and smoking cessation.

Discussion

Of the focal behaviors of interest, diabetes screening, high blood pressure screening, depression/anxiety screening, healthy BMI before pregnancy, starting prenatal care in the first trimester, and multi-vitamin/folic acid intake every day/week one month before pregnancy were

found to have a statistically significant relationship to preconception counseling. All behaviors, except healthy BMI before pregnancy, were found to have a positive relationship with the reception of preconception care, indicating that preconception counseling is positively associated. The negative direction of the effect on having a healthy weight before pregnancy indicates that preconception counseling is negatively associated with healthy BMI.

The health behaviors which did not have a statistically significant relationship were: being a healthy weight before pregnancy, any level of multi-vitamin/folic acid intake one month before pregnancy, achieving appropriate weight gain during pregnancy, smoking cessation during pregnancy, and alcohol consumption cessation during pregnancy. Of these behaviors, the finding for smoking and alcohol cessation in relation to preconception counseling were consistent with the findings by Williams et al (Williams et al., 2012). Smoking and alcohol cessation may require targeted interventions to have a significant impact. The lack of a statistically significant relationship between levels of multi-vitamin/folic acid intake above none could be from lack of guidance in the level of intake needed, once selection bias has been accounted for in the data. The reason behind the lack of a statistically significant relationship for both women achieving a healthy weight before pregnancy and achieving appropriate weight gain during pregnancy is not clear, but implies the need for a target intervention during the preconception period in order to have the desired outcomes occur.

Strengths

This is one of the first studies to incorporate screening for chronic conditions and mental health issues, as well as taking into account the potential selection bias which is present in the raw data with the use of propensity score matching. Previous studies which have looked into preconception counseling have not controlled for selection bias, potentially leading to misleading

results. Additionally, this study shows how large surveys, such as PRAMS scale, have the potential to be used to study the effects of preconception care on health behaviors. The ability to measure the effect of preconception care is important if policy makers and health care providers are to evaluate how to influence birth outcomes in the most appropriate way possible. These results are also able to be generalized to a national level, due to the large number of states included.

Limitations

PRAMS requires women to recall information and events from over 2 years before the survey was taken, as the questions cover topics which occurred before and during pregnancy 4 to 6 months after birth when completing the surveys. This means that there is the risk of recall bias to be introduced into the data set, though it is not clear whether the women would be more likely to under- or over-report events and information. The women included in the survey also only include those who had live births, which may bias the women selected towards those with engaged in more positive health behavior habits. The way the question is constructed for multi-vitamin/folic acid intake makes it impossible to tease the two apart, forcing the inclusion of multivitamin intake in the measure. This may be inflating the levels recorded folic acid intake since the two cannot be disentangled. The preconception period questions are limited in utility for determining relationships, only allowing for associations to be made.

Conclusion

This study has shown the current capabilities of general preconception care in influencing health behaviors, and shows how it could potentially be improved or supplemented. In order to increase the number of women who receive preconception counseling, more health care workers need to be trained to provide preconception counseling, regardless of intention of pregnancy. By doing so, the number of potential interaction points in the health care system for preconception

counseling would increase, improving the likelihood that a woman would receive preconception counseling. Women who have been identified as smoking, drinking, or not having a normal BMI should be targeted for interventions before pregnancy. To address the disparity in the uninsured rate between women who received and did not receive preconception counseling, Medicaid should be expanded to include more women who are not pregnant, as well as have family planning services be expanded through the use of waiver programs. This study has also shown the potential using surveillance surveys, such as PRAMS, in evaluation the effectiveness of preconception counseling, and potentially preconception care.

Preterm births have long been an issue which healthcare professionals and researchers have sought to address, and preconception counseling is currently one of the methods which is of interest. This study shows that preconception counseling does have an impact on select behaviors, and with further research we can better understand its effects. Future studies should include more states, as well as investigate the relationships of targeted preconception counseling. This study provides a solid foundation for which future studies can build upon, and supports the potential impact of the preconception care on health behaviors, and by extension preterm births.

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Appendix

Table 7. Questions and Sources for Variables

Independent Variables	
Before pregnancy: advise about improving health	10. Before you got pregnant with your new baby, did a doctor, nurse, or other health care worker talk to you about how to improve your health before pregnancy? No Yes
Diabetes Screening	7. At any time during the 12 months before you got pregnant with your new baby, did you do any of the following things? For each item, check No if you did not do it or Yes if you did it d. I visited a health care worker and was checked for diabetes
High Blood Pressure Screening	7. At any time during the 12 months before you got pregnant with your new baby, did you do any of the following things? For each item, check No if you did not do it or Yes if you did it e. I visited a health care worker and was checked for high blood pressure
Depression/Anxiety Screening	7. At any time during the 12 months before you got pregnant with your new baby, did you do any of the following things? For each item, check No if you did not do it or Yes if you did it f. I visited a health care worker and was checked for depression or anxiety
Healthy Weight before Pregnancy	Using the pre-pregnancy categories, women were coded as healthy if they had a normal BMI, otherwise coded as not healthy.
Multi-vitamin/folic acid intake	9. During the month before you got pregnant with your new baby, how many times a week did you take a multivitamin, a prenatal vitamin, or a folic acid vitamin?
Prenatal Care in the 1st Trimester	Provided in the PRAMS Analytical data set
Appropriate Weight Gain during Pregnancy	Using ACOG recommendation, women were placed into either appropriate or inappropriate weight gain during pregnancy. Weight gain during pregnancy was derived by using: 40. By the end of your most recent pregnancy, how much weight had you gained? Check ONE answer and fill in blank if needed Women were then coded as either having appropriate or inappropriate weight gain according the answer given.

Smoking Cessation during Pregnancy	31. In the last 3 months of your pregnancy, how many cigarettes did you smoke on an average day? A pack has 20 cigarettes. If reported as 0, then women stopped smoking, otherwise coded as continued. Note: Only applies to women who were coded as smokers.

Dependent Variables

Maternal Age	Age provided by PRAMS and pre-assigned to categories.
Maternal Education	Education provided by PRAMS and pre-assigned to categories.
Trying to Become Pregnant	14. When you got pregnant with your new baby, were you trying to get pregnant?
Previous -- live birth	4. Before you got pregnant with your new baby, did you ever have any other babies who were born alive?
Maternal Race/Ethnicity	Race provided by PRAMS and pre-assigned to categories. Any women with Hispanic were priority coded as such.
Insurance Status	8. During the month before you got pregnant with your new baby, what kind of health insurance did you have?
Total Number of Stressors 12 months before Pregnancy	36. This question is about things that may have happened during the 12 months before your new baby was born. For each item, check No if it did not happen to you or Yes if it did. (It may help to look at the calendar when you answer these questions.)
Kotelchuck Index Score	Kotelchuck Index Score provided by PRAMS.
BMI Category	Pre-pregnancy BMI calculated using the following information: 1. How tall are you without shoes? 2. Just before you got pregnant with your new baby, how much did you weigh? Women were then placed in either Underweight, Normal, Overweight, or Obese.
Smoker	Women who indicated that they smoked(x>0) for both questions were coded as smokers. 30. In the 3 months before you got pregnant, how many cigarettes did you smoke on an average day? A pack has 20 cigarettes 31. In the last 3 months of your pregnancy, how many cigarettes did you smoke on an average day? A pack has 20 cigarettes.
Drinker	Women who indicated that they smoked(x>0) for both questions were coded as drinkers. 34. During the 3 months before you got pregnant, how many alcoholic drinks did you have in an average week? 35. During the last 3 months of your pregnancy, how many alcoholic drinks did you have in an average week?

Experienced Domestic Violence 12 Months Before Pregnancy	37. During the 12 months before you got pregnant with your new baby, did your husband or partner push, hit, slap, kick, choke, or physically hurt you in any other way?
Health prob -- Diabetes	11. Before you got pregnant with your new baby, did a doctor, nurse, or other health care worker tell you that you had any of the following health conditions? For each one, check No if you did not have the condition or Yes if you did. a. Type 1 or Type 2 diabetes (NOT the same as gestational diabetes or diabetes that starts during pregnancy)
Health prob -- HBP	11. Before you got pregnant with your new baby, did a doctor, nurse, or other health care worker tell you that you had any of the following health conditions? For each one, check No if you did not have the condition or Yes if you did. b. High blood pressure or hypertension
Health prob -- Depression	11. Before you got pregnant with your new baby, did a doctor, nurse, or other health care worker tell you that you had any of the following health conditions? For each one, check No if you did not have the condition or Yes if you did. c. Depression

Table 8. Preconception Period Non-Propensity and Propensity Scored Proportions

	Before Propensity Scoring		After Propensity Scoring					
	Unadjusted Entire Sample		Screening for Diabetes, HBP, and Depression		Healthy BMI before Pregnancy		Vitamin Intake One Month before Pregnancy	
Received Preconception Counseling	No	Yes	No	Yes	No	Yes	No	Yes
Age		P = 0.000		P = 0.4778		P = 0.6242		P = 0.389
17 or Younger	2.00%	1.49%	0.94%	0.85%	1.11%	0.99%	0.98%	0.76%
18-19	5.00%	2.98%	2.61%	2.41%	2.65%	2.38%	2.49%	2.32%
20-24	22.78%	14.86%	14.44%	13.78%	14.63%	14.11%	14.63%	13.68%
25-29	29.79%	30.16%	30.28%	31.25%	30.43%	31.17%	31.16%	31.28%
30-34	26.05%	31.64%	33.85%	32.69%	33.11%	32.40%	32.65%	32.72%
35-39	11.64%	15.10%	14.29%	15.15%	14.65%	15.19%	14.38%	15.35%
40 or More	2.76%	3.77%	3.60%	3.87%	3.43%	3.76%	3.70%	3.90%
Education		P = 0.000		P = 0.3701		P = 0.4454		P = 0.8052
0-8 Years	3.51%	2.80%	1.65%	1.48%	2.27%	1.88%	1.62%	1.58%
9-11 Years	10.85%	9.51%	7.28%	7.30%	7.84%	7.74%	7.69%	7.36%
12 Years	25.63%	18.49%	18.39%	17.07%	18.18%	17.45%	17.58%	17.05%
13-15 Years	29.08%	23.59%	24.05%	25.08%	24.32%	24.39%	24.58%	24.41%
16 or More Years	30.92%	45.61%	48.64%	49.08%	47.39%	48.54%	48.52%	49.60%
Trying to Become Pregnant		P = 0.000		P = 0.0517		P = 0.621		P = 0.3963
Yes	45.98%	71.61%	71.65%	73.33%	72.94%	72.54%	73.31%	74.00%
Previous -- live birth		P = 0.000		P = 0.0364		P = 0.0188		P = 0.0268
Yes	60.47%	50.69%	53.76%	51.77%	54.13%	51.98%	52.64%	50.60%

Race/Ethnicity		P = 0.0002		P = 0.6343		P = 0.3053		P = 0.4588
White, Non-Hispanic	62.65%	61.22%	67.40%	67.93%	65.86%	66.24%	65.60%	66.56%
Black, Non-Hispanic	13.12%	13.84%	10.90%	11.11%	11.43%	11.78%	11.73%	11.69%
Other, Non-Hispanic	9.47%	11.00%	10.47%	9.77%	10.88%	9.88%	11.14%	10.29%
Hispanic	14.75%	13.94%	11.23%	11.19%	11.83%	12.10%	11.54%	11.46%
Insurance Before Pregnancy		P = 0.000		P = 0.0612		P = 0.4851		P = 0.1398
Private	52.93%	65.63%	70.18%	70.40%	68.85%	68.87%	69.72%	70.40%
Public	20.85%	21.18%	17.41%	18.19%	19.15%	18.77%	18.99%	18.21%
Other	4.30%	4.34%	3.62%	3.94%	3.55%	4.07%	3.36%	3.99%
None	21.92%	8.85%	8.78%	7.47%	8.45%	8.28%	7.94%	7.40%
Insurance During Pregnancy		P = 0.000						
Private	50.84%	64.44%						
Public	41.85%	29.57%						
Other	4.03%	4.03%						
None	3.28%	1.96%						
Stressors		P = 0.000		P = 0.574		P = 0.1253		P = 0.6506
None	29.10%	32.68%	33.71%	32.76%	33.37%	32.55%	33.37%	32.55%
1-2	40.02%	41.50%	42.04%	41.98%	42.81%	41.71%	42.81%	41.71%
3-5	24.30%	21.03%	19.82%	20.80%	19.38%	21.04%	19.38%	21.04%
6 or more	6.58%	4.79%	4.42%	4.46%	4.44%	4.70%	4.44%	4.70%
Kotelchuck Index		P = 0.000						
Inadequate	12.23%	9.50%						
Intermediate	12.64%	11.97%						

Adequate	46.53%	46.37%						
Adequate Plus	28.60%	32.15%						
BMI Pre-pregnancy		P = 0.000		P = 0.9259				P = 0.5818
Underweight	4.23%	3.56%	3.53%	3.53%			3.44%	3.46%
Normal	50.72%	47.29%	48.75%	48.75%			48.99%	47.73%
Overweight	24.23%	24.48%	24.54%	24.54%			24.33%	24.84%
Obese	20.82%	24.68%	23.18%	23.18%			23.23%	23.97%
Smoked Before and During Pregnancy		P = 0.000		P = 0.7252		P = 0.8071		P = 0.6898
Yes	12.22%	9.37%	9.87%	10.08%	9.89%	9.75%	10.00%	9.77%
Alcohol Before and During Pregnancy		P = 0.7314		P = 0.5159		P = 0.4339		P = 0.4187
Yes	48.38%	48.14%	51.70%	52.32%	50.82%	51.54%	51.40%	52.15%
Experienced Domestic Abuse before Pregnancy		P = 0.000		P = 0.0664		P = 0.3069		P = 0.4665
Yes	3.02%	1.99%	2.32%	1.80%	2.25%	1.98%	2.03%	1.84%
Vitamin Intake/Week		P = 0.000		P = 0.8266		P = 0.8135		
None	60.77%	25.49%	25.47%	25.01%	25.81%	25.33%		
1-3 Days	7.40%	7.80%	8.09%	7.82%	8.09%	7.92%		
4-6 Days	5.78%	8.20%	8.49%	8.82%	8.27%	8.66%		
Everyday	26.05%	58.51%	57.96%	58.35%	57.83%	58.10%		
Household Income		P = 0.000		P = 0.2014		P = 0.1248		P = 0.2531
$ 0 TO $19,000	33.10%	23.67%	21.95%	20.63%	22.92%	22.26%	22.13%	21.04%

$19,001 TO $26,000	10.54%	7.62%	7.17%	7.50%	7.04%	7.55%	6.85%	7.22%
$26,001 TO $37,000	10.31%	7.85%	7.72%	8.05%	7.69%	7.96%	7.24%	7.77%
$37,001 TO $52,000	10.67%	8.71%	9.71%	9.36%	9.49%	8.99%	9.36%	9.11%
$52,001 TO $67,000	7.86%	9.00%	8.44%	9.59%	8.21%	9.48%	8.66%	9.62%
$67,001 or more	27.51%	43.16%	45.01%	44.88%	44.66%	43.75%	45.76%	45.24%
Pre-existing Diabetes		P = 0.000		P = 0.5431		P = 0.8197		P = 0.9735
Yes	2.08%	4.60%	3.45%	3.67%	3.62%	3.70%	3.69%	3.68%
Pre-existing HBP		P = 0.000		P = 0.9233		P = 0.6065		P = 0.6195
Yes	3.69%	7.54%	5.87%	5.91%	6.16%	6.39%	6.19%	6.41%
Pre-existing Depression		P = 0.0005		P = 0.7475		P = 0.3894		P = 0.4248
Yes	9.79%	11.20%	10.25%	10.43%	10.10%	10.59%	10.02%	10.46%
Checked Diabetes		P = 0.000		P = 0.000				
Yes	14.27%	32.35%	16.24%	30.03%				
Checked HBP		P = 0.000		P = 0.000				
Yes	20.40%	42.79%	25.56%	41.04%				
Checked Depression		P = 0.000		P = 0.000				
Yes	15.38%	26.02%	16.31%	24.55%				
Healthy BMI		P = 0.000				P = 0.000		
Yes	50.72%	47.29%			54.82%	47.44%		
Vitamin Intake		P = 0.000						P = 0.000
None/week	60.77%	25.49%					47.77%	23.90%

1-3 times/week	7.40%	7.80%			7.66%	7.49%
4-6 times/week	5.78%	8.20%			7.89%	8.53%
Everyday times/week	26.05%	58.51%			36.68%	60.08%
Observations	72,000		25,538	27,608	27,688	

Table 9. Pregnancy Period Non-Propensity and Propensity Scored Proportions

	Before Propensity Scoring		After Propensity Scoring			
	Unadjusted Entire Sample		Early Prenatal Care		Appropriate Gestational Weight Gain	
Received Preconception Counseling	No	Yes	No	Yes	No	Yes
Age		P = 0.000		P = 0.3279		P = 0.4778
17 or Younger	2.00%	1.49%	1.03%	0.81%	0.94%	0.85%
18-19	5.00%	2.98%	2.72%	2.41%	2.61%	2.41%
20-24	22.78%	14.86%	14.82%	13.79%	14.44%	13.78%
25-29	29.79%	30.16%	30.32%	31.00%	30.28%	31.25%
30-34	26.05%	31.64%	32.98%	32.78%	33.85%	32.69%
35-39	11.64%	15.10%	14.51%	15.34%	14.29%	15.15%
40 or More	2.76%	3.77%	3.63%	3.87%	3.60%	3.87%
Education		P = 0.000		P = 0.3783		P = 0.3701
0-8 Years	3.51%	2.80%	1.72%	1.54%	1.65%	1.48%
9-11 Years	10.85%	9.51%	7.88%	7.24%	7.28%	7.30%
12 Years	25.63%	18.49%	17.78%	16.96%	18.39%	17.07%
13-15 Years	29.08%	23.59%	24.66%	24.96%	24.05%	25.08%
16 or More Years	30.92%	45.61%	47.96%	49.31%	48.64%	49.08%
Trying to Become Pregnant		P = 0.000		P = 0.1645		P = 0.0517
Yes	45.98%	71.61%	71.90%	73.08%	71.65%	73.33%
Previous -- live birth		P = 0.000		P = 0.0243		P = 0.0364
Yes	60.47%	50.69%	53.74%	51.63%	53.76%	51.77%
Race/Ethnicity		P = 0.0002		P = 0.6382		P = 0.6343

White, Non-Hispanic	62.65%	61.22%	67.44%	67.55%	67.40%	67.93%
Black, Non-Hispanic	13.12%	13.84%	11.16%	11.59%	10.90%	11.11%
Other, Non-Hispanic	9.47%	11.00%	10.38%	9.76%	10.47%	9.77%
Hispanic	14.75%	13.94%	11.01%	11.10%	11.23%	11.19%
Insurance Before Pregnancy		P = 0.000		P = 0.3275		P = 0.0612
Private	52.93%	65.63%	69.93%	70.39%	70.18%	70.40%
Public	20.85%	21.18%	17.83%	17.94%	17.41%	18.19%
Other	4.30%	4.34%	3.72%	4.02%	3.62%	3.94%
None	21.92%	8.85%	8.52%	7.65%	8.78%	7.47%
Insurance During Pregnancy		P = 0.000		P = 0.3575		P = 0.5419
Private	50.84%	64.44%	68.51%	69.20%	68.77%	69.23%
Public	41.85%	29.57%	26.84%	25.76%	26.42%	25.86%
Other	4.03%	4.03%	3.07%	3.53%	3.18%	3.50%
None	3.28%	1.96%	1.57%	1.51%	1.64%	1.41%
Stressors		P = 0.000		P = 0.6075		P = 0.574
None	29.10%	32.68%	33.08%	32.51%	33.71%	32.76%
1-2	40.02%	41.50%	41.96%	41.77%	42.04%	41.98%
3-5	24.30%	21.03%	20.18%	21.15%	19.82%	20.80%
6 or more	6.58%	4.79%	4.79%	4.58%	4.42%	4.46%
Kotelchuck Index		P = 0.000				P = 0.4938
Inadequate	12.23%	9.50%			8.71%	8.30%
Intermediate	12.64%	11.97%			11.99%	11.69%
Adequate	46.53%	46.37%			46.22%	47.67%
Adequate Plus	28.60%	32.15%			33.08%	32.34%

BMI Pre-pregnancy		P = 0.000		P = 0.6289		P = 0.9259
Underweight	4.23%	3.56%	3.60%	3.56%	3.47%	3.53%
Normal	50.72%	47.29%	49.70%	48.51%	49.25%	48.75%
Overweight	24.23%	24.48%	24.10%	24.68%	24.03%	24.54%
Obese	20.82%	24.68%	22.60%	23.25%	23.25%	23.18%
Smoked Before and During Pregnancy		P = 0.000		P = 0.7351		P = 0.7252
Yes	12.22%	9.37%	9.60%	9.79%	9.87%	10.08%
Alcohol Before and During Pregnancy		P = 0.7314		P = 0.5369		P = 0.5159
Yes	48.38%	48.14%	51.94%	52.52%	51.70%	52.32%
Experienced Domestic Abuse before Pregnancy		P = 0.000		P = 0.2393		P = 0.0664
Yes	3.02%	1.99%	2.21%	1.89%	2.32%	1.80%
Vitamin Intake/Week		P = 0.000		P = 0.5364		P = 0.8266
None	60.77%	25.49%	26.29%	25.26%	25.47%	25.01%
1-3 Days	7.40%	7.80%	8.19%	7.93%	8.09%	7.82%
4-6 Days	5.78%	8.20%	8.47%	8.73%	8.49%	8.82%
Everyday	26.05%	58.51%	57.04%	58.08%	57.96%	58.35%
Household Income		P = 0.000		P = 0.3297		P = 0.2014
$ 0 TO $19,000	33.10%	23.67%	22.30%	21.04%	21.95%	20.63%
$19,001 TO $26,000	10.54%	7.62%	6.91%	7.34%	7.17%	7.50%
$26,001 TO $37,000	10.31%	7.85%	7.30%	7.85%	7.72%	8.05%

$37,001 TO $52,000	10.67%	8.71%	9.79%	9.26%	9.71%	9.36%
$52,001 TO $67,000	7.86%	9.00%	8.98%	9.56%	8.44%	9.59%
$67,001 or more	27.51%	43.16%	44.71%	44.96%	45.01%	44.88%
Pre-existing Diabetes		P = 0.000		P = 0.7201		P = 0.5431
Yes	2.08%	4.60%	3.43%	3.56%	3.45%	3.67%
Pre-existing HBP		P = 0.000		P = 0.885		P = 0.9233
Yes	3.69%	7.54%	6.05%	5.99%	5.87%	5.91%
Pre-existing Depression		P = 0.0005		P = 0.3747		P = 0.7475
Yes	9.79%	11.20%	10.02%	10.52%	10.25%	10.43%
Early PNC		P = 0.000		P = 0.0030		
Yes	84.09%	89.99%	89.94%	91.57%		
Appropriate Gestational Weight Gain		P = 0.2638				P = 0.7176
Yes	33.10%	33.83%			35.13%	34.80%
Observations	72,000		27,608		27,688	

Table 10. Pregnancy Period Non-Propensity and Propensity Scored Proportions

	Before Propensity Scoring		After Propensity Scoring	
	Unadjusted Smoking Sample		Smoking Cessation	
Received Preconception Counseling	No	Yes	No	Yes
Age		P = 0.000		P = 0.64
17 or Younger	2.34%	2.10%	1.47%	1.47%
18-19	7.88%	6.84%	5.97%	6.17%
20-24	32.59%	26.85%	24.79%	25.91%
25-29	28.69%	28.74%	29.81%	30.12%
30-34	19.46%	24.39%	25.91%	25.19%
35-39	7.38%	8.88%	10.35%	9.03%
40 or More	1.66%	2.19%	1.71%	2.11%
Education		P = 0.000		P = 0.961
0-8 Years	1.82%	1.92%	1.27%	1.15%
9-11 Years	18.38%	19.38%	16.55%	16.99%
12 Years	37.94%	32.36%	33.03%	32.67%
13-15 Years	31.72%	29.13%	31.72%	31.24%
16 or More Years	10.13%	17.22%	23.94%	21.22%
Trying to Become Pregnant		P = 0. 000		P = 0.631
Yes	29.79%	50.88%	52.65%	51.97%
Previous -- live birth		P = 0.564		P = 0.375
Yes	57.16%	56.60%	59.09%	57.86%
Race/Ethnicity		P = 0.000		P = 0.459
White, Non-Hispanic	63.53%	51.83%	55.11%	55.99%
Black, Non-Hispanic	14.16%	21.97%	19.34%	19.66%
Other, Non-Hispanic	14.43%	18.16%	19.06%	17.39%
Hispanic	7.87%	8.04%	6.49%	6.96%
Insurance Before		P = 0.000		P = 0.978

Pregnancy				
Private	33.38%	38.78%	40.47%	40.63%
Public	35.33%	42.92%	41.46%	40.95%
Other	5.33%	6.34%	5.93%	6.13%
None	25.95%	11.96%	12.14%	12.30%
Insurance During Pregnancy		P = 0.000		P = 0.26
Private	30.63%	36.96%	38.82%	38.68%
Public	63.63%	56.44%	56.31%	55.16%
Other	3.88%	5.11%	3.89%	4.90%
None	1.86%	1.49%	0.97%	1.26%
Stressors		P = 0.000		P = 0.994
None	14.37%	17.93%	18.23%	18.09%
1-2	34.18%	36.25%	36.39%	36.77%
3-5	35.84%	32.35%	32.01%	31.83%
6 or more	15.61%	13.47%	13.38%	13.31%
Kotelchuck Index		P = 0.002		P = 0.825
Inadequate	15.73%	13.87%	13.62%	12.80%
Intermediate	11.61%	13.68%	13.04%	13.34%
Adequate	37.15%	36.77%	37.39%	37.16%
Adequate Plus	35.51%	35.68%	35.95%	36.71%
BMI Pre-pregnancy		P = 0.000		P = 0.728
Underweight	6.28%	4.73%	4.58%	4.58%
Normal	45.56%	40.68%	41.50%	40.67%
Overweight	23.13%	23.73%	22.76%	24.11%
Obese	25.03%	30.86%	31.16%	30.64%
Alcohol Before and During Pregnancy		P = 0.000		P = 0.689
Yes	62.28%	55.65%	58.46%	57.90%
Experienced Domestic		P = 0.024		P = 0.2

Abuse before Pregnancy				
Yes	7.18%	6.05%	6.83%	5.94%
Vitamin Intake		P = 0.000		P = 0.474
None	76.70%	43.68%	45.72%	45.44%
1-3 Days	6.29%	9.15%	9.19%	9.59%
4-6 Days	3.17%	6.68%	6.17%	7.16%
Everyday	13.83%	40.49%	38.92%	37.80%
Household Income		P = 0.000		P = 0.853
$ 0 TO $19,000	53.63%	47.88%	47.91%	47.23%
$19,001 TO $26,000	12.48%	10.63%	9.87%	10.58%
$26,001 TO $37,000	10.07%	8.50%	8.20%	8.79%
$37,001 TO $52,000	8.45%	7.56%	8.64%	7.96%
$52,001 TO $67,000	5.03%	6.03%	6.17%	6.21%
$67,001 or more	10.34%	19.39%	19.22%	19.22%
Pre-existing Diabetes		P = 0.000		P = 0.543
Yes	2.67%	5.93%	4.38%	4.74%
Pre-existing HBP		P = 0.000		P = 0.157
Yes	5.66%	12.71%	9.35%	10.55%
Pre-existing Depression		P = 0.005		P = 0.135
Yes	20.93%	23.15%	20.85%	22.59%
Smoking Cessation		P = 0.000		P = 0.946
Yes	48.68%	53.82%	55.16%	55.07%
Observations	18,000		5,026	

Table 11. Preconception Behaviors –Propensity Score Matched

	Diabetes Screening	High Blood Pressure Screening	Depression/Anxiety Screening	Health Weight before Pregnancy
Before pregnancy: advise about improving health	0.140*	0.165*	0.090*	-0.076*
	(0.000)	(0.000)	(0.000)	(0.000)
Maternal Age				
17 or Younger	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
18-19	0.018	0.042	0.007	0.067
	(0.688)	(0.430)	(0.895)	(0.177)
20-24	-0.008	0.012	-0.033	-0.082
	(0.847)	(0.799)	(0.478)	(0.076)
25-29	0.003	0.027	-0.035	-0.123*
	(0.939)	(0.574)	(0.450)	(0.008)
30-34	0.018	0.084	-0.011	-0.160*
	(0.666)	(0.085)	(0.813)	(0.001)
35-39	0.044	0.128*	-0.006	-0.186*
	(0.302)	(0.011)	(0.894)	(0.000)
40 or More	0.047	0.131*	-0.004	-0.167*
	(0.305)	(0.016)	(0.933)	(0.001)
Maternal Education				
0-8 Years	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
9-11 Years	-0.070	-0.074	-0.064	-0.078
	(0.130)	(0.121)	(0.179)	(0.082)
12 Years	-0.137*	-0.155*	-0.104*	-0.067
	(0.002)	(0.001)	(0.024)	(0.110)
13-15 Years	-0.162*	-0.165*	-0.107*	-0.101*
	(0.000)	(0.000)	(0.022)	(0.016)
16 or More Years	-0.179*	-0.154*	-0.137*	0.024
	(0.000)	(0.001)	(0.004)	(0.565)
Trying to Become Pregnant	-0.005	-0.019	-0.010	-0.009
	(0.663)	(0.139)	(0.338)	(0.485)
Previous -- live birth	-0.003	-0.022*	0.016	-0.029*
	(0.702)	(0.037)	(0.068)	(0.008)
Maternal Race/Ethnicity				
Non-Hispanic White	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
Non-Hispanic Black	0.084*	0.097*	-0.014	-0.140*
	(0.000)	(0.000)	(0.303)	(0.000)
Non-Hispanic Other	0.058*	0.016	-0.025*	0.031*
	(0.000)	(0.285)	(0.036)	(0.045)
Hispanic	0.085*	0.054*	-0.001	-0.103*
	(0.000)	(0.002)	(0.936)	(0.000)
Insurance Status Before Pregnancy				

Private	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
Public	0.034*	0.022	0.042*	-0.002
	(0.036)	(0.238)	(0.010)	(0.934)
Other	-0.004	-0.032	0.007	0.038
	(0.832)	(0.203)	(0.715)	(0.148)
None	-0.059*	-0.091*	-0.036*	0.026
	(0.000)	(0.000)	(0.021)	(0.247)
Insurance Status during Pregnancy				
Private				
Public				
Other				
None				
Total Number of Stressors 12 months before Pregnancy				
None	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
1-2	0.011	0.010	0.019*	-0.028*
	(0.210)	(0.344)	(0.032)	(0.013)
3-5	0.040*	0.054*	0.063*	-0.052*
	(0.001)	(0.000)	(0.000)	(0.000)
6 or more	0.067*	0.072*	0.083*	-0.053
	(0.006)	(0.012)	(0.001)	(0.067)
Multi-Vitamin/Folic Acid Intake 1 Month Before Pregnancy				
None	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
1-3 times/week	0.028	0.037*	0.018	0.054*
	(0.064)	(0.049)	(0.250)	(0.008)
4-6 times/week	0.033*	0.055*	0.023	0.087*
	(0.031)	(0.004)	(0.147)	(0.000)
Every day/week	0.061*	0.072*	0.013	0.058*
	(0.000)	(0.000)	(0.205)	(0.000)
Kotelchuck Index Score				
Inadequate				
Intermediate				
Adequate				
Adequate Plus				
BMI Category				
Underweight	0.000	0.000	0.000	
	(.)	(.)	(.)	
Normal	0.011	0.030	0.006	

	(0.578)	(0.201)	(0.776)	
Overweight	0.050*	0.069*	0.021	
	(0.015)	(0.005)	(0.326)	
Obese	0.112*	0.139*	0.028	
	(0.000)	(0.000)	(0.182)	
Smoker	-0.005	-0.005	0.012	-0.034
	(0.747)	(0.785)	(0.371)	(0.056)
Drinker	-0.033*	-0.012	-0.010	-0.006
	(0.000)	(0.237)	(0.236)	(0.567)
Experienced Domestic Violence 12 Months Before Pregnancy	0.037	0.004	0.033	-0.018
	(0.192)	(0.902)	(0.229)	(0.618)
Total Household Income				
$ 0 TO $19,000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
$19,001 TO $26,000	-0.003	-0.027	-0.027	-0.025
	(0.889)	(0.196)	(0.123)	(0.250)
$26,001 TO $37,000	-0.023	-0.023	-0.021	0.003
	(0.203)	(0.304)	(0.253)	(0.901)
$37,001 TO $52,000	-0.050*	-0.058*	-0.058*	-0.010
	(0.006)	(0.008)	(0.001)	(0.677)
$52,001 TO $67,000	-0.030	-0.040	-0.064*	-0.023
	(0.137)	(0.091)	(0.001)	(0.342)
$67,001 or more	-0.021	-0.001	-0.023	0.065*
	(0.262)	(0.956)	(0.209)	(0.003)
Health prob -- Diabetes	0.216*	-0.083*	-0.122*	0.001
	(0.000)	(0.020)	(0.000)	(0.964)
Health prob -- HBP	0.013	0.401*	0.001	-0.177*
	(0.463)	(0.000)	(0.945)	(0.000)
Health prob -- Depression	0.035*	0.046*	0.394*	-0.034
	(0.011)	(0.006)	(0.000)	(0.057)
States and City				
AK	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
AR	-0.003	-0.038	-0.012	-0.001
	(0.926)	(0.342)	(0.719)	(0.974)
CO	0.012	-0.018	-0.003	0.122*
	(0.633)	(0.545)	(0.904)	(0.000)
DE	-0.014	-0.060*	-0.037	0.047
	(0.555)	(0.039)	(0.114)	(0.136)
GA	0.004	-0.056	-0.000	0.062
	(0.923)	(0.211)	(0.990)	(0.215)
HI	-0.050*	-0.076*	-0.072*	0.119*
	(0.027)	(0.008)	(0.001)	(0.000)
IA	-0.022	-0.046	-0.030	-0.009
	(0.508)	(0.254)	(0.339)	(0.837)
IL	0.004	-0.005	-0.011	0.097*
	(0.857)	(0.863)	(0.627)	(0.001)
MA	-0.011	-0.024	0.007	0.105*

	(0.642)	(0.396)	(0.761)	(0.001)
MD	0.010	-0.006	-0.003	0.049
	(0.701)	(0.846)	(0.908)	0.000
ME	0.013	0.059	0.057*	(.)
	(0.642)	(0.071)	(0.047)	-0.000
MI	-0.021	-0.034	-0.004	(0.995)
	(0.366)	(0.229)	(0.883)	0.120*
MN	-0.044	-0.040	0.024	(0.000)
	(0.058)	(0.161)	(0.316)	0.048
MO	-0.001	-0.034	-0.023	(0.119)
	(0.973)	(0.261)	(0.349)	0.029
NE	-0.016	-0.051	-0.018	(0.532)
	(0.494)	(0.077)	(0.448)	0.112*
NH	0.006	-0.037	-0.017	(0.000)
	(0.862)	(0.354)	(0.600)	-0.014
NJ	0.025	-0.005	0.014	(0.736)
	(0.336)	(0.865)	(0.591)	0.086*
NM	0.070*	0.053	-0.004	(0.003)
	(0.006)	(0.077)	(0.856)	0.110*
NY	-0.005	-0.033	-0.011	(0.000)
	(0.894)	(0.419)	(0.748)	0.046
OH	-0.005	-0.028	-0.016	(0.131)
	(0.867)	(0.405)	(0.563)	-0.002
OK	-0.023	-0.016	-0.002	(0.961)
	(0.396)	(0.621)	(0.956)	0.037
OR	-0.059*	-0.057	0.001	(0.220)
	(0.019)	(0.085)	(0.963)	0.017
PA	0.011	0.000	-0.015	(0.569)
	(0.683)	(0.988)	(0.570)	0.011
RI	0.054*	0.048	0.076*	(0.723)
	(0.029)	(0.096)	(0.003)	0.030
TN	-0.021	-0.059	-0.027	(0.326)
	(0.458)	(0.083)	(0.329)	-0.004
UT	-0.047*	-0.063*	-0.041	(0.927)
	(0.044)	(0.034)	(0.078)	0.087*
VT	-0.009	-0.015	0.020	(0.005)
	(0.729)	(0.599)	(0.416)	0.046
WA	-0.007	-0.026	-0.001	(0.124)
	(0.783)	(0.398)	(0.965)	0.029
WI	-0.023	-0.003	-0.008	(0.478)
	(0.337)	(0.913)	(0.730)	0.016
WV	0.002	-0.062	-0.044	(0.634)
	(0.938)	(0.057)	(0.085)	0.012
WY	-0.044	-0.050	-0.049	(0.712)
	(0.130)	(0.171)	(0.068)	0.074*
YC	0.052*	0.020	0.008	(0.036)
	(0.040)	(0.496)	(0.748)	0.035
Observations	25089	25105	25112	(0.274)

p-values in parentheses
* $p < 0.05$

Table 12. Preconception Behaviors –Propensity Score Matched

	1-3/week	4-6/week	Everyday/week
Before pregnancy: advise about improving health	0.001	0.007	0.218*
	(0.898)	(0.137)	(0.000)
Maternal Age			
17 or Younger	0.000	0.000	0.000
	(.)	(.)	(.)
18-19	0.067*	-0.035	-0.046
	(0.027)	(0.422)	(0.401)
20-24	0.031	-0.006	-0.025
	(0.150)	(0.894)	(0.608)
25-29	0.031	0.013	0.027
	(0.150)	(0.757)	(0.573)
30-34	0.026	0.007	0.061
	(0.228)	(0.872)	(0.212)
35-39	0.016	0.006	0.101*
	(0.476)	(0.886)	(0.043)
40 or More	0.023	0.008	0.116*
	(0.336)	(0.850)	(0.028)
Maternal Education			
0-8 Years	0.000	0.000	0.000
	(.)	(.)	(.)
9-11 Years	-0.028	-0.036	-0.025
	(0.114)	(0.188)	(0.560)
12 Years	-0.016	-0.017	-0.038
	(0.372)	(0.532)	(0.360)
13-15 Years	0.004	-0.009	-0.021
	(0.824)	(0.729)	(0.621)
16 or More Years	0.006	0.009	0.024
	(0.762)	(0.755)	(0.563)
Trying to Become Pregnant	-0.013*	0.017*	0.147*
	(0.023)	(0.014)	(0.000)
Previous -- live birth	0.033*	0.024*	-0.088*
	(0.000)	(0.000)	(0.000)
Maternal Race/Ethnicity			
Non-Hispanic White	0.000	0.000	0.000
	(.)	(.)	(.)
Non-Hispanic Black	0.016	0.010	-0.083*
	(0.072)	(0.395)	(0.000)
Non-Hispanic Other	0.015	-0.019*	-0.076*
	(0.074)	(0.007)	(0.000)
Hispanic	0.020*	-0.010	-0.041*
	(0.032)	(0.266)	(0.008)
Insurance Status Before Pregnancy			
Private	0.000	0.000	0.000
	(.)	(.)	(.)

Public	0.001	0.016	-0.029
	(0.908)	(0.201)	(0.093)
Other	0.012	0.017	-0.046
	(0.362)	(0.285)	(0.053)
None	0.017	0.004	-0.100*
	(0.178)	(0.747)	(0.000)
Insurance Status during Pregnancy			
Private			
Public			
Other			
None			
Total Number of Stressors 12 months before Pregnancy			
None	0.000	0.000	0.000
	(.)	(.)	(.)
1-2	0.000	0.006	-0.036*
	(0.999)	(0.291)	(0.000)
3-5	0.009	0.005	-0.076*
	(0.236)	(0.553)	(0.000)
6 or more	0.002	0.004	-0.062*
	(0.866)	(0.823)	(0.012)
Multi-Vitamin/Folic Acid Intake 1 Month Before Pregnancy			
None			
1-3 times/week			
4-6 times/week			
Every day/week			
Kotelchuck Index Score			
Inadequate			
Intermediate			
Adequate			
Adequate Plus			
BMI Category			
Underweight	0.000	0.000	0.000
	(.)	(.)	(.)
Normal	-0.002	0.022	-0.013
	(0.872)	(0.081)	(0.559)
Overweight	-0.006	0.002	-0.024
	(0.649)	(0.882)	(0.315)

Obese	-0.004	0.008	-0.044
	(0.762)	(0.541)	(0.061)
Smoker	0.027*	0.007	-0.093*
	(0.001)	(0.440)	(0.000)
Drinker	0.003	-0.012*	0.004
	(0.624)	(0.020)	(0.676)
Experienced Domestic Violence 12 Months Before Pregnancy	0.009	-0.021	0.038
	(0.618)	(0.463)	(0.268)
Total Household Income			
$ 0 TO $19,000	0.000	0.000	0.000
	(.)	(.)	(.)
$19,001 TO $26,000	-0.001	0.023	-0.008
	(0.959)	(0.055)	(0.691)
$26,001 TO $37,000	0.009	0.015	-0.015
	(0.452)	(0.192)	(0.445)
$37,001 TO $52,000	0.012	0.027*	0.001
	(0.314)	(0.017)	(0.961)
$52,001 TO $67,000	0.000	0.042*	0.023
	(0.977)	(0.002)	(0.275)
$67,001 or more	-0.007	0.033*	0.070*
	(0.540)	(0.003)	(0.000)
Health prob -- Diabetes	0.022	0.018	-0.013
	(0.077)	(0.197)	(0.627)
Health prob -- HBP	-0.007	-0.004	0.045*
	(0.530)	(0.738)	(0.023)
Health prob -- Depression	-0.011	-0.012	-0.015
	(0.207)	(0.190)	(0.332)
States and City			
AK	0.000	0.000	0.000
	(.)	(.)	(.)
AR	0.017	-0.064*	0.004
	(0.518)	(0.001)	(0.926)
CO	-0.032*	-0.009	0.030
	(0.035)	(0.593)	(0.259)
DE	-0.032*	-0.035*	0.016
	(0.044)	(0.034)	(0.541)
GA	0.004	0.003	0.020
	(0.866)	(0.923)	(0.610)
HI	-0.019	-0.022	-0.023
	(0.217)	(0.197)	(0.417)
IA	-0.014	-0.053*	0.028
	(0.533)	(0.005)	(0.428)
IL	-0.017	-0.026	0.017
	(0.269)	(0.095)	(0.498)
MA	-0.020	-0.014	-0.008
	(0.179)	(0.380)	(0.740)
MD	-0.016	-0.018	0.022
	(0.310)	(0.293)	(0.402)

ME	-0.037*	-0.007	0.060*
	(0.028)	(0.702)	(0.047)
MI	-0.008	-0.013	0.023
	(0.639)	(0.452)	(0.394)
MN	-0.010	0.011	-0.000
	(0.530)	(0.527)	(0.993)
MO	-0.023	-0.014	-0.028
	(0.144)	(0.407)	(0.291)
NE	-0.016	-0.021	0.019
	(0.323)	(0.204)	(0.483)
NH	-0.001	-0.018	0.010
	(0.977)	(0.406)	(0.785)
NJ	-0.035*	-0.017	0.032
	(0.026)	(0.333)	(0.244)
NM	-0.012	-0.011	0.024
	(0.461)	(0.552)	(0.371)
NY	-0.059*	-0.046*	0.072*
	(0.001)	(0.015)	(0.043)
OH	-0.040*	-0.015	0.069*
	(0.015)	(0.449)	(0.027)
OK	-0.021	0.004	0.013
	(0.219)	(0.825)	(0.678)
OR	-0.001	0.039	-0.003
	(0.978)	(0.099)	(0.915)
PA	-0.037*	-0.028	0.050
	(0.022)	(0.123)	(0.082)
RI	-0.020	-0.024	0.028
	(0.190)	(0.121)	(0.270)
TN	-0.005	-0.033	0.006
	(0.806)	(0.075)	(0.854)
UT	0.017	0.004	0.010
	(0.355)	(0.819)	(0.729)
VT	-0.010	-0.018	0.011
	(0.548)	(0.265)	(0.682)
WA	-0.013	-0.031	0.012
	(0.442)	(0.060)	(0.643)
WI	-0.009	-0.028	0.010
	(0.583)	(0.098)	(0.709)
WV	-0.028	-0.021	0.017
	(0.124)	(0.277)	(0.593)
WY	0.011	-0.016	0.005
	(0.621)	(0.477)	(0.892)
YC	-0.010	0.000	-0.035
	(0.516)	(0.990)	(0.186)
Observations	27603	27603	27603

p-values in parentheses
* $p < 0.05$

Table 13. Pregnancy Behaviors –Propensity Score Matched

	PNC Started 1st Trimester	Appropriate Gestational Weight Gain	Smoking Cessation
Before pregnancy: advise about improving health	0.012*	-0.005	-0.001
	(0.002)	(0.609)	(0.928)
Maternal Age			
17 or Younger	0.000	0.000	0.000
	(.)	(.)	(.)
18-19	0.013	-0.028	0.005
	(0.478)	(0.626)	(0.928)
20-24	0.026	0.002	-0.083
	(0.134)	(0.966)	(0.101)
25-29	0.027	0.021	-0.126*
	(0.130)	(0.675)	(0.014)
30-34	0.027	0.021	-0.144*
	(0.137)	(0.679)	(0.006)
35-39	0.014	0.050	-0.195*
	(0.452)	(0.345)	(0.000)
40 or More	-0.018	0.025	-0.149*
	(0.455)	(0.651)	(0.031)
Maternal Education			
0-8 Years	0.000	0.000	0.000
	(.)	(.)	(.)
9-11 Years	0.064*	-0.019	0.058
	(0.006)	(0.675)	(0.406)
12 Years	0.071*	-0.018	0.135
	(0.002)	(0.687)	(0.052)
13-15 Years	0.075*	-0.011	0.212*
	(0.001)	(0.808)	(0.002)
16 or More Years	0.092*	0.028	0.359*
	(0.000)	(0.542)	(0.000)
Trying to Become Pregnant	0.035*	0.017	0.012
	(0.000)	(0.181)	(0.413)
Previous -- live birth	-0.012*	0.020	-0.075*
	(0.009)	(0.050)	(0.000)
Maternal Race/Ethnicity			
Non-Hispanic White	0.000	0.000	0.000
	(.)	(.)	(.)
Non-Hispanic Black	-0.019*	-0.012	0.122*
	(0.008)	(0.505)	(0.000)
Non-Hispanic Other	-0.018*	-0.024	0.104*
	(0.005)	(0.105)	(0.000)
Hispanic	0.008	-0.004	0.169*
	(0.145)	(0.825)	(0.000)
Insurance Status Before Pregnancy			
Private	0.000	0.000	0.000

	(.)	(.)	(.)
Public	-0.015	-0.044	-0.087*
	(0.183)	(0.117)	(0.014)
Other	-0.019	0.014	0.018
	(0.333)	(0.741)	(0.688)
None	-0.028*	-0.013	-0.040
	(0.036)	(0.683)	(0.269)
Insurance Status during Pregnancy			
Private	0.000	0.000	0.000
	(.)	(.)	(.)
Public	-0.020	-0.044	-0.008
	(0.083)	(0.117)	(0.822)
Other	-0.018	0.014	-0.022
	(0.397)	(0.741)	(0.664)
None	-0.062*	-0.013	-0.009
	(0.011)	(0.683)	(0.896)
Total Number of Stressors 12 months before Pregnancy			
None	0.000	0.000	0.000
	(.)	(.)	(.)
1-2	0.004	0.001	0.008
	(0.393)	(0.890)	(0.678)
3-5	0.002	-0.017	-0.002
	(0.783)	(0.230)	(0.941)
6 or more	-0.010	0.004	-0.088*
	(0.281)	(0.886)	(0.001)
Multi-Vitamin/Folic Acid Intake 1 Month Before Pregnancy			
None	0.000	0.000	0.000
	(.)	(.)	(.)
1-3 times/week	-0.003	0.018	0.036
	(0.705)	(0.361)	(0.121)
4-6 times/week	-0.003	-0.006	0.044
	(0.712)	(0.735)	(0.126)
Every day/week	0.005	0.006	0.033*
	(0.296)	(0.658)	(0.029)
Kotelchuck Index Score			
Inadequate		0.000	0.000
		(.)	(.)
Intermediate		0.022	-0.016
		(0.304)	(0.523)
Adequate		0.031	0.045*
		(0.101)	(0.038)
Adequate Plus		0.026	0.017
		(0.172)	(0.444)
BMI Category			
Underweight	0.000	0.000	0.000
	(.)	(.)	(.)
Normal	0.000	-0.022	0.068*
	(0.989)	(0.421)	(0.042)
Overweight	0.009	-0.177*	0.050

	(0.411)	(0.000)	(0.151)
Obese	0.010	-0.197*	0.070*
	(0.364)	(0.000)	(0.038)
Smoker	0.002	-0.048*	
	(0.690)	(0.006)	
Drinker	0.010*	0.001	0.129*
	(0.021)	(0.951)	(0.000)
Experienced Domestic Violence 12 Months Before Pregnancy	-0.019*	-0.114*	-0.052
	(0.046)	(0.005)	(0.062)
Total Household Income			
$ 0 TO $19,000	0.000	0.000	0.000
	(.)	(.)	(.)
$19,001 TO $26,000	0.022*	-0.021	0.057*
	(0.008)	(0.330)	(0.016)
$26,001 TO $37,000	0.011	0.010	0.075*
	(0.278)	(0.671)	(0.006)
$37,001 TO $52,000	0.025*	0.039	0.067*
	(0.015)	(0.088)	(0.021)
$52,001 TO $67,000	0.030*	0.030	0.144*
	(0.006)	(0.211)	(0.000)
$67,001 or more	0.044*	0.032	0.192*
	(0.000)	(0.138)	(0.000)
Health prob -- Diabetes	-0.001	-0.039	0.045
	(0.910)	(0.238)	(0.181)
Health prob -- HBP	-0.005	0.034	-0.041
	(0.477)	(0.150)	(0.087)
Health prob -- Depression	0.006	-0.041*	-0.052*
	(0.282)	(0.020)	(0.002)
States and City			
AK	0.000	0.000	0.000
	(.)	(.)	(.)
AR	-0.004	0.026	0.060
	(0.839)	(0.524)	(0.246)
CO	0.032*	0.127*	0.153*
	(0.013)	(0.000)	(0.001)
DE	0.001	0.019	0.075
	(0.925)	(0.499)	(0.140)
GA	0.037*	-0.006	0.164*
	(0.020)	(0.883)	(0.025)
HI	0.029*	0.093*	0.109*
	(0.014)	(0.001)	(0.019)
IA	0.019	0.070	0.094
	(0.280)	(0.080)	(0.173)
IL	0.031*	0.066*	0.109*
	(0.016)	(0.014)	(0.036)
MA	0.039*	0.061*	0.116*
	(0.001)	(0.026)	(0.023)
MD	0.010	0.080*	0.149*

	(0.491)	(0.006)	(0.006)
ME	0.026	0.086*	0.036
	(0.072)	(0.005)	(0.493)
MI	0.015	0.056*	0.061
	(0.243)	(0.044)	(0.143)
MN	-0.004	0.075*	0.020
	(0.793)	(0.006)	(0.661)
MO	0.029*	0.064*	0.058
	(0.022)	(0.030)	(0.258)
NE	0.026*	0.065*	0.075
	(0.043)	(0.021)	(0.109)
NH	0.026	0.066	0.053
	(0.165)	(0.106)	(0.488)
NJ	0.013	0.092*	0.065
	(0.351)	(0.002)	(0.201)
NM	0.012	0.054	0.253*
	(0.302)	(0.059)	(0.000)
NY	0.020	0.062	0.097
	(0.264)	(0.117)	(0.101)
OH	0.022	0.033	0.043
	(0.112)	(0.309)	(0.417)
OK	0.009	0.097*	0.114*
	(0.542)	(0.003)	(0.006)
OR	0.017	0.035	0.142*
	(0.252)	(0.295)	(0.005)
PA	0.016	0.070*	0.053
	(0.278)	(0.020)	(0.317)
RI	0.037*	0.061*	0.108*
	(0.002)	(0.027)	(0.040)
TN	0.034*	0.036	0.069
	(0.011)	(0.291)	(0.196)
UT	0.002	0.123*	0.192*
	(0.917)	(0.000)	(0.000)
VT	0.029*	0.094*	0.104*
	(0.034)	(0.001)	(0.048)
WA	0.015	0.049	0.150*
	(0.260)	(0.098)	(0.004)
WI	0.001	0.099*	0.058
	(0.947)	(0.001)	(0.181)
WV	0.023	0.089*	-0.041
	(0.116)	(0.008)	(0.378)
WY	-0.027	0.109*	0.087
	(0.223)	(0.003)	(0.099)
YC	0.014	0.046	0.224*
	(0.299)	(0.103)	(0.000)
Observations	25452	24896	4570

p-values in parentheses
* $p < 0.05$