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Are There Benefits of Smoking Reduction During Pregnancy? Smoking Status of Pregnant Women and the Effect on Pre-Term Delivery

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Are There Benefits of Smoking Reduction During Pregnancy? Smoking Status of Pregnant Women and the Effect on Pre-Term Delivery

Capstone Project Paper

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INTRODUCTION

Premature delivery is defined as a baby born before thirty-seven completed weeks of pregnancy. Premature delivery can result in a longer hospital stay after delivery compared to babies born at full-term.[1] Babies born before 37 gestational weeks also have a greater potential for health problems such as acute respiratory, gastrointestinal, immunologic, central nervous system, hearing, and vision problems, as well as longer-term motor, cognitive, visual, hearing, behavioral, social-emotional, health, and growth problems.[2] Premature births can impact at the individual level and at a societal level. "The birth of a preterm infant can bring considerable emotional and economic costs to families and have implications for public-sector services, such as health insurance, educational, and other social support systems."[3] According to the U.S. Department of Health and Human Services, the estimated annual societal economic burden associated with preterm birth in the United States is over $25 billion dollars per year.[1]

According to preliminary data for 2012, around 12% of live births were preterm in the United States.[4] Worldwide, fifteen million babies are born premature every year, and around one million die from preterm delivery related problems.[5] Unfortunately, preterm deliveries are on the rise. According to Chang, there has been an increase in preterm births in almost all countries with reliable data in the last twenty years.[5] Many organizations and reports, such as the March of Dimes and Healthy People 2020 have recognized this trend and are trying to reduce preterm deliveries by 5-10% by 2020.[6]

One of the causes of preterm delivery most studied in the literature is the use of cigarettes by pregnant women. Smoking during pregnancy has been associated with multiple complications, including low birth weight, premature rupture of the membranes, placenta previa, placental abruption, and preterm birth.[3, 7] Most of the previous research conducted has been on low birth weight and the association with smoking during pregnancy.[3, 7] However, according to Shiono et al, women who smoke one or more packs a day increased their chances of delivering before 33 weeks gestation by 60%, and 4% of preterm (33-36 weeks) and 9% of very preterm births (<32 weeks) were attributed to smoking.[8] Overall, smokers in this study had a greater likelihood of having a preterm birth, and had around 24% greater risk of preterm birth than non-smokers.[8]

While research has shown that smoking during pregnancy is problematic, a well-defined health intervention or smoking cessation program for pregnant women supported by all obstetricians and gynecologists has not been conceived. The American College of Obstetricians and Gynecologists suggests the use of prenatal visits to assess adherence to the evidence-based clinical practice guideline for smoking cessation, the 5 A's (Ask, Advice, Assess, Assist, and Arrange). [9] Other smoking cessation programs include the use of pharmacology, such as nicotine replacement therapy, counseling, or psychosocial interventions.[10] Overall, findings from existing systematic reviews suggest that nicotine replacement therapy, behavioral and educational cessation strategies, and multicomponent interventions may be beneficial to women who smoke in pregnancy or the postpartum period, however; the effectiveness and the impact of these various strategies on smoking and

infant outcomes in pregnant women remain unclear.[10] The focus of these interventions is complete cessation of cigarette usage, and there is little emphasis on cigarette reduction interventions.

Harm Reduction theory in public health is the use "of practical strategies that reduce negative consequences of drug use and unsafe behaviors by incorporating a spectrum of strategies ranging from safer use to managed use to abstinence."[11] Harm Reduction's intention is not to exclude abstinence as a final goal for individuals, but rather provides people with more realistic short-term choices that are attainable. While one study examined the risk of pre-term delivery associated with pregnant women who quit smoking by trimester, there is no research on the effects of *reducing* smoking through all three trimesters on pre-term delivery.[3] This study would expand on those findings to examine whether women who reduce the number of cigarettes they smoke during pregnancy have a lower risk of preterm birth. Findings from this study may be used to inform interventions with pregnant women to reduce their smoking intake during pregnancy, which could lead to lower preterm deliveries and reduce their own risk of smoking related diseases.

METHODS

Study Design

This study is a cross-sectional research design with responses being collected from the U.S. Standard Certificate of Live Birth, which is completed after the live birth of a child. All data represented in this study are from births registered in the 50 States, the District of Columbia, and New York City. The U.S. Standard Certificate of Live Birth is a survey that includes informational sections on the newborn, mother,

father, and the medical and health information of the mother and newborn. Data are obtained directly from the mother (e.g., race, Hispanic origin, education, cigarette smoking, WIC participation) and from medical records of the mother and infant (e.g., date of last menstrual period (LMP), birth weight, risk factors, method of delivery.) The data are then sent via electronic files to the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS) through the Vital Statistics Cooperative Program. The Institutional Review Board at the University of Kentucky waived review of this study because of the use of publically available, de-identified secondary data.

Participant Selection

Participants include all women who have had a live birth in the United States of America in 2011, and in one of the states using the 2003 Revision of the Live Birth Certificate (86% of all births). This study included 3,124,771 mother/child pairs. These participants were included due to their completed responses on the United States National Birth Certificate from 2011. The variables studied include pre-term delivery and the amount of cigarettes smoked per trimester by the mother. Demographic characteristics (age, infant gender, race, education, and principal source of payment for delivery) were also examined.

Measures

The independent variable, smoking reduction by trimester will be measured using the following questions.

Cigarette smoking before and during pregnancy was measured with the following question: "For each time period, enter either the number of cigarettes or

the number of packs of cigarettes smoked per day." Response options included number of cigarettes or packs per day for three months before pregnancy, first three months of pregnancy, second three months of pregnancy, and third trimester of pregnancy. We recoded these responses into our Smoking Reduction variable based on before pregnancy and third trimester data. These are: Never Smoked (Never), Stopped Smoking (Quit), Continuous Smoking (Same), Reduced Smoking (Reduced), Started Smoking (Started), and Increased Smoking (Increased). Smoking reduction was further coded into Reduced to 75-99.9% of number of cigarettes or packs of cigarettes smoked per day pre-pregnancy, Reduced to 50-75%, Reduced to 25-50%, and Reduced to 25% or less of pre-pregnancy smoking (excluding 0).

The outcome variable of pre-term delivery was measured by using the "obstetric estimate of gestation." Response options included the estimated completed weeks of gestation: Under 20 weeks, 20-27 weeks, 28-31 weeks, 32-33 weeks, 34-36 weeks, 37-38 weeks, 39 weeks, 40 weeks, 41 weeks, 42 weeks and over, and unknown. Premature delivery was examined using a dichotomous variable that defined a premature birth as a baby born before thirty-seven completed weeks of pregnancy, and a term birth as 37 weeks or more.

Demographics. The U.S. Standard Certificate of Live Birth included items to assess infant gender, maternal age, education, race, and principal method of payment for delivery. Maternal age was grouped into six categories based on previous data surrounding pregnancies. These categories were <18 years, 18-19 years, 20-24 years, 25-29 years, 30-34 years, and >35 years. Education was coded as less than high school, high school graduate/GED, some college, Bachelor's degree or more, and

Unknown. The principal method of payment for delivery was used as an indicator for socioeconomic status. The response options were private insurance, Medicaid, self-pay, other, and unknown. Race was coded as White (non-Hispanic), African American (non-Hispanic), Hispanic, non-Hispanic other races, and origin unknown or not stated.

Statistical Analyses

A Chi-squared test was used to evaluate the bivariate association between smoking status of the mother and births categorized as preterm (<37 weeks) or term (≥ 37 weeks) in the sample population. Logistic regression was used to estimate unadjusted and adjusted odds ratios and 95% confidence intervals to determine the association between smoking status and pre-term birth. Logistic regression was also used to estimate unadjusted and adjusted odds ratios and 95% confidence intervals to determine the association between participants that quit smoking during pregnancy and participants that reduced smoking during pregnancy. Lastly, logistic regression was used to estimate unadjusted odds ratios and 95% confidence intervals for the variables of stayed the same, quit, and reduction, which was broken down into 4 specific categories; reduced smoking to 25% or less (excluding 0), reduced smoking to 25-50% less, reduced smoking 50-75% less, and reduced smoking 75-99.9% less. Statistical analyses were performed using IBM SPSS Statistics 21. Any cases with missing data on any variable were excluded.

RESULTS

The majority of the participants in this sample fell between the ages of 24-34 (76.8%), and were primarily non-Hispanic White (53.7%) or Hispanic (25.3%; Table

1). Most participants paid for their delivery with private insurance (43.0%) or through Medicaid (46.5%), and had at least some college (28.3%) or a Bachelor's degree or more (28.3%). Male births were more common (51.2%). In this sample 88.4% of the births were categorized as term ($\geq$ 37 weeks), and 11.5% were pre-term births (<37 weeks).

Most participants reported never smoking during the three months prior to or during pregnancy (88.6%). Of the 11.4% who did smoke before pregnancy, 39% quit (4.4% of all participants), 32% reduced smoking (3.6% of all participants), 28% continued smoking (3.2% of all participants), 1.1% increased their smoking during pregnancy (0.1% of all participants), and 1.1% started smoking during pregnancy (0.1% of all participants).

In bivariate analyses there was a significant association between smoking and preterm birth. Participants with a preterm delivery had lower proportions of *never* smokers (86.7% never smoked before or during pregnancy, versus 88.9% of term births), and higher proportion of participants quitting smoking (4.6% versus 4.4% of term births), smokers staying the same (4.3% versus 3.0% of term births), reducing smoking (4.1% versus 3.6% of term births), and increasing smoking (0.2% versus 0.1% of term births ($\chi^2 = 2157$, $p<.001$; Table 2).

When predicting the crude odds of pre-term delivery by smoking status (Table 3), participants that quit smoking during pregnancy had the smallest increased risk of preterm delivery of the sample population that smoked (OR=1.08, 95% CI 1.06-1.10). Participants that reduced their smoking during pregnancy had 18.9% higher odds of pre-term birth than never smokers, participants that started

smoking during pregnancy had 34.8% higher odds of pre-term birth than never smokers, participants that stayed the same had 44.9% higher odds of pre-term birth than never smokers, and participants that increased smoking had 45.2% higher odds of pre-term birth than never smokers.

In a model adjusting for mother's race, age, and education, payment for delivery, and infant gender, participants that reduced smoking during pregnancy had 18.3% higher odds of pre-term birth compared to never smokers, and participants that quit smoking during pregnancy had 9.7% higher odds of having a pre-term birth than never smokers. Of these births, participants that paid with private insurance had 6.9% lower odds than those enrolled in Medicaid to have a pre-term delivery, and those who self-paid had 9.3% lower odds. Women 35 years or older, and women less than 18 years old had the highest odds of pre-term delivery. The results also showed that higher education led to lower odds of pre-term delivery. White (Non-Hispanic) had the lowest odds of a pre-term birth (OR=.96, 95% CI .95-.97), and Black (Non-Hispanic) had the highest odds of a pre-term birth (OR=1.55, 95% CI 1.54-1.58).

When examining ONLY those who reduced smoking versus those who quit smoking, the unadjusted odds of pre-term birth were 10.1% higher among reducers (Table 3). In an adjusted model controlling for mother's race, age, and education, payment for delivery, and infant gender, participants that reduced smoking during pregnancy had 5% higher odds of pre-term birth compared to those who quit smoking. Of these births, participants that paid with private insurance had 12.9% lower odds than those enrolled in Medicaid to have a pre-term delivery, and those

who self-paid had 28.4% higher odds. Women 35 years or older had the highest odds of pre-term delivery, and women 18-19 years old had the lowest odds of a pre-term delivery. The results also showed that furthered education led to lower odds of pre-term delivery. White (Non-Hispanic) had the lowest odds of a pre-term birth, and Black (Non-Hispanic) had the highest odds of a pre-term birth.

When looking at levels of reduction and pre-term birth in the unadjusted OR in Table 4, the data showed that participants who quit smoking had 25.5% less odds of having a pre-term birth than participants who stayed the same. Participants who reduced their smoking to 25% or less (excluding 0) had 18.2% less odds of having a pre-term birth than participants that stayed the same, participants who reduced their smoking to 25%-50% had 18.1% less odds of having a pre-term birth, participants that reduced their smoking to 50-75% had 18.6% less odds of having a pre-term birth, and participants who reduced their smoking to 75-99.9% less had 3.9% less odds of having a pre-term birth than participants that stayed the same.

DISCUSSION

The main finding of this study is that the more a woman reduces the number of cigarettes smoked per day during pregnancy, the greater the reduction in her risk of a preterm birth. Though quitting is the best method to prevent pre-term birth due to smoking, the majority of people struggle to maintain their smoking cessation when they quit "cold turkey." According to the Cooper/Clayton Method, out of 100 smokers attempting to quit smoking, at one year only 5 participants would still be nonsmokers if they quit "cold turkey."[12] When a person quits "cold turkey", they can have issues with their central nervous system, blood pressure, and it can send the

body into a state of shock.[12] Currently, physicians use the 5 A's (Ask, Advice, Assess, Assist, and Arrange), pharmacology such as nicotine replacement therapy, counseling, or psychosocial interventions for smoking cessation for pregnant women.[9] The focus of these interventions is complete cessation of cigarette usage, and there is little emphasis on cigarette reduction interventions.

The findings show that quitting is the best method to prevent a pre-term birth, however; if quitting is an unattainable goal then reduction may also reduce the odds of a pre-term births. While physicians should continue advising towards complete smoking cessation, they may also discuss harm reduction methods and the potential benefits for the unborn child of reducing cigarette usage. Harm reduction methods, such as slowly reducing cigarette usage, using nicotine replacement therapy, gum, patch, or lozenge, or the Cooper/Clayton patented program, tend to be three to five times more successful than quitting "cold turkey."[12] Harm reduction could lead to better health outcomes than no change in smoking for both the child and the mother, and may help maintain smoking cessation longer for the mother.

The findings of this study could greatly impact how physicians inform interventions on smoking cessation for pregnant women. The focus would stay on complete smoking cessation, however; physicians could teach harm reduction as a means to complete smoking cessation. This would lead to better transitions for mothers that smoke, and potentially lead to longer smoking cessation. According to the CDC, "of women who smoked 3 months before pregnancy, 54% quit during pregnancy, and among women who quit smoking during pregnancy, 44% relapsed

within 6 months after delivery."[13] Harm reduction is an alternative, small step that pregnant smokers could take if they were unable or unwilling to completely stop smoking. In a study conducted by Jordan, 62% of physicians believed smoking cessation advice would be of significant value, but when following the steps of the 5 A's only 66% of physicians engaged in advising, 42% in assessing, 29% in assisting, and 6% for arranging for follow-up visits or referrals.[14] Physician protocol is to teach minimal smoking cessation to all patients who are all smokers. In 17 trials in which they compared brief advice versus no advice on smoking cessation by physicians, results detected a significant increase in the rate of quitting (relative risk (RR) 1.66, 95% confidence interval CI 1.42 to 1.94), which showed that intervention can increase quitting by 5%. [15] When comparing intensive smoking cessation advice versus minimal advice, results showed a small advantage of intensive advice (RR 1.37, 95% CI 1.20 to 1.56). [15] This shows that intensive discussion with a patient could possibly increase their odds of smoking cessation.[15] Minimal or intensive discussion of harm reduction benefits from physicians could potentially open a woman's mind more to stopping smoking than if a doctor offers quitting as the only option or does not mention smoking cessation. Harm reduction interventions should be delivered on an individual basis during prenatal care when a pregnant woman has expressed that she is unable and unwilling to quit smoking.

There is a lack of research on harm reduction methods for smoking cessation and pre-term birth. Previously, studies have examined quitting smoking and low birth weight babies, however; these studies did not look at the effect that smoking reduction could have on low birth weight babies.[3] Similar to the finding of the

present study, these previous studies have also found that quitting smoking leads to the best health outcomes for the unborn child, but have not studied the potential benefits of harm reduction.

Advantages of the current study are derived from using the United States National Birth Certificates. The database provided a sample size large enough to understand the birth trends from an entire population for a single year, and was representative of the population. Also, the use of hospital data potentially reduced information bias. This study is one of the first to examine the relationship between harm reduction and pre-term birth.

Possible limitations include response bias for the self-reported variable of number of cigarettes smoked per day before and during pregnancy. Due to the sensitive nature of this topic, the participants could have underrepresented the actual number of cigarettes they smoke per day. There are multiple unknown factors that cause pre-term births. Because of this, this study could be affected by confounding of an unmeasured variable. This effect could be the explanation for the low R values seen in Table 3. Further, our large sample size could have lead to statistically significant results that may not maintain significance in smaller populations; however, any intervention that reduces pre-term birth could be classified as clinically significant. Finally, the timing of reduction could have an additional effect on preterm birth that was not measured in this study because the Smoking Reduction variable was based on before pregnancy and third trimester data.

The causes of pre-term birth are still unknown; however, additional data are

needed to provide a more precise picture of harm reduction and pre-term birth. Each year, preterm birth affects nearly 500,000 babies born in the United States.[13] In 2009, preterm-related causes of death together accounted for "35% of all infant deaths, which was more than any other single cause."[13] Preterm birth is also a leading cause of long-term neurological disabilities in children, and costs the U.S. health care system more than $25 billion dollars a year.[13] Harm reduction, as a step to complete smoking cessation, could potentially lower the pre-term birth rate and lead to better health outcomes for pregnant women and their unborn children now and in the future. Future efforts should study all areas of prematurity and harm reduction, such as low birth weight babies and congenital anomalies. Finally, collaborations between CDC scientists, local, state, and federal health departments, university researchers, and other health care professionals should be encouraged to understand why pre-term births occur and what can be done to help prevent them.[13]

References Cited

1. Why Is 40 Weeks so Important? New York State Department of Health Website. http://www.health.ny.gov/community/pregnancy/why_is_40_weeks_so_important.htm. Published August, 2009. Accessed March 29, 2014.

2. Disease and Conditions Premature Births. Mayo Clinic Website. http://www.mayoclinic.org/diseases-conditions/premature-birth/basics/complications/con-20020050Accessed March 30, 2014.

3. Polakowski L, Akinbami L, Mendola P. Prenatal Smoking Cessation and the Risk of Delivering Preterm and Small-for-Gestational-Age Newborns. *Obstetrics & Gynecology.* 2009;114: 318-325.

4. Preterm Birth. Child Health USA 2013 Website. http://mchb.hrsa.gov/chusa13/perinatal-health-status-indicators/p/preterm-birth.html. Accessed March 27, 2014.

5. Chang H, Larson J, Blencowe H, Spong CY, Howson CP, Cairns-Smith S, Lackritz EM, Lee SK, Mason E, Serazin AC, Walani S, Simpso JL, Lawn JE, Born Too Soon preterm prevention analysis group. Preventing preterm births: analysis of trends and potential reductions with interventions in 39 countries with very high human development index. *The Lancet.* 2013;381:223-234.

6. U.S. Department of Health and Human Services. Office of Disease Prevention and Health Promotion. Healthy People 2020. Washington, DC.

7. Meville N. Smoking During Pregnancy Increases Risk for Preterm Birth. *Preventive Medicine 2010: the Annual Meeting of the American College of Preventive Medicine (ACPM)*. 2010.

8. Shiono P, Klebanoff M, Rhoads G. Smoking and Drinking During Pregnancy. *JAMA.* 1986;255:82-84.

9. Chang J, Alexander S, Holland C, Arnold R, Landsittel D, Tulsky J, Pollak K, Smoking Is Bad for Babies: Obstetric Care Providers' Use of Best Practice Smoking Cessation Counseling Techniques. *American Journal of Health Promotion*. 2013; Vol. 27, No. 3:170-176.

10. Smoking Cessation Interventions During Pregnancy and the Postpartum Period. US Department of Health and Human Services Website. http://effectivehealthcare.ahrq.gov/index.cfm/search-for-guides-reviews-and-reports/?productid=1423&pageaction=displayproduct Published March 8, 2013. Accessed March 28, 2014.

11. Enders K. Harm Reduction as a Model of Intervention and Treatment: Theory, Definition and Approaches to Working with LGBT Populations. LGBT Tristar. http://038212c.netsolhost.com/wp-content/uploads/2013/08/09-report-harm.pdf. Accessed January 10, 2014.

12. Cooper T, Clayton R. The Cooper/Clayton Method to Stop Smoking. Lexington(KY):Institute for Comprehensive Behavioral Smoking Cessation; 2009.

13. Tobacco Use and Pregnancy. Centers for Disease Control and Prevention Website.http://www.cdc.gov/Reproductivehealth/TobaccoUsePregnancy/index.htm Published January 28, 2014. Accessed March 26, 2014.

14. Jordan, TR, Dake, JR, Price, JH. Best practices for smoking cessation in pregnancy: do obstetrician/gynecologists use them in practice? Journal of Women's Health. 2006; 15:400-401.

15. Stead LF, Buitrago D, Preciado N, Sanchez G, Hartmann-Boyce J, Lancaster T. Physician advice for smoking cessation. Cochrane Database of Systematic Reviews 2013, 5. DOI: 10.1002/14651858.CD000165.pub4.

Biographical Sketch

This capstone has been prepared by Kelli McLane. In preparation for graduate school, Kelli attended the University of Tennessee where she received her Bachelor of Arts in Psychology. She was a member of the University of Kentucky Student Public Health Association and will earn a graduate certificate in Maternal and Child Health. This certification will become complete once she graduates with her Master's in Public Health. If you would like to contact her please use the following information:

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TABLE 1-Sociodemographic and Health Characteristics in Pregnant Women: United States National Birth Certificate Data, 2011, N=3,124,771

Variables	N (%)
Maternal Demographics	
Maternal Age (years)	
<18 years	78,361 (2.5)
18-19 years	182,692 (5.8)
20-24 years	722,177 (23.1)
25-29 years	893,924 (28.6)
30-34 years	784,388 (25.1)
≥35 years	463,229 (14.8)
Race	
White (non-Hispanic)	1,679,397 (53.7)
African American (non-Hispanic)	416,441 (13.3)
Hispanic	790,684 (25.3)
Non-Hispanic Other Races	217,285 (7.0)
Origin unknown or not stated	20,964 (0.7)
Principal Source of Payment for Delivery	
Private Insurance	1,343,986 (43.0)
Medicaid	1,451,915 (46.5)
Self-pay	131,792 (4.2)
Other	149,874 (4.8)
Mother's Education	
Less than high school	563,593 (18.0)
High School Graduate or GED completed	763,679 (24.4)
Some college	883,049 (28.3)
Bachelor's degree or more	882,887 (28.3)
Unknown	31,563 (1.0)
Maternal Smoking Status (by Trimester)	
Never Smoked (Never)	2,768,679 (88.6)
Stopped Smoking (Quit)	137,220 (4.4)
Continuous Smoking (Stayed the Same)	99,271 (3.2)
Reduced Smoking (Reduced)	113,339 (3.6)
Started Smoking (Started)	2,354 (0.1)

Variables	N (%)
Increased Smoking (Increased)	3,908 (0.1)
Infant characteristics	
Infant Gender	
Male	1,599,513(51.2)
Female	1,525,258 (48.8)
Gestational Age (Preterm Birth)	
Under 37 weeks	360,107 (11.5)
37 weeks and over	2,760,736 (88.4)
Gestational Age	
Under 20 weeks	1191 (.0)
20-27 weeks	20,734 (.7)
28-31 weeks	36,617 (1.2)
32-33 weeks	46,629 (1.5)
34-36 weeks	254,936 (8.2)
37-38 weeks	806,415 (25.8)
39 weeks	913,508 (29.2)
40 weeks	607,670 (19.4)
41 weeks	261,986 (8.4)
42 weeks and over	171,157 (5.5)
Unknown	3928 (.1)

Table 2. Smoking Characteristics of the Population by Preterm (<37 weeks) or Term (≥ 37 weeks) Birth: United States National Birth Certificate Data, 2011, N=3,124,771

	Never Smoked	Quit Smoking	Stayed the Same	Reduced Smoking	Started Smoking	Increased Smoking	Total	X^2	p-value
<37 weeks (preterm)	312,291 86.7%	16,558 4.6%	15,429 4.3%	14,877 4.1%	344 0.1%	608 0.2%	360,107 100.0%		
37 weeks and over	2,453,061 88.9%	120,473 4.4%	83,624 3.0%	98,284 3.6%	2,004 0.1%	3,290 0.1%	2,760,736 100.0%		
Total	2,765,352 88.6%	137,031 4.4%	99,053 3.2%	113,161 3.6%	2,348 0.1%	3,898 0.1%	3,120,843 100.0%	2157	p<.001

Table 3. Unadjusted and Adjusted Logistic Regression Models Predicting Pre-term Birth, United States National Birth Certificate Data, 2011, N=3,124,771

Variables	Unadjusted OR	Adjusted OR	Unadjusted OR	Adjusted OR
Smoking Variables				
Never Smoked	Ref	Ref		
Quit Smoking	1.080 (1.062-1.098)	1.097 (1.097-1.116)	Ref	Ref
Stayed the Same	1.449 (1.424-1.475)	1.395 (1.370-1.421)		
Reduced Smoking	1.189 (1.168-1.210)	1.183 (1.162-1.205)	1.101 (1.076-1.128)	1.050 (1.024-1.077)
Started Smoking	1.348 (1.203-1.512)	1.234 (1.100-1.385)		
Increased Smoking	1.452 (1.331-1.583)	1.350 (1.237-1.473)		
Payment for Delivery				
Medicaid		Ref		Ref
Private Insurance		.931 (.923-.940)		.871 (.845-.897)
Self-pay		.907 (.891-.924)		1.284 (1.186-1.391)
Other		.941 (.925-.957)		.974 (.923-1.028)
Unknown		1.075 (1.045-1.106)		1.161 (1.065-1.266)
Mother's Age				
<18 years		Ref		Ref
18-19 years		.867 (.846-.889)		.950 (.866-1.042)
20-24 years		.808 (.791-.826)		1.006 (.923-1.097)
25-29 years		.828 (.810-.846)		1.144 (1.048-1.249)
30-34 years		.930 (.909-.951)		1.357 (1.240-1.484)
≥35 years		1.197 (1.197-1.225)		1.832 (1.667-2.013)
Mother's Race				
Hispanic		Ref		Ref
White (Non-Hispanic)		.957 (.947-.966)		.976 (.930-1.023)
Black (Non-Hispanic)		1.557 (1.540-1.575)		1.575 (1.492-1.663)
Other (Non-Hispanic)		.973 (.958-.989)		1.056 (.973-1.146)
Origin Unknown		1.042 (.996-1.091)		1.124 (.917-1.377)
Mother's Education				
Less than High School		Ref		Ref
High School Grad/GED		.939 (.929-.949)		.858 (.830-.886)
Some college		.877 (.867-.887)		.789 (.762-.817)
Bachelor's or more		.739 (.729-.749)		.634 (.596-.675)
Unknown		1.030 (.994-1.069)		.958 (.792-1.160)
Infant Gender				
Male		Ref		Ref
Female		1.110 (1.102-1.118)		1.120 (1.094-1.147)
R^2	.001	.014	.000	.016

Table 4. Unadjusted Logistic Regression Model Predicting Pre-term Birth Due by Smoking Reduction, United States National Birth Certificate Data, 2011 (n=3,124,771)

Variables	Unadjusted OR
Quit Smoking	.745 (.728-.763)
Stayed the Same	Ref
Reduced Smoking to 25% or less	.818(.792-.846)
Reduced Smoking to 25-50% less	.819 (.795-.844)
Reduced Smoking to 50-75% less	.814 (.768-.863)
Reduced Smoking to 75-100% less	.961 (.841-1.098)
R^2	.003

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