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Tobacco Use Among Pregnant Women in North Carolina: Predictors of Smoking Cessation During Pregnancy

**Results from the North Carolina Pregnancy Risk Assessment Monitoring System
(PRAMS), 1997-2001**

by

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ABSTRACT

Objectives: This study examines the differences in the rate of smoking cessation during pregnancy among mothers who smoked before pregnancy, by selected maternal characteristics. We also identify differences in maternal behaviors and birth outcomes between women who did and did not quit smoking during pregnancy, among women who smoked before pregnancy.

Methods: The sample for this study was obtained from the North Carolina Pregnancy Risk Assessment Monitoring System (PRAMS). This is a random sample of 7,935 live births for the period 1997-2001. For most analyses in this study, we exclude women who did not smoke before pregnancy (5,608) and those with data missing on smoking before or during pregnancy (255). Mothers who smoked before pregnancy and smoked at least one cigarette a day during the last three months of pregnancy are defined as persistent smokers, and those who smoked before pregnancy and did not smoke at least one cigarette a day during the last three months of pregnancy are defined as quitters in this study.

Results: Overall, 24.6 percent of women reported cigarette smoking before pregnancy, 13.8 percent during pregnancy, and 20.3 percent after pregnancy. Of those who smoked before pregnancy and quit during pregnancy, roughly half began smoking again by the time they completed the PRAMS survey at 3-6 months postpartum. After controlling for demographic and other characteristics, the strong predictors of smoking cessation during pregnancy were low intensity of smoking before pregnancy, higher maternal education, higher income, and no previous births. Mothers who did not quit smoking during pregnancy were significantly more likely to deliver a low birth weight baby and to have their infant exposed to second-hand smoke after giving birth and less likely to breastfeed.

Conclusions: While many women who smoke before becoming pregnant reduce the amount of cigarettes smoked during pregnancy, these women are having a difficult time completely quitting. Less than four percent of women who smoked before their pregnancy reported receiving classes on how to stop smoking during their pregnancy. More work is needed to educate women on the dangers of smoking during their pregnancy, particularly those in high-risk groups. Reducing the percentage of women who smoke during pregnancy is a National Healthy People 2010 objective and should remain a priority of North Carolina public health programs.



Introduction

The public health community has made intensive efforts to educate the general public on the hazards of cigarette smoking. These hazards are exceedingly detrimental during pregnancy. Previous studies have found that women who smoke during pregnancy are at greater risk for preterm labor and delivery, spontaneous abortion, reduced infant birth weight, and neonatal and fetal deaths.¹⁻⁶ In addition, Sudden Infant Death Syndrome (SIDS) and respiratory illnesses in children have been associated with maternal smoking after delivery and infant exposure to second-hand cigarette smoke.^{7,8}

Smoking is recognized as the number one preventable risk factor associated with adverse birth outcomes in the United States.⁷ In fact, the *Surgeon General's 2001 Report on Women and Smoking* stated that by eliminating maternal smoking during pregnancy, we might reduce infant mortality by 10 percent, low birth weight births by 20 percent, and preterm deliveries by eight percent in this country.⁷ This report from the Surgeon General also found that infants born to mothers who quit smoking during the first trimester are comparable to infants of non-smoking mothers by weight and body measurements.

Recognizing the hazardous effects of smoking on unborn babies, many expectant mothers quit smoking during pregnancy. In North Carolina, smoking prevalence among reproductive age women is approximately 25 percent⁹ and half of those quit smoking during pregnancy. A number of previous studies have explored correlates of persistent smoking during pregnancy. A clinical study with a small number of pregnant women reported that smokers were more likely to engage in negative health behaviors compared to those who quit or never smoked.¹⁰ Another clinical study of 200 pregnant women in the UK found that there were no differences among smokers, ex-smokers, and women who never smoked in the level of knowledge about the dangers of maternal smoking, and that partner smoking habits had a significant effect on maternal smoking.¹¹ Studies in England and Denmark found that a higher level of smoking before pregnancy, coffee consumption, partner smoking, a higher number of previous live births, and lower education were associated with smoking during pregnancy.^{12,13} A study using the 1998 National Health Interview Survey (NHIS) supplement on Pregnancy and Smoking found that, when comparing women who successfully quit and women

who tried to quit and failed, nicotine dependence (i.e., longer duration of previous smoking) interconnected with age (older women are less likely to quit), was associated with lower success in smoking cessation.¹⁴ Pregnant women who quit tend to have less risky demographic profiles compared to women who smoke during pregnancy. They are more likely to have graduated from high school and less likely to be a single parent.^{15,16}

While these and other previous studies tend to focus on the sociodemographic and economic differences between women who quit smoking during pregnancy and persistent smokers, less is known about the social and behavioral differences between women who quit and those who continue to smoke, as well as differences in birth outcomes. Moreover, the sample sizes of previous population-based surveys and clinic-based studies are often too small for multivariate analyses. The North Carolina Pregnancy Risk Assessment Monitoring System (PRAMS) collects data on various maternal behaviors before, during, and after pregnancy using a representative sample of North Carolina mothers with a recent live birth. In this study, by using North Carolina PRAMS data, we identify maternal sociodemographic factors as well as maternal behaviors and birth outcomes associated with smoking behavior during pregnancy among women who smoked before pregnancy. We also look at the intensity of smoking among women who do not quit smoking during pregnancy compared to the intensity of smoking before pregnancy. The information presented in this study may be used to evaluate health programs and plan future efforts to reduce smoking among pregnant women in North Carolina.

Methods

The Sample

The sample used in this study was obtained from the North Carolina Pregnancy Risk Assessment Monitoring System (PRAMS). PRAMS was developed by the Centers for Disease Control and Prevention in 1987 to provide state-specific, population-based surveillance of selected maternal behaviors and conditions that occur before, during, and after pregnancy. PRAMS is a random, stratified, monthly mail/telephone survey of North Carolina women who recently delivered a live-born infant. Each month around 200 women are selected from the Provisional Live Birth File and are interviewed

approximately 3-6 months after giving birth. For North Carolina PRAMS sampling, live births are stratified on birthweight, with oversampling occurring among low birthweight (1,500-2,499 g) and very low birthweight (<1,500 g) births. Excluded from the sampling frame are births to North Carolina residents that took place out of state, those where the birth certificate did not contain the mother's last name, multiple gestations of four or more births, and births to mothers under the age of 13. Data collection began in North Carolina on July 1, 1997, providing us with six months of data for 1997. Since 1997, PRAMS data have been collected every year.

All women in the selected sample are mailed an introductory letter describing the study. Next they are mailed a copy of the NC PRAMS survey instrument. Nonrespondents are then mailed up to two more surveys. Women who do not respond to any of the mailings are contacted by telephone and are asked to complete the survey via telephone. There were a total of 519,095 live births in North Carolina between July 1, 1997 and December 31, 2001. During this period, 10,812 women were included in the PRAMS sample, with 7,935 responding (overall response rate approximately 73 percent). The sample used for most of the analyses in this study is 2,101 women who had a live birth in the 1997-2001 period and reported that they smoked before pregnancy.

Measures of Smoking

Women reported average daily cigarette smoking during the three months before pregnancy, during the last three months before delivery, and at the time of the survey. Therefore, the questions regarding smoking before and during pregnancy are retrospective. Mothers who smoked before pregnancy and smoked at least one cigarette a day during the last three months of pregnancy are defined as persistent smokers, and those who smoked before pregnancy and did not smoke at least one cigarette a day during the last three months of pregnancy are defined as quitters in this study.

Analysis

The data were analyzed with the SUDAAN¹⁷ software to take the complex survey sampling methods into account. The percentages shown are weighted percentages, designed to reflect the entire population of North Carolina women having a live birth. The 95

percent confidence intervals for the percentages, calculated by SUDAAN, are also shown. This is the range within which we would expect the "true" population percentage to fall 95 percent of the time. As an approximation, if the confidence intervals of groups being compared do not overlap, then the difference is statistically significant at the $p < .05$ level. Multivariate logistic regression was used to identify independent correlates of smoking cessation.

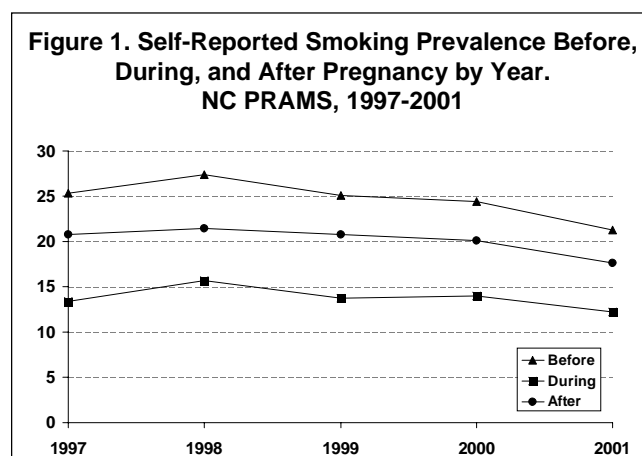
Results

Maternal Characteristics

An examination of the sociodemographic characteristics of the women in the entire 1997-2001 PRAMS sample revealed that the majority were White Non-Hispanic (60%), married (65%), and had a high school education or less (55%). The women ranged from 13 to 48 years of age (mean = 26 years). Forty-nine percent of women had their delivery paid for by Medicaid, 44 percent had prenatal care paid for by Medicaid, and 13 percent of the mothers were on Medicaid before their pregnancy.

Smoking Prevalence

The percentages of women who smoked before, during, and after pregnancy are shown in Figure 1. The three pregnancy periods show similar trends over time, i.e., the prevalence of reported smoking has decreased. However, the prevalence of self-reported smoking does differ substantially for the pregnancy periods (before, during, and after pregnancy). Overall (1997-2001), 24.6 percent of women reported smoking before pregnancy, 13.8 percent during pregnancy, and 20.3 percent after



pregnancy. Among the women who reported smoking before pregnancy, 45 percent quit smoking during pregnancy by three months before delivery, which is similar to quit rates from other population-based surveys, such as the National Health Interview Survey (NHIS).^{15,18} However, of that 45 percent who quit, 50 percent began smoking again by the time they completed the PRAMS survey.

Factors Associated with Smoking Cessation

Table 1 shows the percentages of women who smoked before pregnancy who quit smoking during pregnancy, by maternal characteristics. The adjusted odds of quitting from logistic regression are also shown. Overall, 45.3 percent of the mothers who reported smoking before pregnancy quit by three months before delivery. Levels of self-reported quitting were highest for women who reported only smoking one to nine cigarettes per day before pregnancy (71.0%), had more than a high school education (59.1%), and who reported that their delivery was not paid for by Medicaid (55.2%). Other groups of women who had a higher percentage of quitting during pregnancy than the overall quit rate were women under the age of 20, minorities, married women, women who did not receive WIC benefits during pregnancy, women who did not drink during the third trimester, obese women, women who took a multivitamin containing folic acid every day before pregnancy, women who did not report physical violence, women who did not have a previous live birth, women who received prenatal care during the first trimester, and women who did not receive counseling on the dangers of smoking (Table 1, Column 2).

Results from the logistic regression analysis, adjusting for all factors simultaneously, are presented in Table 1, Column 3. Younger women were more likely to quit than older women. Women under the age of 20 were significantly more likely to quit than mothers over the age of 35 (OR = 3.3, 95% CI = 1.8,6.2). Women between 20 and 34 years of age were more likely to quit compared to mothers over the age of 35 (OR = 2.2, 95% CI = 1.3,3.5). Higher education and income (using delivery paid by Medicaid as a marker for low income) were both significant predictors of quitting. Mothers whose delivery was not paid by Medicaid were significantly more likely

to quit than mothers whose delivery was paid by Medicaid (OR = 1.6, 95% CI = 1.1,2.3). Women with more than a high school education were more likely to quit than women who had a high school education or less (OR = 1.9, 95% CI = 1.4,2.7). The intensity of smoking before pregnancy was also a significant predictor of quitting. Compared to women who reported smoking 20 or more cigarettes per day prior to pregnancy, women who smoked fewer than 10 cigarettes per day were much more likely to quit (OR = 4.2, 95% CI = 2.9,6.2). Women who reported smoking 10-19 cigarettes per day prior to their pregnancy were also more likely to quit (OR = 1.7, 95% CI = 1.2,2.3) than women who smoked 20 or more cigarettes. Other factors independently associated with quitting smoking during pregnancy were parity (women who did not have a previous live birth were more likely to quit), drinking (women who reported that they did not drink during the last three months of pregnancy were more likely to quit), and counseling from a health care worker about the dangers of smoking during pregnancy (women who did not have this counseling were more likely to quit) (Table 1, Column 3).

Selected pregnancy outcomes and maternal behaviors were compared between mothers who reported quitting smoking during pregnancy and those mothers who did not quit smoking during pregnancy (Table 2). Mothers who did not quit were nearly *two* times as likely to deliver a low birth weight (<2500 grams) baby. Although the difference was not statistically significant, mothers who did not quit were more likely to have a preterm delivery (12.2% compared to 10.6% of those who quit). Additionally, mothers who quit smoking were significantly more likely to initiate breastfeeding (63.1%), compared to those who did not quit (44.3%). Mothers who reported quitting were also slightly more likely to place their infant to sleep on their back, although the difference was not significant at the .05 level. As might be expected, infants of mothers who did not quit were more than five times as likely to be exposed to second hand smoke, compared to those whose mother quit smoking during their pregnancy. After adjusting for maternal characteristics (age, race, delivery paid by Medicaid, WIC benefits during pregnancy, and parity) via logistic regression, quit status remained significantly associated with low birth weight, breastfeeding initiation, and infant exposure to tobacco smoke.

**Table 1. Quit Rates During Pregnancy For Women Who Reported Smoking Before Pregnancy.
NC PRAMS, 1997-2001**

Variables	N	Percent Quitting	Adjusted OR (95%CI)
All Women	2072	45.3 (42.4,48.4)	
Maternal Age			
Under 20 Years	360	51.7 (44.7,58.7)	3.3 (1.8,6.2)
20-34 Years	1523	44.9 (41.5,48.3)	2.2 (1.3,3.5)
35+ Years	189	34.2 (24.2,34.2)	Referent
Maternal Race			
Other	469	49.6 (42.5,56.7)	1.1 (0.7,1.6)
White	1603	44.6 (41.3,47.9)	Referent
Maternal Education			
High School or Less	1503	40.1 (36.6,43.6)	Referent
More Than High School	568	59.1 (53.8,64.4)	1.9 (1.4,2.7)
Delivery Paid by Medicaid			
Yes	1331	39.7 (36.0,43.4)	Referent
No	738	55.2 (50.5,59.9)	1.6 (1.1,2.3)
Marital Status			
Not Married	911	41.3 (36.7,45.9)	Referent
Married	1161	48.6 (44.8,52.4)	1.3 (0.9,1.8)
WIC During Pregnancy			
Yes	1208	43.0 (39.2,46.8)	1.4 (1.0,2.1)
No	859	49.1 (44.6,53.8)	Referent
Stress			
High Stress	732	39.1 (34.1,44.1)	Referent
Low Stress	1331	43.4 (39.7,47.1)	1.3 (1.0,1.8)
Pre-Pregnancy Weight			
Obese	335	48.3 (40.7,55.9)	1.2 (0.8,1.7)
Not Obese	1730	44.9 (41.7,48.1)	Referent
Maternal Drinking During Last Three Months of Pregnancy			
Yes	103	31.5 (18.8,44.2)	Referent
No	1953	46.2 (43.2,49.6)	2.1 (1.0,4.1)
Multivitamin Use Before Pregnancy			
Not Every Day or Not At All	1764	44.2 (41.0,47.4)	Referent
Took Every Day	300	53.4 (45.7,61.1)	1.2 (0.8,1.9)
Physical Violence Before or During Pregnancy			
Yes	145	33.9 (22.9,44.9)	Referent
No	1875	46.5 (43.4,49.6)	1.2 (0.6,2.2)
Parity			
Second or Later Birth	1094	37.5 (33.5,41.5)	Referent
First Birth	963	54.4 (50.1,58.7)	1.9 (1.4,2.5)
Prenatal Care First Trimester			
No	511	40.8 (34.8,46.8)	Referent
Yes	1529	47.2 (43.8,50.6)	1.2 (0.9,1.7)
Health Care Worker Discuss the Dangers of Smoking During Prenatal Visits			
No	172	62.6 (53.3,71.9)	2.2 (1.4,3.4)
Yes	1851	44.1 (41.0,47.2)	Referent
Cigarettes Per Day Before Pregnancy			
One to nine	455	71.0 (65.4,76.6)	4.2 (2.9,6.2)
Ten to nineteen	541	47.2 (41.4,53.0)	1.7 (1.2,2.3)
>= 20	1076	33.0 (29.1,36.9)	Referent

All estimates are weighted; N refers to the unweighted sample size. The sample excludes cases of women who did not smoke before pregnancy (5,608) and those with data missing on smoking before or during pregnancy (255). CI = confidence interval; OR = odds ratio. Statistically significant odds ratios are shown in bold print.

Table 2. Comparison of Mothers Who Smoked Before Pregnancy By Whether They Quit Smoking During Pregnancy For Selected Pregnancy Outcomes and Maternal Behaviors. NC PRAMS, 1997-2001

Variables	Percent for Women Who Quit	95% CI	Percent for Women Who Did Not Quit	95% CI
Low Infant Birth Weight (<2500 grams)	7.0	(4.2,9.8)	13.0*	(11.8,14.2)
Preterm Delivery	10.6	(8.5,12.7)	12.2	(10.3,14.1)
Initiated Breastfeeding	63.1	(58.7,67.5)	44.3*	(40.2,48.4)
Placed Infant to Sleep on Back	54.8	(50.3,59.3)	50.0	(45.9,54.1)
Infant Exposure to Tobacco Smoke	4.8	(2.8,6.8)	24.9*	(21.3,28.5)

All estimates are weighted; CI = confidence interval.

*Difference is significant at the p<.05 level

Discussion

Despite the well-documented health risks associated with cigarette smoking during pregnancy, approximately 14 percent of pregnant women reported cigarette smoking during their third trimester. This is well above the *Healthy People 2010* objective to reduce the prevalence of tobacco use during pregnancy to two percent.¹⁹ Our findings identify the sociodemographic groups who are at higher risk to continue smoking during pregnancy. This study shows that women who are less educated, poor, older, drink during their third trimester, and have had a previous live birth are less likely to quit. The more cigarettes a woman smokes before pregnancy, the less likely she is to quit during pregnancy.

Reducing the prevalence of tobacco use during pregnancy is a national *Healthy People 2010* objective and should be a high priority of North Carolina public health programs. Due to the high postpartum relapse rates of women in this study (nearly 50%), smoking cessation during pregnancy may be more of an effort to protect the unborn child rather than an intention to quit for the long term. Because of the increased contact between the pregnant mother and health care providers during pregnancy, it is important for doctors and other medical providers to stress the importance of quitting permanently for the health of the mother and for the health of the child after birth. Less than four percent of all mothers surveyed by PRAMS who smoked before pregnancy reported receiving classes on how to stop smoking during their pregnancy – evidence that these women are not receiving the kind of help they might need

to stop smoking. Our findings can help medical providers and policy makers understand the factors related to smoking cessation and can aid in the design and implementation of effective, long-term interventions for pregnant women.

More than 90 percent of the PRAMS respondents who smoked before pregnancy reported that a health care worker did discuss with them during prenatal visits the dangers of smoking during pregnancy. A curious finding of this study was that the women who reported that they did *not* have a health care worker discuss the dangers with them had a significantly higher rate of quitting smoking during pregnancy (both the unadjusted and adjusted results). This is a small group of women (172 survey respondents) who may have very select characteristics. Some of these women may have not received counseling during prenatal visits because they had already quit smoking early in pregnancy. The PRAMS data show that, among the women who smoked before pregnancy, 52 percent of the women who did receive counseling smoked more than 20 cigarettes a day before pregnancy, compared to 44 percent of the women who did not receive counseling. Thus, because of their previous smoking history, the women who did receive counseling would have a harder time quitting during pregnancy.

Our study is in agreement with the previous studies that found that mothers who do not quit smoking cigarettes are significantly more likely to deliver a low birth weight infant. Low birth weight is a factor in nearly 65 percent of infant deaths.^{20,21} Mothers who quit are also more

likely to engage in other healthy behaviors such as breastfeeding and placing their infant to sleep on his/her back.

The PRAMS smoking intensity data, along with the high rate of quitting, show that expectant mothers are aware of the dangers of smoking. Almost all smokers in this study who continued to smoke during pregnancy reduced the amount of cigarettes smoked by approximately one-half. Moreover, more than 70 percent of mothers who smoked 1-9 cigarettes per day before pregnancy quit during pregnancy. Substantial reductions in smoking were also observed among those who smoked 10-19, 20-29, 30-39, and more than 40 cigarettes per day before pregnancy, with these groups having quit rates of 55, 38, 30, and 31 percent, respectively. Mothers seem to be receiving the message about the hazards of smoking during pregnancy, but many are not able to quit completely. Thus, pregnancy presents a window of opportunity for public health and health care professionals to increase smoking cessation efforts.

The results for WIC are interesting, though the differences are not quite statistically significant. The unadjusted results in Table 1 show that women who received WIC services during pregnancy had a lower quit rate during pregnancy than women who did not receive WIC. This may reflect the lower socioeconomic status of the women in the WIC program. However, after statistical adjustment for education, income, and the other factors shown in Table 1, the women receiving WIC had higher odds of quitting smoking during pregnancy than the women not receiving WIC (adjusted odds ratio = 1.4). This suggests that counseling and other services received during WIC visits may reduce smoking during pregnancy.

Limitations of this study should be taken into account when viewing the findings. This study is based on retrospective, self-reporting of cigarette smoking by women through a mail or telephone interview and we cannot verify the accuracy of the information. Survey responses concerning sensitive topics, such as tobacco use, are prone to various forms of recall and response bias which may lead to underestimation of the true percentage of cigarette smoking among pregnant women. Also, the PRAMS survey is limited to pregnancies that resulted in live-born infants; the results cannot be generalized to

women whose pregnancies resulted in outcomes other than a live birth. Finally, we do not have data on two important variables that may affect smoking cessation during pregnancy: family support regarding quitting and partner smoking habits. Even with these limitations, the results of this study can help inform programs and policies designed to reduce smoking during pregnancy.

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