
The Effect of Smoking Cessation During Pregnancy on Preterm Delivery and Low Birthweight

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Background. Evidence exists that maternal cigarette smoking is associated with preterm birth. Our purpose was to investigate the relation between maternal smoking cessation at different points during pregnancy and the preterm delivery rate and low birthweight.

Methods. Data from the 1988 National Health Interview Survey were analyzed. The study included women who gave birth to children within 6 years of the 1988 interview date (N = 4876). Preterm delivery and infant low birthweight were the main outcome measures. These measures were compared with maternal smoking status during pregnancy. Logistic regression models were computed to control for maternal age at the time of birth, parity, race, and total family income.

Results. Women who did not smoke cigarettes during pregnancy were less likely to give birth prematurely

(5.9% vs 8.2%, $P = .003$) or give birth to a low-birthweight baby (5.5% vs 8.9%, $P < .001$) than women who smoked at some time during the year before giving birth. A significant association existed between maternal smoking status and both preterm delivery and low birthweight. Compared with those who smoked beyond the first trimester, those who quit smoking within the first trimester had reductions in the proportion of preterm deliveries (6.7% vs 9.1%) and low birthweight infants (7.9% vs 9.6%).

Conclusions. Low birthweight and preterm delivery are reduced in women who stop smoking in the first trimester of pregnancy.

Key words. Smoking cessation; birthweight; infant, low birthweight; infant, premature. (*J Fam Pract* 1994; 38:262-266)

The disproportionate morbidity and mortality of low birthweight infants¹ makes reduction of preterm delivery an important goal.^{2,3} Neonatal mortality resulting from low birthweight has declined, but this can be attributed primarily to advances in the care and treatment of the complications of prematurity. Little progress has been made toward preventing preterm birth.⁴

Strategies for preterm birth prevention have focused on two major areas: (1) early detection of preterm labor and prompt institution of tocolytic therapy, and (2)

identification and modification of maternal risk factors associated with preterm birth. In spite of these strategies, preterm prevention programs have yielded disappointing results.⁵ In most cases, educational and home-uterine monitoring programs have increased the incidence in which preterm labor is diagnosed but have not reduced the incidence of preterm birth.⁵⁻⁷ Additionally, once preterm labor has been diagnosed, tocolytic agents are limited in their effectiveness in delaying birth.^{8,9}

For these reasons, identification and reduction of preterm delivery risk factors have become even more important. Modifiable risk factors for preterm delivery include cigarette smoking,¹⁰⁻¹² illicit drug use,¹² bacterial vaginal colonization or cervicitis,¹³ antepartum vaginal bleeding,¹⁴ and poor weight gain.¹⁵ Evidence that maternal cigarette smoking is associated with preterm birth has prompted the call for smoking cessation programs during pregnancy.^{10,16,17} Since about 25% of all women smoke during pregnancy,¹⁸ the potential impact

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of smoking cessation during pregnancy on preterm birth and low birthweight may be substantial.^{10,19}

Although it is appealing to believe that elimination of a risk factor during early pregnancy will produce a more favorable outcome, there are few data to indicate that this is true for maternal smoking cessation. In a trial of maternal smoking reduction and cessation among primarily black (69%) inner-city women, smoking reduction and cessation were associated with a decline in preterm delivery and low birthweight,²⁰ but it is unclear whether smoking cessation will have the same effect in a more representative population. Additionally, the influence of gestational age at which smoking cessation occurs on preterm delivery or low birthweight is still unknown.

This study was undertaken to investigate the relation between the rate of preterm delivery and low birthweight and maternal smoking cessation at different points during pregnancy. Its objectives were to determine whether smoking cessation during pregnancy is associated with a reduction in preterm deliveries and low birthweight infants; to assess the magnitude of this effect; and to find the point during pregnancy at which maternal smoking cessation is most effective.

Methods

The data used in this study were obtained from the 1988 National Health Interview Survey (NHIS),²¹ an annual personal interview household survey using a nationwide sample of the civilian, noninstitutionalized population of the United States. The NHIS, which has been in existence since 1957, uses a multistage probability sampling design. All information collected in the survey is reported by responsible family members residing in the household. When possible, all adult family members participate in the interview.

Because the present research focuses on maternal smoking habits and delivery characteristics, the sample is limited to data supplied by biological mothers of children younger than 6 years of age. This criterion for participation should limit respondents' recall error.

Preterm delivery is defined as delivery occurring 4 or more weeks earlier than expected (36 or fewer weeks' gestation). For women who reported that the birth was earlier than expected but could not name the number of weeks ($n = 27$), the question was cross-referenced with one regarding the number of months pregnant the woman was when the child was born. For women who reported that the birth was earlier than expected but could not name the number of weeks, those who stated that the birth was at 8 months or less were considered preterm.

Because of the possible connection between mater-

nal cigarette smoking and both preterm delivery and low birthweight, the relation between maternal cigarette smoking cessation and infant birthweight was examined. Low birthweight is defined as less than 2500 g at birth.^{22,23}

To classify cigarette smoking behavior, several categorizations were used. A nonsmoker was defined as a woman who did not smoke cigarettes at all during the year before her child was born. Smokers were subdivided into two categories: (1) those who stopped smoking during the first trimester of pregnancy, and (2) those who continued smoking cigarettes beyond the first trimester of pregnancy.

This differentiation of smoking status was used to examine the impact of possible early intervention. Although the National Health Interview Survey categorizes smoking cessation later than the first trimester, there is no indication of the time before delivery at which smoking was discontinued (eg, during the second trimester or 2 weeks before giving birth). Because of the uncertainty of time inherent in this categorization and because only 2.5% of the respondents were in this category, these mothers were combined with mothers who reported smoking during the entire pregnancy.

Chi-square analyses were computed for the relations between smoking status and both preterm delivery and low birthweight. To examine each association as a possible trend, Kendall's tau B was computed. Chi-square and t tests were computed to compare the demographic characteristics of smokers and nonsmokers. Multiple logistic regressions were computed to determine the relation between smoking status and both preterm delivery and low birthweight, controlling for the potential confounding variables of race, parity, total family income, and mother's age at the time of birth.²⁴⁻²⁶ Mother's age and total family income were entered as continuous variables. These four variables were the only possible confounding variables suggested by the literature available in the 1988 NHIS. Because smoking status contained three categories, it was entered as a dummy variable with nonsmokers as the reference category. Thus, effects and odds ratios for the remaining categories were computed in comparison with nonsmokers. All analyses were computed with SPSS PC+ software. Responses of "don't know," a refusal, or no answer were eliminated from the analysis.

Results

Demographic characteristics of respondents were as follows: the age of the mothers ranged from 13 to 46 years with a mean age of 25.7 years ($SD = 5.3$), 76% resided

Table. Demographic Characteristics of Participants in a Study of Women Who Smoked and Did Not Smoke During Pregnancy

Characteristic	Smokers (n = 1487)	Nonsmokers (n = 3279)	P
Mother's age at birth (mean years)	24.8	26.1	<.001
Rural/urban residence (% in MSA)	75.9	75.4	.72
Family income less than \$20,000, %	48.1	33.8	<.001
Firstborn child, %	57.8	56.0	.27
Male, %	50.1	51.4	.42
White, %	83.6	80.4	.01
Child's age at time of survey (mean years)	2.3	2.3	.21

MSA denotes metropolitan statistical area.

in a metropolitan statistical area (urban), and 62% had an annual total family income of \$20,000 or more. Fifty-six percent of the sample children were first children, the mean age of the children was 2.3 years (SD = 1.8), 51% were male, and 81% were white. Smoking status of the responding mothers indicated that 1487 (30.5%) smoked during the year before the birth of their child, 3279 (67.2%) did not smoke, and 110 (2.3%) did not know, refused the question, or did not answer. The final group was not included in the analyses.

Among women who smoked during the pregnancy (n = 1487), 549 stopped smoking within the first trimester of pregnancy, and 928 continued smoking beyond the first trimester. Ten women who admitted to smoking cigarettes during the year before giving birth did not supply a response when asked if they continued to smoke during the entire pregnancy or quit during the first 3 months or later, and thus were excluded from analyses employing maternal smoking status. Demographic characteristics of mothers who smoked during the year before their children were born and those who did not are shown in the table.

Of 4766 sample children (one per respondent), 305 (6.4%) were preterm deliveries. Respondents who did not smoke cigarettes during the year before giving birth were less likely to give birth prematurely than those who smoked at some time during the year before the birth of their children (5.9% vs 8.2%, $P = .003$). Figure 1 indicates that a significant relation existed between smoking during pregnancy and the likelihood of preterm deliveries. The likelihood of preterm delivery was significantly associated with the length of time the mother smoked during pregnancy (χ^2 , $P < .005$; Kendall's tau B = .05, $P < .001$). The relation between smoking status and preterm delivery was examined in a logistic regression controlling for potential confounding variables. The odds ratio for a preterm delivery for those smoking

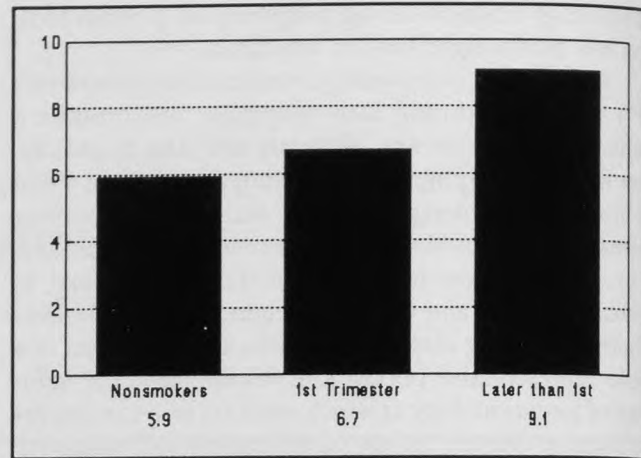


Figure 1. Percentage of preterm deliveries in mothers who were nonsmokers, mothers who stopped smoking during the first trimester of pregnancy, and mothers who smoked beyond the first trimester.

beyond the first trimester compared with nonsmokers was 1.59 (95% CI, 1.18 to 2.13). The odds ratio for a preterm delivery for those who discontinued smoking in the first trimester compared with nonsmokers was 0.95 (95% CI, 0.62 to 1.45).

Among women who smoked at some time during the year before the birth of their children, 8.9% gave birth to infants weighing less than 2500 g, whereas only 5.5% of the children of the nonsmokers weighed less than 2500 g ($P < .001$). A significant relation existed between smoking during pregnancy and the likelihood of low birthweight (Figure 2). As with preterm birth, the likelihood of giving birth to a low birthweight infant was associated with the length of

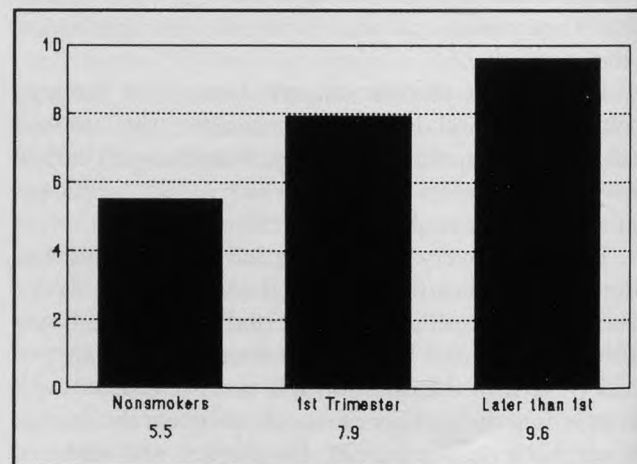


Figure 2. Percentage of low-birthweight infants (<2500 g) born to mothers who were nonsmokers, mothers who stopped smoking during the first trimester, and those who smoked for a longer period during pregnancy.

time the mother smoked during pregnancy (χ^2 , $P < .001$; Kendall's tau B = .07, $P < .001$). A logistic regression examining the relation between smoking status and low birthweight delivery controlling for potential confounding variables yielded a significant relation between smoking status and low birthweight. The odds ratio for a low birthweight infant for mothers smoking later than the first trimester compared with nonsmokers was 1.82 (95% CI, 1.36 to 2.45). The odds ratio for a low birthweight infant for mothers who quit smoking in the first trimester compared with nonsmokers was 1.53 (95% CI, 1.05 to 2.23).

Discussion

Identification of potential risk factors and interventions to change these factors have been advocated as a means to reduce preterm birth.^{10,20} However, few data have been generated to demonstrate the clinical effectiveness of this approach. Recent evidence that an intervention to correct a known risk factor has failed to improve maternal obstetric outcomes²⁷ underscores the importance of empiric testing of the effects of interventions before widespread recommendations are made.

This study serves as evidence that early intervention to help pregnant women quit smoking might improve outcomes. However, although women who were able to quit smoking early in pregnancy showed improved outcomes, they were more likely than women who did not smoke within a year of birth to have low birthweight infants. These results confirm those of a British study, which concluded that smoking cessation occurring early in pregnancy has the most beneficial effect on birthweight and gestational age.²⁸ Given the family physician's access to women before conception as well as during prenatal care, it may be particularly advantageous for these clinicians to stress smoking cessation in preconception planning.

Based on the data in this study, smoking cessation in the first trimester results in an 18% reduction in low birthweight infants (less than 2500 g) as compared with the infants of mothers who smoke later in pregnancy. If the national smoking rate during pregnancy is similar to the 1988 NHIS rate of 30%, more than 1.25 million women are at increased risk for preterm delivery related to cigarette smoking.²⁹ If 50% of all pregnant women smokers stop smoking in the first trimester of pregnancy, the overall low-birthweight incidence may drop by nearly 10,000 per year, a saving of almost \$600 million per year for the care of low-birthweight infants.³⁰

While these data should encourage smoking cessation early in pregnancy, some limitations to the general-

izability of these findings should be considered. The data are self-reports. Respondents were asked to remember their smoking behavior and the infant's gestational age and birthweight. Although to minimize recall error, respondents were included only if the birth of the child occurred within the past 6 years, some recall error could be present. Previous studies suggest, however, that retrospective data regarding cigarette use are highly reliable, even if obtained from a family member.³¹

Additionally, this study focused on the effect of maternal cigarette smoking and smoking cessation on preterm birth and low birthweight without controlling for other risk factors of preterm delivery. Although there are many advantages to analyzing large data sets such as the NHIS for sheer size and representativeness, this investigation was limited to information supplied in the data set. Consequently, several variables that might have been useful to examine as possible confounders (eg, number of cigarettes smoked and history of preterm births) were not available for study.

Because the purpose of this study was to examine the effect of reduction of maternal cigarette smoking, a known risk factor, on the likelihood of preterm delivery, rather than to determine the relative effect of a variety of factors on preterm delivery, the data used in this study could be misleading. If patients who quit smoking early in pregnancy also changed other behaviors that placed them at high risk for preterm delivery, then the effects of smoking cessation on reducing preterm birth may be overestimated by this study. Prospective studies of risk-factor modification would be useful in sorting out the independent effects of smoking cessation from other risk-factor interventions.

Conclusions

This study showed that discontinuing smoking in the first trimester of pregnancy reduced the incidence of preterm deliveries by 26% and low-birthweight infants by 18%. Nevertheless, since smoking at any time during pregnancy increased morbidity, women who are contemplating pregnancy should be advised to stop smoking before becoming pregnant.

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