Trends in Pregnancy-Related Smoking Rates in the United States, 1987-1996

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Context Rates of smoking are increasing among adolescents and young adults, but trends in smoking among pregnant women have not been studied.

Objective To assess pregnancy-related variations in smoking behaviors and their determinants among women of childbearing age in the United States.

Design Analysis of data collected between 1987-1996 from the Behavioral Risk Factor Surveillance System survey.

Setting and Subjects A total of 187 302 (178 499 nonpregnant and 8803 pregnant) noninstitutionalized women aged 18 to 44 years from 33 states.

Main Outcome Measures Prevalence rates of smoking initiation and current smoking, median number of cigarettes smoked, and adjusted odds ratios for smoking stratified by pregnancy status; prevalence rate ratio for current smoking comparing pregnant with nonpregnant women.

Results The overall percentage of women who had ever initiated smoking decreased significantly from 44.1% in 1987 to 38.2% in 1996. During that 10-year period, the prevalence of current smoking also decreased significantly among both pregnant women (16.3% to 11.8%) and nonpregnant women (26.7% to 23.6%). Overall, pregnant women were about half (54%) as likely as nonpregnant women to be current smokers during 1987-1996. Over time, the median number of cigarettes smoked per day by pregnant smokers remained at 10, whereas among nonpregnant smokers it decreased from 19 to 15 ($P<.05$ for trend). In the same period, among young women (aged 18-20 years), prevalence rates of smoking initiation and current smoking increased slightly. Sociodemographic subgroups of women at increased risk for current smoking were the same for pregnant and nonpregnant women (ie, those with a completed high school education or less, whites, and those who were unmarried).

Conclusions In this analysis, the decline in smoking over time among pregnant women was primarily due to the overall decline in smoking initiation rates among women of childbearing age, not to an increased rate of smoking cessation related to pregnancy. To foster effective perinatal tobacco control, efforts are needed to further reduce the number of young women who begin smoking. Clinicians should query all pregnant women and women of childbearing age about smoking and provide cessation and relapse interventions to each smoker.

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THE ADDITION OF SMOKING TO the list of nationally notifiable health conditions in 1996 recognized the role of tobacco use as the leading preventable cause of death in the United States.[1,2] For several reasons, the public health implications of smoking are potentially compounded for women. Tobacco is associated with many adverse reproductive health effects in women, including adverse effects on pregnancy.[3,4] Exposure to tobacco during the prenatal period and to environmental tobacco smoke during the postnatal period are leading causes of mortality and morbidity, including problem behaviors, among children.[4-6]

Most women who quit smoking during pregnancy do so on their own.[3,7] Nevertheless, most smokers do not quit smoking during their pregnancy.[3,7] Prenatal smoking cessation programs have been shown to increase quitting rates; however, postpartum relapse rates are very high.[7-9] Although the prevalence of smoking in the United States has declined since the 1980s, it has increased among adolescents and young adults.[2,10-12] Therefore, it is not known whether progress has been made toward achieving the desired reduction in the national prevalence of smoking by year 2000 among pregnant women and women of childbearing age.[13]

To assess recent temporal trends in pregnancy-related differences in the prevalence of smoking, we compared smoking behaviors of pregnant women with those of nonpregnant women of reproductive age. This report is based on Behavioral Risk Factor Surveillance System (BRFSS)[14] data from 33 states that collected information on smoking each year from 1987 through 1996. These states represent all of the major US geographical regions and contain about three fourths of the US population.[15]

METHODS

Data

The BRFSS[14] is an ongoing, state-representative telephone survey that gathers information about modifiable

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risk behaviors related primarily to chronic diseases. Designed to produce risk factor estimates for the noninstitutionalized civilian population aged 18 years or older, it provides baseline data for setting national health promotion and disease prevention objectives.[13] The sampling weights used in the BRFSS are based on the probability of selection and adjusted for nonresponses and disproportionate sampling of subgroups relative to the state's population. The median response rate to the survey (ratio of completed interviews to the sum of completed interviews and refusals) during the study period varied between 80% and 85%.

In this analysis, *ever smokers* (smoking initiation) were defined as those who responded "yes" to the opening question on smoking: "Have you smoked at least 100 cigarettes in your entire life?" *Current smokers* were defined as ever smokers who responded "yes" to the question "Do you smoke cigarettes now?" (which was asked each year from 1987 to 1995) or who responded "everyday" or "some days" to the question "Do you smoke cigarettes every day, some days, or not at all?" (which was asked during 1996). The median number of cigarettes currently smoked was calculated from participants' responses to the question "On the average, how many cigarettes a day do you smoke?" Women who were classified as having quit[16] smoking were those who had initiated smoking but were not current smokers. As an indirect measure of motivation to quit smoking,[16] we obtained the percentage of current smokers who had attempted to quit[16] smoking, which was based on participants' response to the question "During the past 12 months, have you quit smoking for 1 day or longer?" asked from 1992 on. *Heavy smoking* was defined as smoking 20 or more cigarettes per day. A question on pregnancy status ("To your knowledge, are you now pregnant?") was asked after all questions on smoking and alcohol use.

Analyses

We aggregated the weighted state-specific data from women aged 18 to 44 years from the 33 states selected for this analysis. From the total sample, we obtained the percentages of women who reported ever smoking (smoking initiation rate), were current smokers, and had quit smoking. We used 3 measures to assess annual differences in current smoking behaviors between pregnant women and nonpregnant women: the prevalence rate ratio (PRR), the median number of cigarettes smoked by current smokers, and the adjusted odds ratio; we used the latter measure to identify sociodemographic subgroups of women at differential risk for smoking. In the absence of information on each woman's smoking habits before and after planning or recognizing a pregnancy, the PRR provides an indirect measure of the magnitude of the reduction in smoking prevalence after women recognize they are pregnant (pregnancy-related reduction). A PRR close to zero indicates the greatest pregnancy-related reduction in smoking.

The overall rates of smoking initiation, current smoking, and quitting were age-adjusted to the age distribution of pregnant women in 1987 (TABLE 1). To examine variations in current smoking among sociodemographic subgroups and time trends in current smoking within those subgroups, we conducted analyses stratified by age, education, race, marital status, and employment status. Using these variables as independent variables, we created multiple logistic regression models to calculate adjusted odds ratios for current smoking separately for pregnant and nonpregnant women. Although a given odds ratio may overstate the strength of an association compared with the corresponding PRR, it is a valid measure for identifying sociodemographic subgroups at low or high risk for smoking. We used SUDAAN[17] to obtain valid estimates of SEs. We created weighted least squares linear regression models (using the inverse of the variance estimates for weights) to determine the statistical significance of trends over time. A *P* value less than .05 was considered statistically significant for all analyses. Because most outcome measures showed

Table 1. Characteristics of Women Aged 18 to 44 Years in the Behavioral Risk Factor Surveillance System, 33 States, 1987-1996

	Pregnant Women, % (No.)*		Nonpregnant Women, % (No.)*	
Characteristics	1987 (n = 712)	1996 (n = 980)	1987 (n = 14 563)	1996 (n = 21 604)
Age range, y				
18-20	13 (66)	12 (81)	11 (996)	10 (1416)
21-30	58 (456)	54 (541)	40 (5567)	35 (7168)
31-44	29 (190)	35 (358)	49 (8000)	55 (13 020)
Race				
White	70 (564)	66 (727)	77 (11 854)	69 (16 305)
Nonwhite	30 (147)	34 (253)	23 (2676)	31 (5260)
Marital status				
Married	80 (581)	74 (739)	58 (8356)	56 (11 419)
Not married	20 (131)	26 (241)	42 (6198)	45 (10 185)
Education				
Less than high school	13 (59)	15 (91)	11 (1315)	10 (1657)
High school graduate	40 (286)	29 (267)	35 (5330)	30 (6533)
More than high school	48 (367)	57 (620)	54 (7914)	60 (13 400)
Employment status				
Employed	55 (432)	59 (592)	68 (10 307)	68 (15 034)
Not employed	45 (277)	41 (360)	32 (4239)	32 (5787)

*Because sampling weights are calculated based on the probability of selection and adjusted for nonresponse and disproportionate sampling relative to each state's population, distribution of the weighted sample by sociodemographic variables (shown in percentages) varies from that of actual number of respondents (in parentheses). Percentages may not add up to 100 in each category because of rounding.

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either a linear relationship with calendar year or no significant secular variation, the results of the stratified analyses are reported only for the beginning and ending years.

RESULTS

Study Sample

Of the 188 541 women aged 18 to 44 years who responded to the survey during the 10-year period, we excluded 793 (4.2%) who were not sure of their pregnancy status and 446 (2.4%) who chose not to answer the question on pregnancy. Between 1987 and 1996, the actual number of respondents increased from 712 (weighted estimate, 1.7 million) to 980 (weighted estimate, 1.7 million) among pregnant women and from 14 563 (weighted estimate, 32.1 million) to 21 604 (weighted estimate, 35.7 million) among nonpregnant women. The percentage of women who reported that they were pregnant varied little over the study period (average weighted annual prevalence, 5%). The sociodemographic characteristics of the survey respondents (Table 1) are comparable with those of the population in the 33 states combined.[15]

Trends in Smoking Initiation, Quitting, and Current Smoking

Overall, the smoking initiation rate among women aged 18 to 44 years decreased significantly, from 44.1% in 1987 to 38.2% in 1996 (FIGURE 1). The largest decline in the smoking initiation rate occurred between 1987 and 1991 (Figure 1). However, among women aged 18 to 20 years, smoking initiation rates changed little between 1987 (26.1%) and 1996 (27.4%). There was no statistically significant difference in yearly smoking initiation rates between pregnant and nonpregnant women either in 1987 (41.7% vs 42.3%) or 1996 (36.4% vs 37.6%).

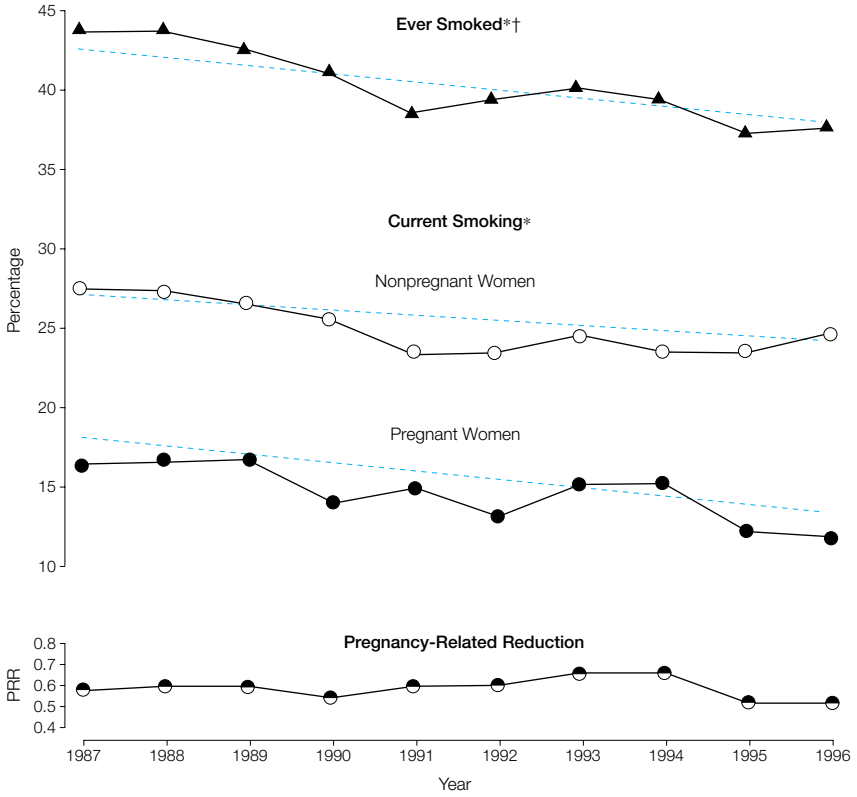
In the total sample, the percentage who had quit smoking changed little between 1987 and 1996 among both pregnant women (from 26.3% to 25.2%) and nonpregnant women (from 16.3% to 14.4%). Also, BRFSS data from 1992 through 1996 indicated that the percentage of currently smoking women of childbearing age who had attempted to quit smoking for at least 1 day in the past year actually declined significantly, from 57.8% to 50.3%.

Over time, the percentage of current smokers decreased significantly among both pregnant and nonpregnant women (Figure 1, TABLE 2). However, in each year, pregnant women were about half as likely as nonpregnant women to be current smokers, and the variation in the PRR over time was not statistically significant (average annual PRR, 0.54) (Figure 1, Table 2). Data available from BRFSS for 1994-1996 indicate that pregnant women who smoked were significantly more likely to be daily smokers than their nonpregnant counterparts (88.9% vs 79.2%). Among pregnant women who were current smokers, there was no statistically significant variation in the median number of cigarettes smoked per day during the 10-year period (average annual median number, 10), whereas among nonpregnant women, the median number of cigarettes smoked per day decreased significantly, from 19 in 1987 to 15 in 1996 (FIGURE 2).

Subgroup Variations in Current Smoking

For both pregnant and nonpregnant women, the secular decline in the percentage of current smokers occurred largely among women who had smoked 1 or more packs of cigarettes per day (Table 2). This subgroup of women also had the largest pregnancy-related reduc-

Figure 1. Trends in Smoking Rates Among Women Aged 18 to 44 Years, United States, 1987-1996



Data are age-adjusted to the age distribution of pregnant women in 1987 using the following weights: 0.13 for ages 18 to 24 years; 0.58 for ages 25 to 34 years; and 0.29 for ages 35 to 44 years. The dashed lines represent fitted linear regression lines. Asterisks indicate $P<.05$ for linear trend; dagger, percentage of women who ever smoked at least 100 cigarettes; and PRR, prevalence rate ratio (pregnant to nonpregnant women).

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tion in smoking each year (indicated by the lowest PRR value of 0.3 in 1996).

Among both pregnant and nonpregnant women, the percentage of current smokers decreased between 1987 and 1996 within most sociodemographic subgroups studied, except for the youngest women and oldest pregnant women, among whom it increased slightly (Table 2). Among the subgroups of women in which current smoking rates decreased, the decrease was not significant among pregnant women who were married or were high school graduates or among nonpregnant women who had higher education or were white, unmarried, or unemployed (Table 2).

Smoking prevalence rates varied widely in 1987 among the sociodemographic subgroups studied (range, 9.4%-34.1% for pregnant and 20.0%-43.4% for nonpregnant), as did the PRRs (range, 0.4-1.2) (Table 2). By 1996, the variations in the PRRs had narrowed (range, 0.3-0.7), particularly among the subgroups that had the highest smoking prevalence rates in 1987, indicating that these subgroups had greater pregnancy-related reductions over time (Table 2).

Factors that were independently associated with a high risk for current smoking each calendar year were the same for pregnant and nonpregnant women, namely, having a high school education or less, being white, and being unmarried (TABLE 3). Among pregnant women, the variation between the odds of smoking in 1987 and the odds of smoking in 1996 was significant only within the 21- to 30-year-old age group, in which it decreased (Table 3). Among nonpregnant women, the odds of smoking increased significantly between 1987 and 1996 among white women and women who were unmarried (Table 3).

Table 2. Prevalence Rates and Prevalence Rate Ratios for Current Smoking Among Women Aged 18 to 44 Years by Pregnancy Status, United States, 1987-1996

	Prevalence Rate, %				Prevalence Rate Ratio (95% CI)*	
	Pregnant Women		Nonpregnant Women			
Characteristics	1987 (n = 712)	1996 (n = 980)	1987 (n = 14 563)	1996 (n = 21 604)	1987	1996
Total sample†‡	16.3	11.8§	26.7	23.6§	0.6 (0.5-0.7)	0.5 (0.4-0.6)
No. of cigarettes/d						
1-9	4.9	4.4	5.4	6.7	1.2 (0.6-2.0)	0.5 (0.3-0.9)
10-19	5.9	5.3	7.8	8.4	0.7 (0.4-1.4)	0.5 (0.4-0.7)
≥20 (1 pack)	5.2	2.4§	13.5	8.7§	0.4 (0.2-0.5)	0.3 (0.2-0.4)
Sociodemographic Subgroups						
Age range, y‡						
18-20	13.4	15.3	20.0	23.4	0.7 (0.3-1.3)	0.7 (0.3-1.4)
21-30	18.5	9.0§	28.0	24.1§	0.7 (0.6-0.9)	0.4 (0.3-0.5)
31-44	10.2	12.1	27.1	24.3§	0.5 (0.3-0.9)	0.5 (0.3-0.8)
Education‡						
Less than high school	34.1	23.1§	43.4	36.4§	0.8 (0.5-1.4)	0.6 (0.4-1.0)
High school graduate	16.4	15.8	31.3	31.9	0.5 (0.4-0.7)	0.5 (0.3-0.8)
More than high school	9.4	5.0§	20.1	18.2	0.5 (0.3-0.7)	0.3 (0.2-0.4)
Race‡						
White	16.7	11.9§	27.6	27.3	0.6 (0.5-0.8)	0.4 (0.3-0.6)
Nonwhite	12.2	8.5§	23.1	17.1§	0.5 (0.3-0.9)	0.5 (0.3-0.8)
Marital status‡						
Married	10.3	8.3	25.3	20.0§	0.4 (0.3-0.6)	0.4 (0.3-0.6)
Not married	32.4	18.6§	29.1	39.5	1.1 (0.8-1.9)	0.6 (0.4-0.8)
Employment status‡						
Employed	13.2	8.6§	27.0	23.7§	0.5 (0.4-0.7)	0.4 (0.2-0.6)
Not employed	18.6	14.2§	25.7	24.7	0.7 (0.5-1.0)	0.6 (0.4-0.8)

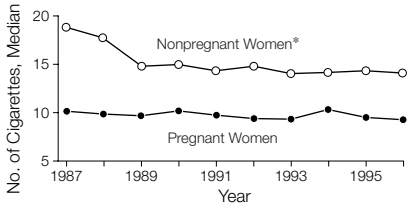
*Prevalence rate ratio is calculated as the percentage among pregnant women divided by the percentage among nonpregnant women. CI indicates confidence interval.
†Overall rates are age-adjusted to the age distribution of pregnant women in 1987 using the following weights: 0.13 for ages 18 to 24 years; 0.58 for ages 25-34 years; and 0.29 for ages 35-44 years.
‡Values for the total sample and the sociodemographic subgroups are for any number of cigarettes.
§$P<.05$ for linear trend over time. In other subgroups, the variation in prevalence rates over time was not statistically significant.

COMMENT

This analysis of population-based survey data indicates that the decline in rates of current smoking among pregnant women in the United States between 1987 and 1996 reflects a decline in smoking initiation among women of childbearing age rather than an increase in quitting rates related to pregnancy. Over time, pregnant women have continued to be about half as likely as nonpregnant women to smoke. Among pregnant women, we found no significant change during the 10-year study period in the median number of cigarettes smoked. Between 1987 and 1996, among young women, prevalence rates of smoking initiation and current smoking increased slightly.

Because this survey excluded people without telephones, those younger than 18 years, and those who did not live in private residences, and because we used self-reported information on pregnancy, these data may have underestimated the actual prevalence of smoking. Furthermore, because the survey produced point-prevalence data, they cannot be used to determine whether a

Figure 2. Trends in the Median Number of Cigarettes Smoked by Pregnant and Nonpregnant Women, United States, 1987-1996



Asterisk indicates $P<.05$ for linear trend.

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woman is truly a nonsmoker. Even women who had quit smoking for a day (on the day of the interview) may have been considered nonsmokers in this survey. However, point-prevalence estimates of current smoking reported by other studies for corresponding years are generally consistent with our findings.[18,19] Because the data were from a cross-sectional survey, we could not assess whether the substantial decline between 1987 and 1996 in the percentage of heavy smokers among both pregnant and nonpregnant women was due to heavy smokers stopping altogether, heavy smokers reducing the number of cigarettes they smoked, or fewer women who started smoking reaching a heavy level. Pregnant smokers were more likely to be daily smokers than their nonpregnant counterparts, probably because proportionately more of the less-than-daily smokers may have quit smoking when they learned they were pregnant.

For US women of reproductive age, the year 2000 national objective of a 12% prevalence rate of current smoking[13] is unlikely to be achieved given that the 1996 prevalence rate of current smoking is about twice that of the year 2000 target. For pregnant women, the 1996 rate is only 2% higher than the year 2000 objective of 10%[13]; however, because of the reported recent increases in smoking initiation among adolescents and young women[10-12] and no concurrent increase in quitting rates by current smokers shown in this analysis, the year 2000 objective for pregnant women is also unlikely to be met. Furthermore, most adult smokers in the United States become regular smokers before age 18 years,[10] and for such smokers quitting is difficult; only 2.5% of the 34% who attempt to quit smoking each year are successful in quitting permanently.[16] The fact that most smokers (54%) continue to smoke after they learn that they are pregnant underscores the need for more extensive efforts to reduce smoking by women over their entire lives and to reduce the number of women who begin smoking.

We found that the risk factors for smoking are similar for pregnant and nonpregnant women and that many such women are likely to rely on publicly funded health care providers for care. Clinicians who provide this care should extend the "ask, advise, assist, and arrange" strategy suggested in the clinical practice guidelines on smoking cessation[20,21] to each woman. Efforts to curb smoking during pregnancy should begin in the preconception period. Clinically proven prenatal smoking cessation interventions that can be delivered in primary care settings are now available.[20-24] "Minimal contact" primary care clinic-based smoking prevention interventions have been found to be effective.[24] Nicotine replacement products can improve the effectiveness of comprehensive behavioral interventions to reduce smoking.[25] For pregnant women, nicotine replacement products should be recommended only if the increased likelihood of smoking cessation outweighs the harmful effects of nicotine and potential concomitant smoking on the fetus.[20]

Pregnancy may represent a period when smoking cessation activities are most effective. If prenatal smoking cessation is not feasible, a reduction in the number of cigarettes smoked could benefit the pregnancy, including a reduction in risk of low birth weight.[8] To reduce postpartum relapses in smoking, interventions should continue beyond the perinatal period. Of note, in our study declines in smoking rates were not as pronounced among married pregnant women as they were among their unmarried counterparts. Because smokers may have partners whose smoking habits match their own, and because the presence of such a partner may negatively affect a woman's attempts to quit smoking,[26] screening for tobacco use should be extended to partners of women who smoke. For women who are unable to quit smoking and who are at risk of becoming pregnant, the feasibility of pregnancy postponement until smoking cessation is achieved should be explored.[27]

Although the importance of reducing tobacco use by current smokers is clear, the findings from our study, including the unchanging trends in current smoking rates among young women, and reports from England,[28]

Table 3. Multiple Logistic Regression Estimates of Odd Ratios Associated With Current Smoking Among Pregnant and Nonpregnant Women, United States, 1987-1996*

	Odds Ratio (95% CI)†			
	Pregnant Women		Nonpregnant Women	
Characteristics	1987 (n = 712)	1996 (n = 980)	1987 (n = 14 563)	1996 (n = 21 604)
Age range, y				
18-20	0.9 (0.4-2.1)	0.5 (0.2-1.0)	0.5 (0.4-0.6)	0.5 (0.4-0.7)
21-30	1.9 (1.1-3.2)	0.7 (0.5-1.1)‡	1.0 (0.9-1.2)	0.9 (0.8-1.0)
31-44	Reference	Reference	Reference	Reference
Education				
Less than high school	7.3 (3.7-14.5)	6.0 (3.5-10.4)	3.9 (3.2-4.8)	3.5 (3.0-4.2)
High school graduate	2.3 (1.4-3.8)	3.1 (2.0-4.9)	2.0 (1.7-2.3)	2.3 (2.1-2.6)
More than high school	Reference	Reference	Reference	Reference
Race				
White	2.8 (1.6-5.0)	2.9 (1.7-5.0)	1.8 (1.3-1.9)	2.4 (2.2-2.8)‡
Nonwhite	Reference	Reference	Reference	Reference
Marital status				
Married	Reference	Reference	Reference	Reference
Not married	3.9 (2.3-6.5)	2.8 (1.8-4.4)	1.5 (1.3-1.7)	2.2 (2.0-2.4)‡
Employment status				
Employed	Reference	Reference	Reference	Reference
Not employed	1.8 (0.5-2.3)	1.3 (0.9-2.0)	0.9 (0.8-1.0)	1.0 (0.9-1.1)

*Data are adjusted for age, race, education, marital status, and employment status.
†CI indicates confidence interval.
‡$P<.05$ for linear trend in odds ratios from 1987 through 1996 for each population subgroup. For other subgroups, the variations over time in odds ratios were not statistically significant.

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which showed that the prevalence of smoking among pregnant women remained unchanged between 1992 and 1999 (average annual prevalence, 28%), signify the need for multiple approaches to reduce smoking initiation. The appeal of smoking and access and exposure to tobacco can be reduced through a broad-based approach that includes restriction of tobacco advertising and the promotion of counteradvertising, as well as economic deterrents such as a higher tobacco excise tax, stronger enforcement of age-at-sale policies, and elimination of smoking in the home, workplace, and schools.[10,29-31] Our findings should alert other countries, especially developing nations in which tobacco marketing efforts and the prevalence of smoking are increasing,[32] about the complexities associated with combating the epidemic of tobacco addiction and the need to stem smoking initiation by young people.

Author Contributions: Dr Floyd and Mr Merritt suggested the analysis, were responsible for the reviews of legal and public health issues surrounding our findings, and made editorial suggestions. Dr Holtzman is the officer responsible for the BRFSS database and she contributed to the writing of the article. Dr Decoufle assisted in the analysis and writing. Dr Ebrahim was responsible for the overall design, analysis, and development of the article.

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