Brief Report

Smoking and Drinking During Pregnancy

Their Effects on Preterm Birth

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• **The effects of cigarette smoking and alcohol consumption on the length of gestation were examined in a prospective study of 30,596 pregnant women in northern California. Preterm births (<37 weeks' gestation) were 20% more common in women smoking at least one pack of cigarettes per day. This effect was strongest for births occurring before 33 weeks, where the excess was 60%. This excess was not accounted for by differences in maternal age, education, ethnicity, time prenatal care began, drinking during pregnancy, or eight other potential confounding factors. The results indicate a probable effect of smoking on the time of parturition, which is additional to its well-known effect on intrauterine growth retardation. The effect of alcohol consumption on preterm births was also examined, but no consistent trends were found.**

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NUMEROUS studies during the past 30 years have reported a reduction in birth weight of 150 to 250 g among the offspring of women who smoked during pregnancy.[1] There is general agreement that smoking is associated with reduced birth weight at all gestational ages, so that the effect of tobacco on birth weight has been thought to be due primarily to intrauterine growth retardation. This explanation is so widely accepted that studies of preterm delivery (<37 weeks' gestation) have specifically excluded smoking as a potential confounder.[2]

In 1969, Buncher[3] noted that smoking was associated with a one- to two-day shortening of gestation. A decrease in mean gestation might result from slight shifts in the timing of deliveries that occur at term or, of greater clinical significance, from an actual increase in preterm deliveries. An increased risk of early delivery among women who smoke has been described,[4-8] but these studies were limited by retrospective collection of data on smoking[8] and failure to adjust for potential confounders, particularly alcohol consumption.[4-8] The present report concerns the effect of smoking and alcohol use on preterm births in a large prospective study.

Methods

The women in this study were members of the Northern California Kaiser-Permanente Birth Defects Study, who had received prenatal care during the period 1974 through 1977 at any of the 13 Kaiser clinics serving northern California. A detailed description of the study has been published elsewhere.[9] As part of their routine prenatal care, women completed a self-administered questionnaire in English or Spanish on prior reproductive and medical history, use of tobacco and alcohol, contraceptive use, exposure to possible teratogens, and a variety of other questions. Clinic and medical records were abstracted for information on previous pregnancy outcomes and health during the present pregnancy. Pregnancy outcomes were ascertained from computerized records of Kaiser hospital admissions. The outcome or reasons for dropping out of the study were obtained for 99.6% of the women.

Gestational age was determined by subtracting the estimated date of conception from the date of delivery. The estimated date of conception was determined by the obstetrician at the woman's first visit to the prenatal clinic, which generally occurred after the woman missed at least two menstrual periods. The estimated date of delivery was based on the obstetrician's best clinical estimate as determined by the menstrual history, uterine size, and quickening.

Information on smoking and alcohol use was obtained from the self-administered questionnaire during the first prenatal visit. The women were asked, "During the first three months of this pregnancy . . . did you take any alcoholic beverages? If yes, did you average six or more drinks, three to five drinks, one to two drinks, or less than one drink a day?" Information on smoking during pregnancy was requested in a similar way; women were asked if they smoked two, one, or less than one pack a day.

Multiple linear logistic regression was used to estimate the adjusted odds ratios for preterm (<37 weeks) and very preterm (<33 weeks) births. Very preterm births were specifically analyzed because of their disproportionate contribution to perinatal mortality. Attributable risks were calculated using the method of Levin and Bertell.[10]

Results

A total of 36,504 women was initially recruited into the study. Criteria for exclusion were delivery at

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home (2%), delivery at a non-Kaiser hospital (1.2%), leaving the area (0.9%), induced abortion (0.8%), not pregnant (0.4%), placing the baby for adoption (0.2%), or unavailability for follow-up (0.4%). The 34,344 women who remained had 34,660 babies.

For these analyses, all women delivered of a live-born singleton infant of 24 or more weeks' gestational age and at least 500 g were eligible (n=31,682). Repeated study pregnancies by the same woman were excluded (n=1,086). After these exclusions, data on 30,596 women were retained for the analyses of preterm births. An additional exclusion was made for the analysis of very preterm births. Women who started prenatal care after 24 weeks' gestational age, who were, therefore, not at equal risk for a very preterm birth, were excluded (n=2,083).

The percentage of preterm births by smoking, and crude and adjusted odds ratios, are shown in Table 1. In our cohort, 14.6% smoked less than one pack per day and 13.3% smoked one or more packs per day. The prevalence of smoking was 38% among blacks, 30% among whites, 21% among Hispanics, and 10% among Asians. Although blacks had the highest prevalence of smoking, whites were more likely to smoke heavily (17% vs 10%). There was an inverse relationship between smoking and maternal age, and unmarried women were more likely than married women to smoke. Smoking and drinking were highly correlated; 80% of nondrinkers were nonsmokers, whereas 40% of heavy drinkers did not smoke.

The preterm birth rate among nonsmokers was 6.8%. Among women who smoked less than one and one or more packs a day, the rates were 8.4% and 8.1%, respectively. The corresponding unadjusted odds ratios were 1.2 ($P<.001$) for light and 1.2 ($P=.003$) for heavy smokers. Adjustment of the odds ratios for the 13 factors listed at the bottom of Table 1 resulted in a decrease in the odds ratio to 1.1 ($P=.05$) for light smokers and no change for heavy smokers. These data can be used to estimate the fraction of all cases of preterm births that might be caused by smoking, sometimes called the "attributable risk." This totals 4%, with 1% being due to light smoking and 3% to

Table 1.—Smoking During Pregnancy and Preterm Births

	Smoking, Packs/Day		
	None	<1	≥1
% Preterm*	6.8	8.4	8.1
Unadjusted odds ratio (95% CL†)	1.0	1.2 (1.1,1.4)	1.2 (1.1,1.4)
Adjusted‡ odds ratio (95% CL)	1.0	1.1 (0.9,1.2)	1.2 (1.1,1.4)
Attributable risk, % (95% CL)	. . .	1 (0,7)	3 (1,5)
% Very preterm§	1.6	2.1	2.4
Unadjusted odds ratio (95% CL)	1.0	1.3 (1.0,2.5)	1.6 (1.3,2.0)
Adjusted‡ odds ratio (95% CL)	1.0	1.1 (0.8,1.5)	1.6 (1.2,2.3)
Attributable risk, % (95% CL)	. . .	2 (0,7)	7 (1,13)

*Less than 37 weeks' gestational age.
†CL indicates confidence level.
‡Adjusted for maternal age, education, ethnicity, marital status, employment, pregnancy history (gravidity, number of induced and spontaneous abortions), sex of child, time prenatal care began, preeclampsia, major malformation of child, and alcohol.
§Less than 33 weeks' gestational age.

Table 2.—Odds Ratios* of Smoking During Pregnancy and Pregnancy Complications Leading to Preterm and Very Preterm Birth

	Smoking, Packs/Day (*P*)			
	Preterm Birth		Very Preterm Birth	
Pregnancy Complications	<1	≥1	<1	≥1
Premature rupture of membranes	1.3 (.06)	1.4 (.03)	1.5 (.13)	2.2 (.001)
Placenta previa	1.3 (.62)	2.5 (.01)	. . .†	5.6 (.001)
Abruptio placenta	1.6 (.08)	1.9 (.01)	1.1 (.80)	1.9 (.10)‡
Without premature rupture, placenta previa, or abruptio placenta	1.2 (.002)	1.1 (.08)	1.3 (.26)	1.4 (.24)§

*Odds ratios compare preterm or very preterm birth with stated complication and uncomplicated term delivery.
†Numbers too small for reliable estimate.
‡*P* for trend =.12.
§*P* for trend =.05.

Table 3.—Drinking During Pregnancy and Preterm Births

	Drinking, Drinks/Day		
	None	<1	≥1
% Preterm*	7.8	6.3	10.6
Unadjusted odds ratio (95% CL†)	1.0	0.8 (0.7,0.9)	1.4 (1.1,1.8)
Adjusted‡ odds ratio (95% CL)	1.0	0.9 (0.8,1.0)	1.3 (1.0,1.7)
Attributable risk, % (95% CL)	. . .	. . .	1 (0,3)
% Very preterm§	2.0	1.4	2.3
Unadjusted odds ratio (95% CL)	1.0	0.7 (0.6,0.9)	1.1 (0.6,1.8)
Adjusted‡ odds ratio (95% CL)	1.0	0.7 (0.6,1.0)	1.2 (0.6,2.2)
Attributable risk, % (95% CL)	. . .	. . .	1 (0,4)

*Less than 37 weeks' gestational age.
†CL indicates confidence level.
‡Adjusted for maternal age, education, ethnicity, marital status, employment, pregnancy history (gravidity, number of induced and spontaneous abortions), sex of child, time prenatal care began, preeclampsia, major malformation of child, and smoking
§Less than 33 weeks' gestational age.

heavy smoking.

There was evidence that this overall, modest effect was focused mainly on the very preterm births (Table 1). The percentage of very preterm births was 1.6% among nonsmokers, 2.1% among light smokers, and 2.4% among heavy smokers. The unadjusted odds ratios for light and heavy smokers were 1.3 (P=.04) and 1.6 (P=.001), respectively. Adjustment for 13 factors resulted in a lower odds ratio for light smokers (1.1; P=.38) and an unchanged odds ratio for heavy smokers (1.6; P=.05). The attributable risk for very preterm births totaled 9%, with 2% for light and 7% for heavy smoking. The effect of smoking on moderately preterm birth (33 to 36 weeks' gestation) was small and not statistically significant.

To determine whether smoking acted through recognized causes of preterm or very preterm birth, the effect of smoking on premature rupture of membranes, placenta previa, and abruptio placenta was analyzed. Smoking among women with preterm or very preterm delivery precipitated by premature rupture of membranes, placenta previa, or abruptio placenta was compared with smoking among women who had term infants without any of these complications (Table 2). Smoking was associated with premature rupture of membranes as well as with placental complications. However, the increased risk of preterm or very preterm births was not totally explained by these pregnancy complications. The odds of a preterm or very preterm birth were still increased even when premature rupture of membranes, placenta previa, and abruptio placenta were excluded from the population.

Analyses were also done for the effects of light and heavy alcohol drinking during pregnancy (Table 3). Light drinkers (<1 drink per day) constituted 44.2% of the women, and heavy drinkers (≥1 drink per day) 2.9%. An unadjusted odds ratio for preterm births of 1.4 (P=.003) and adjusted odds ratio of 1.3 (P=.08) was seen for heavy drinkers. Among very preterm births, the crude and adjusted odds ratios for heavy drinking were 1.1 and 1.2, respectively, and were not statistically significant. No increase in the odds ratios was observed for light drinking. There was no statistically significant interaction between alcohol and smoking.

Comment

This study has demonstrated an association between smoking and preterm delivery; the association persisted after adjusting for confounding variables. It is noteworthy that the excess risk due to smoking was concentrated among the deliveries that occurred before 33 weeks' gestation, as these very preterm infants are at highest risk of mortality. The likelihood of delivery before 33 weeks' gestation was increased about 60% in women smoking one or more packs per day. Four percent of preterm and 9% of very preterm births were attributable to smoking. In the Surgeon General's report, *The Health Consequences of Smoking for Women*,[11] the attributable risk due to smoking for preterm births varied from 11% to 14%. Most of the studies quoted in this report were conducted in populations where the prevalence of smoking was over 40%. The 4% attributable risk found in the present study most likely represents the lower prevalence of smoking in the Kaiser population. Moreover, smoking in the present study was largely determined during the first trimester. It is likely that some of the women identified as smokers stopped smoking after the first trimester; therefore, the odds ratio and attributable risk associated with smoking are probably underestimated in this study.

Daily drinking was also associated with preterm birth, but this risk was more pronounced for moderately preterm infants (33 to 36 weeks' gestation) than for infants born before 33 weeks' gestation. Moreover, after adjustment for other variables, the finding was only of borderline statistical significance. Consumption of less than one drink per day was associated with a decreased risk of preterm and very preterm delivery, so that no overall dose-response relationship was evident. For these reasons, the evidence of an alcohol effect on preterm births seems unconvincing.

There have been several previous descriptions of the association between smoking and preterm delivery. Guzick et al[6] noted an odds ratio of 1.77, but their cases were limited to preterm infants who weighed less than 2,500 g. This biased their study toward smaller preterm infants and would be expected to overestimate the risk associated with smoking. Fedrick and Anderson[8] used this same definition and found relative risks of 1.9 and 2.4 for women who smoked less than one pack and one or more packs per day, respectively. Mulcahy and Murphy,[7] van den Berg,[5] and Meyer[4] noted relative risks of 1.6, 1.4, and 1.4, respectively, for preterm delivery. None of these studies controlled for alcohol consumption.

The findings in this prospective study of northern California women are consistent with these earlier reports and suggest that smoking during pregnancy may lead to preterm birth. This effect is important both to our overall understanding of the impact of smoking on low birth weight as well as in sorting out other potential causes of preterm delivery. An increased risk of early delivery can be added to the list of adverse effects of smoking on reproductive outcomes. Physicians who provide care for pregnant women who smoke have an added impetus to incorporate smoking cessation into prenatal care.

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