Maternal Smoking during Pregnancy and Smoking by Adolescent Daughters

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ABSTRACT

Objectives. Since cigarette smoking in adolescence represents a crucial entry point in the progression to illicit drugs, risk factors for adolescent smoking have public health implications. The influence of mothers on children's smoking appears to be greater than that of fathers. To explain the selective influence of mothers, we examined the consequences of maternal smoking during pregnancy in two longitudinal samples.

Methods. Analyses were conducted on follow-up interview data from two dyadic samples of mothers and firstborn adolescents for whom data on maternal smoking during and after pregnancy were available (192 mother–child pairs originating from New York State and 797 dyads from a national sample).

Results. In both samples, maternal smoking during pregnancy, when postnatal smoking was controlled, selectively increased the probability that female children would smoke and would persist in smoking (adjusted odds ratios of about 4).

Conclusions. The findings suggest that nicotine or other substances released by maternal smoking can affect the fetus, perhaps through the nicotinic input to the dopaminergic motivational system, so as to predispose the brain in a critical period of its development to the subsequent addictive influence of nicotine consumed more than a decade later in life. (*Am J Public Health.* 1994;84:1407–1413)

Introduction

Adolescents who experiment with drugs, and those who ultimately become heavy users, almost invariably first use cigarettes or alcohol.[1–3] Furthermore, the earlier an adolescent begins to experiment with cigarettes and alcohol, the greater the severity and persistence of his or her subsequent involvement with illicit drugs.[3] Thus, it is important to understand the factors that predict early initiation of drinking and cigarette smoking. Among these factors, smoking by parents seems particularly important.

To examine intergenerational effects on drug behavior, we followed a cohort of New York State adolescents for 19 years. In a separate analysis based on mother-father-child triads, we found that maternal smoking was related in a dose-dependent manner to smoking among both boys and girls.[4] The association with paternal smoking was weaker for both sexes. Differences between mothers and fathers were not explained by social influences. Here we report further analyses to identify the sources of the maternal effect in two longitudinal samples, one originally from New York State, the second a national sample. We focus on one factor that differentiates mothers from fathers, namely the mother's smoking behavior during her pregnancy.

Methods

The New York State Follow-Up Cohort

The New York State (NYS) Follow-Up cohort is from a representative sample of adolescents who were enrolled in grades 10 and 11 in NYS public high schools in 1971/72 and were followed for 19 years. The target population for the adult follow-up (n = 1651) was drawn from the enrollment list and included students absent from school at the initial 1971 survey to ensure the representativeness of the sample. Respondents were reinterviewed in 1980, 1984, and 1990, at the average ages of 24–25, 28–29, and 34–35 years; in 1990, 540 men and 620 women (72% of the original target group, excluding those deceased) were reinterviewed. Personal interviews were also conducted with the subjects' two oldest children aged 9–17 years and, when there was a child aged 6–17 years, with the subjects' spouses or partners. The completion rate for the first-born child was 90.5%. Informed consent was obtained from mothers for their own and their children's participation, and separately from the children. The subjects were 192 mothers (mean age = 34.5 years, SD = 0.8) and their first-born children aged 9–17 years (mean age = 12.9, SD = 2.4).

The structured personal interviews took on average 1½ hours to complete for adults and 1 hour for children. Information about the use of 12 classes of drugs within the last 12 months and detailed retrospective monthly drug use histories since the prior survey were obtained at each follow-up. Mothers' use of cigarettes and other drugs during pregnancy with

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Editor's Note. See related editorial by Paneth (p 1372) in this issue.

TABLE 1—Child Smoking Ever and during the Last Year in Two Cohorts, by Maternal Smoking during Pregnancy and Sex of Child

Cohort	Percentage of Children Who Smoked							
	Mother Did Not Smoke during Pregnancy	Mother Smoked during Pregnancy						
		All Smokers	Amount Smoked per Day		Joint χ^2 (df = 1)[a]	P	Joint χ^2 (df = 2)[b]	P
			<1 Pack	≥1 Pack				
A. NYS cohort								
Boys (n)	(71)	(38)	(23)	(15)				
Ever	24.2	26.8	20.4	36.3	0.1	NS	1.3	NS
Last year	14.8	20.2	14.9	28.1	0.5	NS	1.6	NS
Girls (n)	(43)	(41)	(23)	(18)				
Ever	13.2	39.2	46.8	29.4[c]	7.3	<.01	8.9	<.05
Last year	4.3	26.4	24.0	29.4[d]	8.0	<.01	8.2	<.05
B. NLSY cohort								
Boys (n)	(251)	(148)	(115)	(33)				
Ever	17.7	27.9	28.2	26.9[e]	5.8	<.05	5.8	<.10
Last 3 months	3.2	7.7	7.5	8.6	4.0	<.05	4.1	NS
Girls (n)	(249)	(148)	(118)	(30)				
Ever	19.3	20.0	18.2	26.7	0.02	NS	1.1	NS
Last 3 months	5.2	14.4	13.6	17.5[f]	10.0	<.01	10.5	<.01

Note. NYS = New York State; NLSY = National Longitudinal Survey of the Work Experience of Youth; NS = not significant.
[a]Test of independence between child's smoking and any maternal smoking during pregnancy.
[b]Test of independence between child's smoking and amount smoked by mother during pregnancy.
[c]No smoking vs <1 pack, $P < .01$.
[d]No smoking vs <1 pack, $P < .05$; no smoking vs ≥1 pack, $P < .01$.
[e]No smoking vs <1 pack, $P < .05$.
[f]No smoking vs < 1 pack, $P < .01$; no smoking vs ≥1 pack, $P < .01$.

the selected child and amount smoked were ascertained.

The National Longitudinal Survey of the Work Experience of Youth Cohort

The analyses were replicated on a second group of subjects obtained from the National Longitudinal Survey of the Work Experience of Youth (NLSY). This multistage stratified national probability sample, representative of youths born from 1957 through 1963 in the coterminous United States, was drawn in 1979 and interviewed annually thereafter. The 1979 interview completion rate was 90%; retention rates have consistently been over 90%. In 1990, 4510 women (91% of the target group) were interviewed, including 3088 mothers; 5803 children (90% of the target group) born to these mothers were assessed. Interviews were completed with 957 mothers and their oldest children aged 10–18 years.

Analyses were based on 797 of these dyads with complete data on child smoking and maternal smoking during and after pregnancy (mothers' mean age = 30.7 years, SD = 1.9; children's mean age = 12.5 years, SD = 1.9). Prenatal exposure to maternal tobacco and alcohol use was first ascertained in 1983 for the youngest child and in 1986 for all births not asked about previously (62.6% of the children). Questions about current maternal drug use, including cigarette smoking, were asked only in 1984. In 1990, children aged 10 years and older completed a self-administered questionnaire inquiring about cigarette smoking. Informed consent was obtained from mothers for their own and their children's participation.[5]

The NLSY data differ from the NYS data in several respects: (1) mothers were specifically asked whether they had smoked during the 12 months preceding the birth of their children and how much they smoked during the pregnancy; (2) the most recent measure of maternal smoking was obtained in 1984, 6 years prior to the children's assessment; (3) monthly drug histories were unavailable; and (4) children's current smoking was ascertained for the past 3 months, not for the last year.

Statistical Analysis

Pearson's chi-square test was used to test for homogeneity of rates in contingency tables. When this joint test was significant, pairwise rates in the 2 × 2 subtables were compared by using Pearson's chi-square test. Maximum likelihood estimation and hypothesis testing methods were used in the multivariable logistic regressions of binary indicators of the child's smoking behaviors on maternal age, education, and smoking behaviors.[6] The large sample estimates of the standard errors were used to construct confidence intervals. Odds ratios were pooled across samples and tested for significance with the Mantel-Haenszel method.[7,8] The statistical program SPSS (SPSS Inc, Chicago, Ill) was used for weighted calculations.

Results

NYS Analyses

Of the mothers, 40.7% smoked during pregnancy; 28.7% smoked throughout the pregnancy. Twenty-five percent of the male offspring and 25.8% of the female offspring ever smoked; 16.7% and 15.0%, respectively, smoked within the last 12 months. There is a significant association between maternal smoking during pregnancy and the child's smoking 13 years later (Table 1). This association is stron-

ger for the child's smoking during the last year than for ever smoking, and it is stronger for daughters than for sons. We controlled for maternal use of alcohol and marijuana during pregnancy and found that the smoking effect was not altered (data not shown). Only one woman reported using illicit drugs other than marijuana during her pregnancy.

The proportion of current smokers among ever smokers can be interpreted as a measure of persistence of smoking. Persistence of smoking among offspring is more highly related to maternal smoking during pregnancy for daughters than for sons (Table 2, A.).

Of mothers who smoked during their pregnancies, 77.7% were still smoking 13 years later. Since the effect of smoking during pregnancy could be confounded with the effect of current smoking, we carried out two analyses to examine the joint impact of maternal smoking behavior during and after pregnancy.

TABLE 2—Persistence of Child Smoking in Two Cohorts, by Maternal Smoking during Pregnancy and Sex of Child

Cohort	Percentage of Children Who Continued to Smoke[a]: Mother Did Not Smoke during Pregnancy %	(n)	Mother Smoked during Pregnancy %	(n)	Joint χ^2 (df = 1)	P
A. NYS cohort						
Boys	61.4	(17)	75.3	(10)	0.6	NS
Girls	32.3	(6)	67.3	(16)	2.1	NS
B. NLSY cohort						
Boys	17.4	(46)	27.6	(41)	1.3	NS
Girls	26.9	(48)	72.2	(30)	15.2	<.001

Note. NYS = New York State; NLSY = National Longitudinal Survey of the Work Experience of Youth; NS = not significant.
[a]Percentage who continued to smoke (i.e., during the last 12 months in the New York State cohort and during the last 3 months in the National Longitudinal Survey of the Work Experience of Youth) among those who ever smoked.

In the first step, five groups of mothers were identified, depending upon whether they smoked during the pregnancy and within the year preceding the interview (Table 3, A.). The child's exposure to postnatal maternal smoking varied greatly across the groups. On average, mothers in group 2 had last smoked 14.3 years ago, mothers in group 4 had last smoked 6.5 years ago, and mothers in groups 3 and 5 were currently smoking. Total exposure, calculated by dividing the total number of months the mother smoked after childbirth by the child's age in months, ranged from 4% when mothers smoked neither during pregnancy nor within the last year (group 2) to 38% when mothers smoked during pregnancy but not within the last year (group 4), to 63% when mothers did not smoke during pregnancy but smoked within the last year (group 3), and to 91% when mothers smoked in both periods (group 5). The effect of maternal smoking during pregnancy on daughters is apparent across the groups. Rates of smoking among daughters were higher when mothers smoked during pregnancy but not within the last year (group 4) than when mothers did not smoke during pregnancy but did smoke within the last year (group 3). Yet the children of group 3 mothers were exposed to maternal smoking for twice as long in their lives, and much more recently, than the children of the group 4 mothers. Correlatively, the same proportions of daughters were currently smoking if their mothers smoked during pregnancy, irrespective of whether the mothers smoked within the last year. However, daughters of the currently smoking mothers (group 5) were exposed to postnatal maternal smoking for three times as long as daughters of the mothers who had not smoked within the last year (group 4); the latter mothers had last smoked more than 6 years ago. By contrast, recent smoking by sons appears to be more influenced by maternal smoking within the last year. The relationship of daughters' smoking rates to maternal smoking during pregnancy and the lack of relationships to child lifetime exposure and current maternal smoking further support the existence of a prenatal effect of maternal smoking.

In the second step, we estimated logistic regressions predicting the child's smoking—ever and within the year preceding the interview—in which we distinguished the amounts mothers smoked, both during pregnancy and currently (Table 4). (The second model shown did not differentiate maternal smoking during pregnancy according to quantities smoked.) The strongest positive effect of maternal smoking appears when the mother smoked during her pregnancy. This effect is evident only among daughters and is quite marked, regardless of the amount the mother smoked. By contrast, the mother's current smoking is nonsignificant but has a greater effect on boys than on girls.

A Replication in the NLSY Sample

To test the NYS results by replication, we carried out a parallel analysis in the NLSY sample. Of the mothers, 37.1% smoked during pregnancy; 21.5% of the boys and 19.6% of the girls ever smoked and 4.9% and 8.6%, respectively, smoked within the last 3 months. The child's smoking, especially current and persistent smoking (the proportion who smoked in the last 3 months among those who ever smoked), is related to maternal smoking during pregnancy (Tables 1 and 2, B.). As in the NYS sample, the effect was stronger on daughters than on sons.

Also as in the NYS sample, smoking during pregnancy was highly related to smoking afterward: 89% of mothers who had smoked during pregnancy were smoking at the time of the 1984 interview (an average of 6 to 7 years after pregnancy). The joint classification of maternal smoking during and after pregnancy reveals the stronger impact of smoking during pregnancy than afterward and on daughters than on sons (Table 3, B.).

To identify the unique effect of prenatal maternal smoking, we estimated the same logistic regressions for the NLSY sample as for the NYS sample (Table 5). Again, maternal smoking during pregnancy was associated with current and persistent smoking by daughters but not sons. Contrary to the results of the NYS analysis, there was no increased risk of the child's ever smoking due to maternal smoking during pregnancy, and the significant effect on daughters' current smoking was found among mothers who reported smoking less than a pack of cigarettes a day during pregnancy, rather than a pack or more. Heavy maternal smoking 6 years prior to the child's

TABLE 3—Current Child Smoking in Two Cohorts, by Maternal Smoking History during and after Pregnancy and Sex of Child

Cohort	Percentage of Children Who Smoked											
	(1) Mother Never Smoked		(2) Mother Smoked but Not during Pregnancy/ Not Last Year[a]		(3) Mother Did Not Smoke during Pregnancy/ Smoked Last Year[a]		(4) Mother Smoked during Pregnancy/ Not Last Year[a]		(5) Mother Smoked during Pregnancy and Last Year[a]		Joint χ^2 (df = 4)	P
	%	(n)	%	(n)	%	(n)	%	(n)	%	(n)		
A. NYS (smoked last year)												
Boys	15.2	(21)	10.1	(38)	29.5	(12)	11.3	(11)	23.8	(27)	3.9	NS
Girls	0.0	(13)	6.4	(20)	5.7	(9)	26.9	(6)	26.3[b]	(34)	8.3	<.10
B. NLSY (smoked last 3 months)												
Boys	4.8	(60)	2.5	(96)	3.0	(95)	0.0	(22)	9.1[c]	(126)	7.8	<.10
Girls	2.0	(54)	4.4	(98)	7.8	(97)	27.2	(11)	13.4[d]	(137)	14.5	<.01

Note. NS = not significant.
[a]"Last year" refers to the year preceding the current maternal and child interviews in the New York State (NYS) cohort, and the year preceding the maternal interview 6 years before the current child interview in the National Longitudinal Survey of the Work Experience of Youth (NLSY) cohort.
[b]Group 1 vs group 4, $P < .05$; group 1 vs group 5, $P < .05$; group 2 vs group 5, $P < .10$.
[c]Group 2 vs group 5, $P < .05$; group 3 vs group 5, $P < .10$.
[d]Group 1 vs group 4, $P < .001$; group 1 vs group 5, $P < .05$; group 2 vs group 4, $P < .01$; group 2 vs group 5, $P < .05$; group 3 vs group 4, $P < .05$.

TABLE 4—Adjusted Odds Ratios (AORs) and Confidence Intervals (CIs) from Logistic Regressions Predicting Child Smoking from Maternal Smoking during and after Pregnancy, by Sex of Child: New York State Cohort

Predictors[a]	Child Smoking Ever				Child Smoking Last Year			
	Boys (n = 109)		Girls (n = 83)		Boys (n = 109)		Girls (n = 83)	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Model 1								
Child's age[b]	2.3*	1.6, 3.3	1.8*	1.3, 2.6	2.0*	1.4, 2.9	1.9**	1.2, 3.0
Maternal smoking during pregnancy								
Did not smoke (reference group)								
<1 pack per day	0.5	0.1, 2.2	5.2***	0.9, 29.5	0.7	0.1, 3.7	3.0	0.3, 32.1
≥1 pack per day	1.1	0.2, 5.8	4.3	0.5, 40.1	1.5	0.3, 8.1	11.2***	0.7, 179.8
Maternal smoking after pregnancy (last year[c])								
Did not smoke (reference group)								
<1 pack per day	3.1	0.6, 17.4	0.2	0.0, 1.6	2.3	0.4, 13.7	0.6	0.1, 7.9
≥1 pack per day	1.8	0.4, 8.0	0.5	0.1, 3.4	1.7	0.4, 7.9	1.2	0.1, 11.6
Constant	−14.6*		−7.1***		−12.9**		−3.8	
χ^2[d] (df = 6)	43.0*		27.6*		25.8**		23.5*	
Model 2[e]								
Maternal smoking during pregnancy (vs not smoking)	0.7	0.2, 2.4	5.0***	0.9, 27.7	1.0	0.3, 3.8	4.0	0.4, 38.1

[a]Mother's education was included in the model. Nonsignificant coefficients not shown.
[b]Odds ratios are calculated for a 1-year change in this continuous variable.
[c]"Last year" refers to the year preceding interview.
[d]Maximum likelihood chi-square for the difference between a model including only a constant and the model including the set of independent variables.
[e]Same variables included as in Model 1, except that the two categories for amount smoked by mother were combined. Other coefficients not shown.
*$P < .001$; **$P < .01$; ***$P < .10$.

interview, when the child was almost 7 years old, was associated with increased odds of sons' ever smoking; surprisingly, maternal smoking of less than a pack a day was associated with decreased odds of daughters' ever smoking.

In both cohorts, the adjusted odds ratios of any maternal smoking during pregnancy, irrespective of quantities smoked, on daughters' current smoking are very similar (4.0 in the NYS sample, 4.1 in the NLSY sample; see model 2,

TABLE 5—Adjusted Odds Ratios (AORs) and Confidence Intervals (CIs) from Logistic Regressions Predicting Child Smoking from Maternal Smoking during and after Pregnancy, by Sex of Child: National Longitudinal Survey of the Work Experience of Youth Cohort

	Child Smoking Ever				Child Smoking Last 3 Months				Persistent Smoking[a]			
	Boys (n = 406)		Girls (n = 381)		Boys (n = 406)		Girls (n = 381)		Boys (n = 77)		Girls (n = 65)	
Predictors[b]	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Model 1												
Child's age[c]	1.6*	1.4, 1.8	1.7*	1.5, 2.0	1.8*	1.3, 2.3	2.2*	1.7, 2.9	1.3,	0.9, 1.8	1.7**	1.2, 2.5
Maternal smoking during pregnancy												
Did not smoke (reference group)												
<1 pack per day	1.4	0.8, 2.6	1.1	0.5, 2.3	1.5	0.5, 4.7	4.8**	1.6, 14.7	1.0	0.3, 3.5	5.5***	1.3, 22.2
≥ 1 pack per day	1.0	0.4, 2.7	1.0	0.3, 3.0	2.0	0.4, 9.9	1.9	0.4, 9.9	1.4	0.2, 9.2	2.2	0.3, 18.6
Maternal smoking after pregnancy (last year)[d]												
Did not smoke (reference group)												
<1 pack per day	0.8	0.4, 1.7	0.4***	0.2, 1.0	1.6	0.4, 5.9	0.2***	0.1, 0.9	2.3	0.5, 9.9	0.6	0.1, 2.7
≥1 pack per day	2.8**	1.4, 5.7	1.2	0.6, 2.8	3.1	0.8, 12.6	1.4	0.4, 4.5	2.1	0.4, 10.3	1.9	0.4, 8.2
Constant	−7.1*		−8.9*		−11.3*		−13.2*		−5.4		−7.6**	
χ^{2}[e] ($df = 6$)	61.0*		67.0*		25.5*		75.4*		5.3		29.6*	
Model 2[f]												
Maternal smoking during pregnancy (vs not smoking)	1.3	0.7, 2.4	1.1	0.5, 2.2	1.6	0.6, 4.6	4.1***	1.4, 12.1	1.1	0.3, 3.5	4.6***	1.2, 17.2

[a]Smoking in last 3 months among children who ever smoked.
[b]Mother's education was included in the model. Nonsignificant coefficients not shown.
[c]Odds ratios are calculated for a 1-year change in this continuous variable.
[d]Measured 6 years prior to the child's interview.
[e]Maximum likelihood chi-square for the difference between a model including only a constant and the model including the set of independent variables.
[f]Same variables included as in Model 1, except that the two categories for amount smoked by mother were combined. Other coefficients not shown.
*$P < .001$; **$P \leq .01$; ***$P < .05$.

Tables 4 and 5). A Mantel-Haenszel chi-square test of the common underlying association between mother's and daughter's smoking across the two samples is statistically significant ($P < .01$).

To test the hypothesis that the effect of maternal prenatal smoking is stronger for daughters' persistence of smoking than for experimentation with cigarettes, we conducted a logistic regression predicting persistent smoking among adolescents who had ever smoked in the NLSY cohort. Maternal smoking during pregnancy increased the odds of persistent smoking by daughters more than four times, but had no effect among sons (Table 5). The adjusted odds ratios for daughters were statistically significantly different from those for sons. The small sample size precluded the implementation of a sex-specific analysis of persistence in the NYS sample.

Discussion

Although the sample sizes were small, the strength of our findings derives from the test of an a priori hypothesis in one sample and a replication in a second sample. In both, the maternal effect of smoking during pregnancy was stronger on daughters than on sons, and in one sample it was clearly stronger for the child's current smoking and for persistence than for lifetime experimentation.

The impact of maternal smoking during pregnancy on the child's smoking, and especially the differential impact on current smoking compared with ever smoking, is consonant with the existence of a prenatal effect. Such a biological effect should be stronger for persistent and heavy smoking than for simple experimentation; the latter should be more responsive to social influences. The inconsistent findings between the two samples regarding the dose effects parallel findings regarding the effect of prenatal smoking in lowering birthweight.[9] It would be especially important to replicate the analyses in a prospective cohort in which detailed maternal drug use could be assessed during pregnancy.

One mechanism underlying the maternal effect and its greater impact on female than male children might be an intrauterine effect of nicotine on the developing brain of the fetus. Some motivational consequences of reinforcing stimuli, including the craving from drug dependence, are mediated by the mesolimbic and mesocortical components of the dopaminergic system.[10–14] Drug withdrawal leads to decreased activity in components of the dopaminergic system that are clinically manifested in craving. Drug intake restores the rewarding effects

of dopaminergic transmission.[15,16] Nicotine, which crosses the placental barrier and stimulates the action of cholinergic neurons, enhances activity in the dopaminergic system.[13]

Our data raise the possibility that during a critical prenatal period of brain development, nicotine, or other substances released by maternal smoking, may modify the properties of the dopaminergic system of the brain so as to change the threshold of this system (or related systems) to the effects of nicotine at a later time in life and thereby predispose the child to smoke and to persist in smoking. This suggestion is consistent with the notion that nicotine, like other addictive drugs, can alter gene expression and can produce long-lasting functional and structural changes in dopaminergic neurons,[10] an effect that might be particularly profound in the developing brain. The finding that nicotine administered to pregnant mice increases adenylate cyclase activity in the midbrain and brainstem at postpartum and that the levels return to normal within 4 weeks, only to recur in adulthood,[17] lends support to this interpretation.

Why the intergenerational transmission of smoking from mother to child should be stronger for female children than for males is unclear. Perhaps these sex differences reflect the distinctive sexual dimorphism of the brain—including hormonal and structural factors—that emerges during fetal development.[18,19] For example, the release of androgens may protect the male infant against the priming effect of nicotine.

Maternal prenatal exposure to drugs may have two types of consequences for the child: immediately manifest consequences, most clearly evident in crack babies or infants with the fetal alcohol syndrome, and latent consequences that may require more than a decade to become manifest, as may be the case for smoking. The prenatally induced predisposition to smoke might be enhanced further by passive smoking after birth, which would facilitate the child's desire to experiment with cigarettes and his or her potential dependence on tobacco. We could not measure exposure to passive smoking by other household members. We assumed that the effects of passive smoking would be captured by postnatal maternal smoking. Since we showed that postnatal maternal smoking did not retain a unique statistically significant effect and since we had previously shown that current maternal smoking was more important than paternal smoking,[4] we conclude that the prenatal maternal effect is stronger than the effect of subsequent passive smoke. Subtle physiological effects deriving from the child's exposure to prenatal maternal smoking may create in these children a low level of nicotine dependence without their ever having smoked a cigarette. These differences could be reflected in the child's initial response to nicotine and result in tolerance and persistence of smoking. Our data do not exclude a variety of additional social or physiological effects, including a genetic predisposition to smoking, reflected in differential regulation of brain nicotinic receptor numbers and response to nicotine.[15,16] Such a genetic predisposition might be especially strong among women who continue to smoke during their pregnancies despite the well-advertised hazards of doing so.

The present findings are consonant with an increasing body of research that documents latent and deferred effects of fetal exposure to a variety of insults not limited to drug use. Thus, the classic studies on the Dutch famine during World War II have identified adult effects of prenatal food deprivation on obesity and schizophrenia.[20,21] Interestingly, the schizophrenia effects are somewhat stronger among women than among men.

Independent of its mechanism, our evidence indicates that maternal smoking during pregnancy may create a serious risk for smoking dependence in female offspring, a risk that is even greater than that created by the mother's current smoking. Young women have not shown the decline in smoking observed among other adults in the United States.[22] From a public health perspective, it is essential to target these young women for prevention and intervention, since a reduction in their rates of smoking may have unanticipated benefits for the second generation in addition to the direct health benefits for the adult smokers themselves. □

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