Maternal Smoking During Pregnancy and Adult Male Criminal Outcomes

Patricia A. Brennan, PhD; Emily R. Grekin; Sarnoff A. Mednick, PhD, DrMed

Background: Perinatal risk factors are related to persistent and violent criminal outcomes. Prenatal maternal smoking may represent an additional perinatal risk factor for adult criminal outcomes. Our study examines maternal smoking during pregnancy as a predictor of offspring crime in the context of a prospective, longitudinal design.

Methods: Subjects were a birth cohort of 4169 males born between September 1959 and December 1961 in Copenhagen, Denmark. During the third trimester of pregnancy, mothers self-reported the number of cigarettes smoked daily. When the male offspring were 34 years of age, their arrest histories were checked in the Danish National Criminal Register. Additional data were collected concerning maternal rejection, socioeconomic status, maternal age, pregnancy and delivery complications, use of drugs during pregnancy, paternal criminal history, and parental psychiatric hospitalization.

Results: Results indicate a dose-response relationship between amount of maternal prenatal smoking and arrests for nonviolent and violent crimes. Maternal prenatal smoking was particularly related to persistent criminal behavior rather than to arrests confined to adolescence. These relationships remained significant after potential demographic, parental, and perinatal risk confounds were controlled for.

Conclusions: Maternal prenatal smoking predicts persistent criminal outcome in male offspring. This relationship has not been accounted for by related parental characteristics or perinatal problems. Potential physiologic or central nervous system mediators between maternal smoking during pregnancy and offspring criminal outcomes need further study.

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Results of several studies suggest a relationship between perinatal complications and antisocial behavior. Pasamanick et al found a higher rate of pregnancy complications among behavior-disordered children than among age-matched control subjects. Lewis et al found a positive correlation between perinatal complications and rates of recidivism among delinquent children. The significant role of prenatal factors in the development of aggression is also supported by studies of minor physical anomalies, which are small, external deformities that often indicate a history of prenatal trauma. Minor physical anomalies have been correlated with aggression, hyperactivity, impulsivity, and criminal violence.

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The specific prenatal risk factors associated with acting-out behaviors are numerous and diverse, ranging from toxemia to intrauterine insult. One such risk factor is maternal cigarette smoking during pregnancy. Maternal prenatal smoking has been associated with several externalizing behaviors, including impulsivity, trancy, conduct disorder, and attentional difficulties. Maternal prenatal smoking also has been linked to crime in offspring. Rantakallio et al found that individuals whose mothers smoked during pregnancy were twice as likely to have a criminal record at age 22 years as were age-matched controls.

The relationship between maternal prenatal smoking and deviance persists, even when investigators control for potential confounding factors. Weitzman et al found that maternal prenatal smoking predicted behavior problems despite controlling for race, age, sex, birth weight, maternal education, maternal use of alcohol during pregnancy, family income, parental divorce, and quality of the home environment. Other researchers found that maternal prenatal smoking predicts behavior problems after controlling for parental psychopathologic factors, pregnancy risks, number of schools attended, and parenting practices.

Studies have linked maternal smoking behavior to several adverse medical outcomes. Prenatal maternal smoking has been associated with chronic ischemia, hypoxia, hypertonicity, increased tremors, and increased startle response in infants.
suggesting a relationship between maternal smoking and central nervous system deficits. These central nervous system deficits may be the mediating factor between maternal smoking and offspring deviant behavior.

If maternal smoking during pregnancy represents (at least in part) a biological risk for aggression, then it may be predictive of only certain patterns of criminal offending. According to the theory of antisocial behavior...
by Moffitt, life-course persistent offending is more likely to have a biological basis than adolescent-limited offending (ie, arrests limited to adolescence). The 1 study that examined the relationship between maternal prenatal smoking and crime did not examine this potentially important distinction in patterns of offending.

Results of existing research also suggest that perinatal factors may be especially related to aggressive and criminal outcomes for individuals exposed to multiple risk factors. In a prospective, longitudinal study in Kauai, Hawaii, Werner found that the effects of perinatal stress on delinquent outcomes were strongest for children exposed to a disruptive family environment. Results of research in Denmark showed similar biosocial interactions predicting the outcomes of violent and persistent criminal behavior. No studies to date have examined potential interactive effects of maternal prenatal smoking and other risk factors in the prediction of offspring outcomes.

Previous studies have measured the relationship between maternal prenatal smoking and aggression in children and adolescents, but no study has examined this relationship in individuals older than 22 years. This study extended the current literature by examining the relationship between maternal smoking and offspring deviance in adults up to age 34 years. As such, we differentiated the effects of maternal smoking on adolescent-limited vs life-course persistent criminal offending. Our large sample size also enabled us to examine violent offending as a specific outcome variable.

Our data set also provided several methodological advantages over previous research. First, our sample is population based. Second, mothers’ reports of smoking were collected during pregnancy rather than through retrospective reports. Third, related perinatal risk factors were recorded in a detailed, reliable manner by obstetricians and pediatric neurologists in the context of a large-scale birth cohort study. Finally, our data set allowed us to control for a variety of potential confounds and to assess potential interactions of maternal smoking and other risk factors in the prediction of criminal outcomes.

We used a perinatal birth cohort of 4129 males to assess the relationship between maternal prenatal smoking and offspring criminal arrests. We hypothesized that (1) a significant relationship existed between maternal prenatal smoking and offspring criminal behavior, (2) this relationship would be true for violent behavior and persistent criminal behavior rather than for adolescent-limited crime, and (3) the above relationships would remain significant despite controlling for socioeconomic status (SES), maternal rejection, maternal age, pregnancy and delivery complications, use of drugs during pregnancy, maternal criminal history, and parental psychiatric hospitalization. Finally, these data allowed us to explore potential interactions between maternal smoking and other risk factors in the prediction of criminal outcomes.

### RESULTS

χ² Analyses showed a significant positive relationship between amount of maternal smoking during the third trimester of pregnancy and offspring nonviolent arrests (Mantel-Haenszel χ², N = 3728 = 13.28; P < .001). A linear relationship exists between percentage of violent offenders and number of cigarettes the mother smoked daily during her third trimester of pregnancy (Mantel-Haenszel χ², N = 3289 = 34.58; P < .001) (Figure 1, top). A linear relationship exists between percentage of violent offenders and number of cigarettes the mother smoked daily during her third trimester of pregnancy (Mantel-Haenszel χ², N = 3307 = 39.77; P < .001) (Figure 1, bottom).

χ² Analyses were also performed to test for a relationship between maternal prenatal smoking and adolescent-limited vs life-course persistent offending. Maternal smoking during the third trimester was related to higher rates of life-course persistent offending (Mantel-Haenszel χ², N = 3289 = 31.48; P < .001) and adolescent-limited offending (Mantel-Haenszel χ², N = 3176 = 6.85; P < .001).

Logistic regression analyses were performed to test whether the relationship between maternal smoking and offspring criminal outcomes would remain when potential confounds were controlled for. The potential confounds first entered as a block into the model included parental psychiatric hospitalization, pregnancy and delivery complications, mother’s use of drugs during pregnancy, father’s criminal arrest, maternal rejection, mother’s age, and SES. Next, the maternal smoking variable was tested as to whether it would significantly enter the model. Maternal smoking significantly predicted nonviolent arrests (χ², N = 3728 = 13.28; P < .001) and violent arrests (χ², N = 3289 = 15.74; P < .001) when these confounds were controlled for. Maternal smoking was not significantly related to adolescent-limited offending (χ², N = 3176 = 2.70; P = .10) but was significant in the prediction of life-course persistent offending (χ², N = 3289 = 9.42; P < .01) after controlling for potential confounds.

The Table presents significance levels and odds ratios of the variables included in logistic regression models predicting nonviolent, violent, and life-course per-
Figure 2. The relationship between low (top) and high (bottom) delivery complications, maternal prenatal smoking, and offspring criminal violence.

Our results support our hypothesis that maternal smoking during pregnancy is related to increased rates of crime in adult offspring. This general finding is consistent with the literature linking behavior problems, conduct disorder, and adolescent offending to prenatal maternal smoking.11 Our study extended these findings by showing that maternal smoking is related to persistent offending rather than to adolescent-limited offending.

We did not find strong support for a potential interaction of maternal prenatal smoking and other risk fac-
tors in the prediction of adult criminal offending. Only 1 interaction was significant in our analyses. Delivery complications and maternal smoking interacted to predict criminal violence, which is consistent with results of previous works18,22 noting the interactive effect of delivery complications on violent offending in particular. Delivery complications and maternal smoking were slightly negatively correlated in this sample \( (r = -0.04; P < 0.05) \), so this finding does not simply reflect more deleterious or serious effects of smoking. Instead, it indicates a particular vulnerability that results when these risk factors occur together.

Factors indicating potential social risks such as low SES and parental psychopathologic factors did not interact with maternal prenatal smoking to predict criminal outcomes. The Danish systems of national health care and low rates of severe poverty may reduce the potential effects of these social risk factors for this sample. It is also possible that biosocial interactions may be specific and that only particular social and biological risk factors interact in the prediction of criminal outcomes. Results of previous research19 show that maternal rejection, but not low SES, interacted with delivery complications in the prediction of criminal violence.

Maternal smoking during the third trimester predicted nonviolent, violent, and persistent crime even when controlling for parental psychiatric hospitalization, pregnancy and delivery complications, mother’s use of prescription drugs during pregnancy, father’s criminal arrest, maternal rejection, mother’s age, and SES. One important confound that we were not able to assess or control was the mother’s psychological history outside of hospitalization, including her use of alcohol or illicit drugs during pregnancy. In studies9,11 in which these variables were controlled for, the maternal smoking and child behavior problem relationship remained. In addition, we statistically controlled for serious depression, personality disorders, and drug and alcohol abuse that led to psychiatric hospitalization of the mothers. Nevertheless, our study leaves the potential moderating effect of maternal alcohol and other drug use during pregnancy and maternal psychopathologic factors largely unexplored.

Our data set did not include information on specific nicotine doses, smoking during first and second trimesters, paternal smoking, or parental smoking after the birth of the child. Therefore, we were unable to complete more fine-grained analyses on the specific effects of nicotine, specific trimester effects, or the relative impact of prenatal vs postnatal exposure to maternal smoking.

Our data were prospective in nature and did not rely on mothers’ retrospective reports later in the life of the child. In addition, our criminal outcome data were available from a reliable and accurate source, and attrition was a minor concern in our study. Our results are in strong agreement with those of Rantakallio et al,10 who examined 5966 members of a Finnish birth cohort. The fact that similar results were obtained from independent birth cohorts from 2 differing ethnic national populations suggests that these findings may be generalizable to other populations. We theorized that central nervous system damage may mediate the relationship between maternal smoking and offspring criminal outcomes. The next steps in this research may be to attempt to determine specific effects of smoking on the fetal brain and to determine the agent in tobacco smoke that is responsible for these effects.

In this study, maternal smoking during pregnancy predicted persistent criminal offending and violent criminal offending rather than adolescent-limited delinquency. Persistent and violent criminal offending have serious deleterious effects on society. Our results therefore suggest an additional critical reason to support public health efforts aimed at improving maternal health behaviors during pregnancy.

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Corresponding author: Patricia A. Brennan, PhD, Department of Psychology, Emory University, 512 N Kilgo Circle, Atlanta, GA 30322 (e-mail: pbren01@emory.edu).

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