

# Prenatal Smoke Exposure and ADHD: Advancing the Field

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A robust literature indicates a link between maternal smoking during pregnancy and subsequent diagnosis of attention-deficit/hyperactivity disorder (ADHD) in children. However, questions have been raised regarding whether this association is causal and attributable to intrauterine effects or due to other unmeasured factors. Gustavson and colleagues<sup>1</sup> tested this question using a large prospective birth cohort; the findings from their thorough analyses are presented in their paper, "Smoking in pregnancy and child ADHD" published in the current issue of *Pediatrics*. The results showed that maternal smoking during pregnancy was not more strongly associated with childhood ADHD than maternal smoking during previous pregnancies, paternal smoking, or grandmothers' smoking while pregnant with the mother. In addition, the analyses looking at sibling controls also did not suggest that children were more likely to exhibit ADHD symptoms when mothers smoked during pregnancy compared with siblings who did not experience prenatal smoke exposure. This well-designed study replicated other findings<sup>2</sup> that indicate maternal smoking may not be a causal risk factor and that the association may be better explained by other genetic or environmental mechanisms.

The results of Gustavson et al<sup>1</sup> strongly suggest that the association between smoking and childhood ADHD is not attributable to any one mechanism. However, given the complexity of this relationship, the paper and its conclusions left us wondering whether as a field it was time to move beyond the question of whether smoking

during pregnancy causes ADHD. Stated differently, how do the findings of Gustavson et al<sup>1</sup> and others advance the field clinically and scientifically, and should we be focused on different questions?

Clinically, it is incontrovertible that smoking is bad for pregnant women, like it is for the rest of the population. Indeed, smoking is one of the top preventable causes of morbidity and mortality and leads to numerous adverse negative perinatal outcomes, such as risk for premature birth and low birth weight,<sup>3</sup> both of which have been linked to ADHD and other neurodevelopmental disorders.<sup>4,5</sup> Whether maternal smoking during pregnancy causes ADHD will not influence clinicians' approach to care; with or without the answer to this question, clinicians will continue to advise their patients to stop smoking to minimize a host of unwanted health outcomes.

Scientifically, these findings offer compelling evidence that intrauterine smoke exposure does not increase the risk for ADHD when other relevant variables are controlled. However, the focus on ADHD diagnosis or parent-reported symptoms as outcomes is narrow, and an emphasis on the effects of prenatal maternal smoking on a broader range of neurodevelopmental outcomes may be more informative. This is especially relevant because ADHD is highly heterogeneous and often cooccurs with other neurodevelopmental and neuropsychiatric conditions (eg, conduct disorder, oppositional defiant disorder, autism spectrum disorders,



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and learning disorders).<sup>6,7</sup> It would be more fruitful to examine the specific effects of intrauterine exposure on more subtle neurodevelopmental processes not captured by a clinical diagnosis (ie, impairments in sustained attention and behavioral inhibition<sup>8</sup>), or the development of ADHD and comorbid conditions. For example, a recent study in *BMC Psychiatry*, also using a large sample from a national registry, found that prenatal smoke exposure was more strongly linked to ADHD comorbid with conduct disorder and oppositional defiant disorder compared with ADHD alone.<sup>6</sup>

The findings from Gustavson et al<sup>1</sup> also suggest a range of other important research questions that could be posed, including how paternal or transgenerational (ie, grandparent) smoking could influence neurodevelopment. There is a small, but potentially important literature developing on how smoking can influence developmental outcomes via epigenetic processes transmitted from paternal or other nonmaternal sources.<sup>9,10</sup> It would also be important to investigate more thoroughly how smoking by the father or other family members might directly affect offspring development via either secondhand smoke exposure or by changing the likelihood of maternal smoking during pregnancy.

Ultimately, perhaps it is time to stop asking questions about the specific

relationship between maternal smoking during pregnancy and subsequent ADHD in children. Rather, the field should emphasize research that can examine the contributions of intrauterine exposure to maternal smoking on adverse neurodevelopment more broadly. Above all, continued work is needed to help avoid such exposure in the first place via clinical prevention and education efforts to reduce smoking in pregnant women.

#### ABBREVIATION

ADHD: attention-deficit/hyperactivity disorder

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