

# Introduction to the Special Issue: Impact of Prenatal Substance Exposure on Children's Health, Development, School Performance, and Risk Behavior

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## Why a Special Issue on Prenatal Substance Exposure?

In the United States, exposure to maternal use of drugs and alcohol, pre- and/or postnatally, is one of the most common risk factors associated with children's negative behavioral and developmental outcomes. Despite evidence linking alcohol and tobacco to fetal damage and warnings from public health campaigns, currently, at least 10% of women drink alcohol during pregnancy (Centers for Disease Control and Prevention, 2004) and 11% smoke cigarettes (Martin, Kochanek, Strobino, Guyer, & MacDorman, 2005). Although these reported rates have declined in recent years, they may not reflect exposure early in the pregnancy before women know they are pregnant. For instance, recently the Centers for Disease Control and Prevention (2004) reported that over 50% of women of childbearing age who were not using birth control drank alcohol and were, therefore, at risk for pregnancy complicated by fetal risk. Maternal substance use also includes marijuana, "hard drugs" (heroin, cocaine, and methamphetamines), and prescription medications, either through medical advice or misuse. As evidence has accumulated about the teratogenic risk associated with such use, professionals and the public have become aware of the need to understand the impact on pregnancy outcomes and children's development. Initial concerns regarding the presumed, but undocumented, effects of substance exposure on children's development have given way to a more balanced approach that examines how substances interact with environmental factors to influence children's development. Information from current studies demonstrates

the importance of developing strategies to promote the health and development of exposed children, to implement effective prevention programs, and to avoid the unnecessary anxiety that can stigmatize mothers and children.

The knowledge base regarding the effects of prenatal exposure to substances of abuse is growing, often in response to interest by scientists and the support available from federal funding sources. Research on the effects of prenatal exposure to substances of abuse has occurred in response to the scientific awareness of the dangers to children, as when fetal alcohol syndrome was first described in 1973 (Jones and Smith, 1973), and to public health concerns regarding "epidemics" of drug use, such as heroin in the 1960s, and cocaine and crack in the late 1980s and early 1990s. Currently, there is a great deal of attention being paid to the effects of pre- and postnatal exposure to tobacco and to methamphetamines.

Much of the recent research on the effects of prenatal drug exposure has been conducted among young children exposed to cocaine prenatally. The emerging findings on performance during the school-age years have been mixed. Some investigators have found that prenatal cocaine exposure is not associated with cognitive performance (Chasnoff et al., 1998; Richardson et al., 1996), play behavior (Accornero, Morrow, Bandstra, Johnson, & Anthony et al., 2002), academic achievement (Richardson et al., 1996), attention or teacher rated classroom behavior (Richardson et al., 1996). However, others have found that prenatal cocaine exposure may be associated with behavior problems (Chasnoff et al., 1998), task persistence and attention problems (Bandstra, Morrow, Anthony, Accornero, & Fried, 2001), and language performance (Bandstra,

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Vogel, Morrow, Xue, & Anthony, 2004). Although there are controversial findings regarding the impact of cocaine exposure on children's development, the relatively generous support for the investigation of the impact of cocaine during the 1990s has enabled scientists, public health personnel, and the public to adopt a reasoned understanding of the relationship between maternal abuse of cocaine and children's development. Similarly, the understanding of the impact of alcohol on development is more sophisticated currently than it was even 10 years previously (Stratton, Howe, & Battaglia, 1996). Understanding of the effects of other substances on children's development is still in preliminary stages.

### Contents of the Special Issue

The special issue presents the results of several innovative avenues of investigation. Two investigators incorporated physiological measures into the pre- and postnatal periods. Zeskind and Gingras (2006) found that maternal cigarette smoking affected the autonomic regulation of the unborn fetus. Schuetze and Eiden (2006) documented a dose effect linking prenatal cocaine exposure with two physiological measures of regulation (heart rate and respiratory sinus arrhythmia) in the first few weeks of life. One investigator focusing on children's mental health provided evidence that 6-year-old cocaine-exposed children were more likely to self-report mental health symptoms than nonexposed children and that cocaine-exposed children were rated as having more behavior problems when respondents are foster caregivers, compared with maternal or relative caregivers (Linares et al., 2006).

In keeping with recent evidence that many of the effects originally thought to be specific to prenatal drug exposure were in fact due to the quality of the child's environment (Brown et al., 2004; Frank et al., 2001), four investigators examined how contextual factors at the caregiver and household levels, in combination with cocaine exposure, influenced children's development. Sheinkopf et al. (2006) found that mothers' perceptions of their infants' behavioral characteristics were influenced by the mothers' own psychological distress, regardless of their history of drug use. Working with preschoolers, Behnke et al. (2006) reported that cocaine had an indirect effect on development, mediated through head circumference at birth. Bendersky, Bennett, and Lewis (2006) found that although cocaine exposure contributed to aggression among 5-year-olds, male gender and a high-risk environment were important contributors. Finally, in an investigation of 6- and 9.5-year-olds, Beeghly et al. (2006) reported evidence to suggest the

effects of cocaine exposure on language development at 6, but not 9.5 years, and concluded that the effects of cocaine were moderated by age, birthweight, and gender.

Three investigators focused on alcohol exposure. O'Connor, Paley, and Drew (2006) found that prenatal alcohol exposure was associated with negative child affect among 4- and 5-year-olds, and in turn to depressive symptomatology. Howell, Lynch, Platzman, Smith, and Coles (2006) found that adolescents who had been prenatally exposed to alcohol had low scores on tests of IQ and mathematics achievement, but no increased incidence of conduct problems. In the only investigation to focus on an educational intervention, Padgett, Strickland, and Coles (2006) found that children diagnosed with fetal alcohol syndrome learned safety skills efficiently by using a computer-based virtual reality game.

The primary focus on cocaine in this issue may reflect the extent to which attention and resources were focused on this topic over the last 15 years. Alcohol and tobacco, which are commonly used drugs, have not been the focus of as much public health concern as the illicit drugs, and consequently, there are relatively few studies in this area. The impact of methamphetamine use, although currently a focus of attention in the media, has not yet received significant scientific attention, and published research in this area is very limited and certainly tentative. Other substances that might be of interest to the practitioner, such as prescription drugs that are used either with or without medical supervision (e.g., antidepressants and oxiconin) are not represented. Although such substances are widely used, there is limited ongoing research in these areas, and no articles on this topic were submitted for inclusion in this issue.

### Comments and Conclusions

As we read the submissions to this issue, we came to several conclusions about the field. In contrast to the way in which problems were viewed in previous decades, there is now considerable maturity in the approach to problems and in the interpretation of outcomes. The naïve "teratogenic" explanation for all observed behavior that was so common in the late 1980s has yielded to experience and to the accumulation of data, resulting in a much more nuanced understanding of effect and interaction of the multiple factors that lead to given outcomes.

As a consequence, the approach to investigating the effects of prenatal exposure has become much more sophisticated. The limitations inherent in clinical studies and retrospective reporting of use have become obvious; and investigators have learned to refine their

hypotheses and methods to avoid attributing the effects of confounding factors exclusively to drug exposure. Overtime, methods of defining exposure have been refined and investigators often define cocaine exposure by meconium metabolites or toxicology screens. In exposure samples, the need to control and evaluate potentially confounding factors, both pre- and postnatally, requires the recruitment and retention of large samples and the judicious interpretation of results.

The advantage of having many studies on a single topic is evident in the articles in this special issue that deal with cocaine exposure. By examining the result of all these efforts, it is easier to understand the meaning of each. In the case of cocaine exposure, the persistent lack of reliable differences between exposed and contrast groups in growth, dysmorphia and cognition, and the repeated findings associated with emotional and behavioral outcomes across multiple studies provide fairly compelling evidence for the type of risk associated with this exposure.

Although much of the literature on prenatal substance exposure has examined the impact of maternal cocaine use, drug-using women often smoke cigarettes and drink alcohol, substances with known effects on fetal and infant development (Frank et al., 2001). Data from over 8,500 mothers and infants participating in the Maternal Lifestyles Study show that single drug use is very rare; most drug-using women are ingesting multiple substances (Lester et al., 2001). Future researchers need to account for the effects of exposure to multiple substances on children's development.

Several articles in the special issue highlight the importance of considering the contributions of contextual factors, such as poverty, caregiver stability, and ongoing drug use in children's development, regardless of prenatal drug exposure. As scientists, we must address the important role that the home environment plays on children's development, with or without the introduction of a teratogen. The interaction between the effects of the teratogen and the effects of the environment is probably the most interesting scientific question in the field at this time. Children from substance using homes are, in some ways, a model for understanding the development of cognitive delays and developmental psychopathology. Exposure to drugs and alcohol is one of many negative environmental influences on the children whom we study. In many cases, substance use is a marker for substantial family dysfunction that will lead to predictably negative outcomes. In other cases, when children are able to develop in healthy ways despite

their exposure to noxious factors, investigations may provide considerable insight into human resilience.

The research represented by the articles in this special issue was initiated to allow both an understanding of the impact of drugs and alcohol on development and to provide scientifically valid information to practitioners and public health policy makers. These decades of research have given the field and society at large an expanded understanding of the characteristics of exposed and affected children, as well as data that can be used to inform educational decisions, to develop standards of care in medical settings, and to provide policy makers with guidelines needed to treat women and improve outcomes for children.

Many questions remain to be investigated. For example, little is known about the consequences of pre- or postnatal exposure to alcohol or drugs on functioning during adolescence and adulthood, particularly in the context of varying environmental conditions. As scientists and clinicians, one of our goals is to avoid the mistakes of the past in making overly pessimistic predictions about children's future substance abuse, behavior, and acceptance in society based on very limited data. Rather, we need well-conducted research to understand the nature of the long term consequences of early substance exposure on adolescent and adult functioning and to find ways to reduce negative impact.

The areas of education and treatment have received very little attention. Methods for early diagnosis as well as treatment, intervention, and education are still to be created and tested. An important focus for a subsequent special issue of this journal would be methods to provide practitioners with the tools needed to identify and support affected children and their families.

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## References

- Accornero, V. H., Morrow, C. E., Bandstra, E. S., Johnson, A. L., & Anthony, J. C. (2002). Behavioral outcome of preschoolers exposed prenatally to cocaine: Role of maternal behavioral health. *Journal of Pediatric Psychology, 27*, 259–269.
- Bandstra, E. S., Morrow, C. E., Anthony, J. C., Accornero, V. H., & Fried, P. A. (2001). Longitudinal investigation of task persistence and sustained attention in children with prenatal cocaine exposure. *Neurotoxicology and Teratology, 23*(6), 545–559.

- Bandstra, E. S., Vogel, A. L., Morrow, C. E., Xue, L., & Anthony, J. C. (2004). Severity of prenatal cocaine exposure and child language functioning through age seven years: A longitudinal latent growth curve analysis. *Substance Use & Misuse*, *39*, 25–59.
- Beeghly, M., Martin, B., Rose-Jacobs, R., Cabral, H., Augustyn, M., Bellinger, D., et al. April 20, 2005. Prenatal cocaine exposure and children's language functioning at 6 and 9.5 years: Moderating effects of child age, birthweight, and gender. *Journal of Pediatric Psychology*, doi:10.1093/jpepsy/jsj028.
- Behnke, M., Eyler, F. D., Warner, T. D., Garvan, C. W., Hou, W., & Wobie, K. April 6, 2005. Outcome from a prospective, longitudinal study of prenatal cocaine use: Preschool development at three years of age. *Journal of Pediatric Psychology*, doi:10.1093/jpepsy/jsj027.
- Bendersky, M., Bennett, D., & Lewis, M. April 6, 2005. Aggression at age five as a function of prenatal exposure to cocaine, gender and environmental risk. *Journal of Pediatric Psychology*, doi:10.1093/jpepsy/jsj025.
- Brown, J. V., Bakeman, R., Coles, C. D., Platzman, K. A., & Lunch, W. E. (2004). Prenatal cocaine exposure: A comparison of 2-year-old children in parental and nonparental care. *Child Development*, *75*, 1282–1296.
- Centers for Disease Control and Prevention (2004). Alcohol consumption among women who are pregnant or who might become pregnant—United States, 2002. *MMWR. Morbidity and Mortality Weekly Report*, *53*(50), 1178–1181.
- Chasnoff, I. J., Anson, A., Hatcher, R., Stenson, H., Laukea, K., & Randolph, L. A. (1998). Prenatal exposure to cocaine and other drugs: Outcome at four to six years. *Annals of the New York Academy of Sciences*, *846*, 314–328.
- Frank, D. A., Augustyn, M., Knight, W. G., Pell, T., & Zuckerman, B. (2001). Growth, development, and behavior in early childhood following prenatal cocaine exposure: A systematic review. *Journal of the American Medical Association*, *285*(12), 1613–1625.
- Howell, K. K., Lynch, M. E., Platzman, K., Smith, H. G., & Coles, C. D. April 13, 2005. Prenatal alcohol exposure and ability, academic achievement and school functioning in adolescence: A longitudinal follow-up. *Journal of Pediatric Psychology*, doi:10.1093/jpepsy/jsj029.
- Jones, K. L., & Smith, D. W. (1973). Recognition of the fetal alcohol syndrome in early infancy. *Lancet*, *7836*, 999–1001.
- Lester, B. M. E. I., Sohly, M., Wright, L. L., Smeriglio, V. L., Verter, J., Bauer, C. R., et al. (2001). The maternal lifestyle study: Drug use by meconium toxicology and maternal self-report. *Pediatrics*, *107*(2), 309–317.
- Linares, T. J., Singer, L. T., Kirchner, H. L., Short, E. J., Min, M. M., & Minnes, S. March 31, 2005. Mental health outcomes of cocaine exposed children at six years of age. *Journal of Pediatric Psychology*, doi:10.1093/jpepsy/jsj020.
- Martin, J. A., Kochanek, K. D., Strobino, D. M., Guyer, B., & MacDorman, M. F. (2005). Annual summary of vital statistics—2003. *Pediatrics*, *115*(3), 619–634.
- O'Connor, M. J., Paley, B., & Drew, C. R. March 31, 2005. The relationship of prenatal alcohol exposure and the postnatal environment to child depressive symptoms. *Journal of Pediatric Psychology*, doi:10.1093/jpepsy/jsj021.
- Padgett, L. S., Strickland, D., & Coles, C. D. April 13, 2005. Case study: Using a virtual reality computer game to teach fire safety skills to children diagnosed with Fetal Alcohol Syndrome (FAS). *Journal of Pediatric Psychology*, doi:10.1093/jpepsy/jsj030.
- Richardson, G. A., Conroy, M. L., & Day, N. L. (1996). Prenatal cocaine exposure: Effects on the development of school-age children. *Toxicology and Teratology*, *18*(6), 627–634.
- Schuetze, P., & Eiden, R. D. March 23, 2005. The association between maternal cocaine use during pregnancy and physiological regulation in four to eight week old infants: An examination of possible mediators and moderators. *Journal of Pediatric Psychology*, doi:10.1093/jpepsy/jsj022.
- Sheinkopf, S. J., Lester, B. M., LaGasse, L. L., Seifer, R., Bauer, C. R., Shankaran, S., et al. April 6, 2005. Interactions between maternal characteristics and neonatal behavior in the prediction of parenting stress and perception of infant temperament. *Journal of Pediatric Psychology*, doi:10.1093/jpepsy/jsj026.
- Stratton, K., Howe, C., & Battaglia, F., (Eds.). (1996). *Fetal Alcohol Syndrome: Diagnosis, Epidemiology, Prevention, and Treatment*. Washington, DC: National Academy Press.
- Zeskind, P. S., & Gingras, J. L. May 19, 2005. Maternal cigarette-smoking during pregnancy disrupts rhythms in fetal heart rate. *Journal of Pediatric Psychology*, doi:10.1093/jpepsy/jsj031.