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Behavioral Outcome of Preschoolers Exposed Prenatally to Cocaine: Role of Maternal Behavioral Health

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Abstract

Objective—To examine the impact of prenatal cocaine exposure and maternal behavioral health (recent drug use and psychological functioning) on child behavior at age 5 years.

Method—In this longitudinal investigation, maternal report of child behavior was assessed using the Achenbach Child Behavior Checklist (CBCL) in 140 cocaine-exposed and 181 noncocaine-exposed (61 alcohol, tobacco, and/or marijuana-exposed, and 120 nondrug-exposed) low-income, African American children. Structural equation modeling was used to estimate suspected causal relationships between indicators of maternal behavioral health at 5-year follow-up, according to self-report on a modified Addiction Severity Index (ASI) and CBCL scores.

Results—Prenatal cocaine exposure was not related to child behavior at age 5. Recent maternal drug use and psychological functioning had relationships with CBCL Internalizing and Externalizing scores. However, when considered within a combined model, only maternal psychological functioning remained significant.

Conclusions—Findings highlight the importance of maternal functioning in the behavioral outcome of children exposed prenatally to cocaine.

Keywords

prenatal cocaine exposure; child behavior; CBCL

Despite over a decade of research on the developmental consequences of *in utero* cocaine exposure, relatively few studies have addressed child outcome beyond the early preschool years. Several researchers have conceptually linked prenatal cocaine exposure and long-term deficits in arousal and emotional/behavioral regulation, primarily based on cocaine's effect on the monoaminergic system (e.g., Mayes, Grillon, Granger, & Schottenfeld, 1998; Volpe, 1992). Accordingly, cocaine-exposed children may be expected to display more difficulties with attention, aggression, moodiness, impulsivity, and peer problems. However, empirical data on attentional processing and emotional/behavioral adjustment in cocaine-exposed children have only recently emerged. Examiner ratings of behavior in the clinic setting as well as laboratory measures of attention and impulsivity (e.g., continuous performance test, delay of gratification tasks) have differientiated cocaine-exposed children from nondrug-exposed controls, with cocaine-exposed children showing increased levels of inattention, restlessness,

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and poor impulse control (Bandstra, Morrow, Anthony, Accornero, & Fried, 2001; Bendersky & Lewis, 1998; Richardson, 1998; Richardson, Conroy, & Day, 1996). Additionally, one report indicated that cocaine-exposed children displayed more problem behaviors in the classroom, as rated by the teacher (Delaney-Black et al., 1998).

A limited number of studies have examined parent report of emotional and behavioral problems with mixed results. Hawley and colleagues found that preschool children exposed to cocaine *in utero* showed significantly greater internalizing problems and were more likely to score in the clinical range on the CBCL than controls (Hawley, Halle, Drasin, & Thomas, 1995). Conversely, Phelps, Wallace, and Bontrager (1997) reported no difference on the CBCL between similar groups of cocaine- and nondrug-exposed preschoolers. These studies are limited by small sample sizes, the potential confounding effects of polydrug exposure, and failure to consider gestational age.

In larger longitudinal studies, findings to date have generally suggested an increased risk for behavioral difficulties for children exposed prenatally to cocaine. For example, Richardson (1998) found a relationship between first trimester cocaine exposure and greater internalizing and total behavior problems on the CBCL at 3 years of age. Additionally, Chasnoff and colleagues have reported greater internalizing problems (Chasnoff et al., 1998) and externalizing difficulties (Chasnoff et al., 1998; Griffith, Azuma, & Chasnoff, 1994) through age 6, although Azuma and Chasnoff (1993) did not find any group differences on CBCL domain scores at age 3. One limitation of these three reports is the substantial attrition of the original cohort at follow-up.

Whereas inconsistent findings in the behavioral outcome literature may be due in part to methodological limitations, mediating and moderating factors in child behavioral outcomes may also contribute. Women who use drugs during pregnancy often continue to use them long after delivery (Chasnoff et al., 1998). Parental drug use may affect the child indirectly through the negative life-style and psychosocial environments associated with drug use. Factors closely related to poor child outcome, such as high levels of maternal psychopathology, poor parenting, child abuse/neglect, and increased exposure to violence, often accompany caregiver drug use (Bays, 1990).

The co-occurrence of substance abuse and psychopathology is well documented (Campbell & Stark, 1991; Mirin, Weiss, Michael, & Griffin, 1988). Several studies have reported higher risk for depression (Hawley et al., 1995; Woods, Eyler, Behnke, & Conlon, 1993) and maladaptive personality characteristics (Howard, Beckwith, Espinosa, & Tyler, 1995; Singer et al., 1995) in mothers who abuse drugs, including cocaine. Maternal psychological distress has been linked to child developmental and behavioral difficulties (Lee & Gotlib, 1989; Singer et al., 1997; Zahn-Waxler et al., 1988). Therefore, maternal postnatal drug use combined with psychological distress may result in a potentiated risk for later emotional or behavioral difficulties in already vulnerable cocaine-exposed children.

This study evaluated the relationship of prenatal cocaine exposure and indicators of maternal behavioral health, recent maternal drug use and psychological functioning, on child behavioral functioning at 5 years of age. Specifically, we hypothesized that (1) prenatal cocaine exposure would relate to child behavioral functioning at age 5 years, after controlling for prenatal alcohol, cigarette, and marijuana exposure, with possible mediation through maternal drug use and psychological functioning; and (2) recent maternal drug use and psychological distress would relate to internalizing and externalizing difficulties at 5 years, as measured by Achenbach's Child Behavior Checklist (CBCL).

Method

Participants

Participants were children and their mothers enrolled in a longitudinal study of the effects of *in utero* cocaine exposure. The originating cohort included 476 full-term infants enrolled prospectively at birth (253 cocaine-exposed and 223 noncocaine-exposed, of whom 76 were exposed to varying amounts of alcohol, tobacco, and marijuana [ATM-exposed], and 147 were drug free). Prenatal cocaine exposure was determined by maternal self-report or positive assay on one or more biologic markers, including maternal urine, infant urine, and meconium. The sample was intentionally restricted with respect to low socioeconomic status (SES), innercity residence, and African American ethnicity to improve statistical power and covariate control. The mothers were seronegative for HIV infection and had no evidence of opiate, methadone, amphetamine, barbiturate, benzodiazepine, or phencyclidine use during pregnancy. None of the infants had major congenital malformations or disseminated congenital infection.

Data analyses for this study are based on the children and mothers completing the CBCL at the 5-year follow-up evaluation. Of the original 476 families, 414 (87%) returned for the 5-year motor assessment, during which the study measures were collected. Reasons for families not participating were as follows: 33 moved out of the area; 18 refused; 9 were unable to be located; and 2 children were deceased. An additional 15 families were excluded from this report due to incomplete CBCL data. The sample for this study was then restricted to those children with the biological mother as the primary caretaker and respondent on the study measures at age 5 years, yielding data on 321 children. Of the children included in this study, 140 were cocaine-exposed, 61 were ATM-exposed, and 120 were drug-free. There was no differential attrition across study groups. A comparison of birth characteristics of those who did and did not participate in the 5-year assessment showed equivalence on most factors, with the exception that the biological mothers of participants were less likely to have a high school diploma at the time of delivery ($p < .05$). Descriptive information on the participants of the present study is presented in Table I.

Procedures

The study was approved by the institutional review board and conducted under a federal Department of Health and Human Services Certificate of Confidentiality. The purpose of a DHHS Certificate of Confidentiality is to help researchers protect the privacy of participants in health research projects against compulsory legal demands (e.g., court orders and subpoenas) that seek the names or other personally identified information of research participants. Informed consent was obtained from all participants at enrollment and updated at the 5-year assessment. An initial epidemiological survey was conducted with 1,505 African American women residing in preselected zip codes and delivering full-term infants at Miami School of Medicine Jackson Memorial Medical Center during the period of November 1990 to June 1993. From this initial group of women and infants, 476 were recruited for participation in the longitudinal follow-up study.

The overall study design and recruitment of the follow-up cohort have been more extensively detailed in a separate report (Bandstra, Morrow, Anthony, Churchill, et al., 2001). In brief, cocaine-exposed infants were identified by maternal self-report of cocaine use during pregnancy or positive biologic markers (i.e., maternal and infant urine and infant meconium) for cocaine metabolites and had varying amounts of alcohol, tobacco, and marijuana exposure. As shown in Table II, mothers of the cocaine-exposed infants were more likely to have used tobacco during pregnancy than mothers of infants in the ATM group. Eighty-nine percent of the eligible cocaine-exposed mothers and infants were enrolled for follow-up. For the ATM group, 80% of those meeting a minimum ingestion criterion of 20 drinks of alcohol during

pregnancy (with or without marijuana or tobacco use) were enrolled. Noncocaine-exposed drug-free infants had mothers with negative lifetime histories for cocaine use, negative self-report during pregnancy and the 3 months preceding pregnancy, and negative results on all available toxicology assays. The number of mothers who met these drug-free criteria exceeded the target recruitment number. A random numbers table was used to balance recruitment of drug-free mothers across the study period.

The follow-up cohort was assessed at birth and at several subsequent research visits through age 7 years. This study makes use of assessments taken at the time of delivery (i.e., indicators of prenatal drug exposure and infant characteristics used as covariates) and maternal-report measures collected by trained research staff during the child's fifth year.

Birth Measures

Maternal Self-Report of Substance Use During Pregnancy—A structured standardized interview was administered within the first 36 hours postpartum and covered use of alcohol and a variety of commonly used legal and illegal drugs. Questions regarding drug use during pregnancy included number of weeks used, usual days/weeks, and usual dose/day. Daily dosage for key drugs was recorded as follows: number of rocks/lines of cocaine, number of cigarettes, number of marijuana joints, and number of standard drinks of beer, wine, or hard liquor. Standardized definitions (Schneiderman, 1990) were used for determining 1-drink units for each type of alcohol (e.g., beer 12 oz.). Total pregnancy drug usage composites were calculated for each drug by multiplying the number of weeks in which the given substance was used during pregnancy by the usual days/week and the usual dose/day. The composites for alcohol, tobacco, and marijuana were used separately in analyses as covariates.

Biological Markers (Meconium and Urine): Infant urine was collected on 98%, and maternal urine on 79% of the total sample, with 475 of the 476 enrolled infants having either a maternal or infant urine screen. Infant meconium was collected on 86% of the total sample. Sixty-eight percent of the total sample had all three biological markers, with 3% having only one biological marker. In the cocaine-exposed group, of the 18% categorized by urine without meconium samples available, 74% also self-reported positive cocaine use. EMIT® (Syva D. A. U.) was used to perform initial screening of urine and meconium for the cocaine metabolite benzoylecgonine, with a cut-off of 150 ng/ml urine and 150 ng/gm meconium. EMIT®-negative meconium specimens were dual-screened with EMIT® and DPC Coat-a-Count® Cocaine Metabolite, a solid-phase radioimmunoassay. All positive cases were confirmed by gas chromatography/mass spectrometry (GC/MS). Meconium drug testing has been reported to capture exposure as early as 16 weeks gestation and has shown good sensitivity and specificity for cocaine metabolites (Ostrea, Knapp, Ostrea, Tannenbaum, & Saleri, 1994; Ostrea, Knapp, Romero, & Ostrea, 1994). In addition to cocaine, maternal and infant urine specimens were also assayed by EMIT® for marijuana (cannabinoids), opiates, amphetamines, barbiturates, benzodiazepines, and phencyclidine. Meconium specimens were also assayed by EMIT® for marijuana and opiates.

Follow-Up Measures at 5 Years

Psychosocial Interview—This structured standardized interview developed by the investigators assessed the child/family psychosocial history, including family composition, family moves, caregiver changes, child/family social services, childcare, and child developmental/educational services during the year preceding the child's 5-year research visit.

Addiction Severity Index (ASI; McLellan et al., 1992; McLellan, Luborsky, Woody, & O'Brien, 1980): The ASI, a structured interview, was originally designed to assess treatment outcome but is widely used in substance abuse research. The alcohol and drug section of the

ASI was modified to include frequency of substance use in the previous 12 months. Total number of days of substance use in the past year was calculated separately for alcohol, tobacco, marijuana, crack, cocaine, and other drugs. Data from the ASI were positively skewed, with a relatively large number of mothers reporting no drug use. Consequently, frequency of use was recoded based on the frequency distributions for each drug. Alcohol, marijuana, and cocaine were recoded into four categories (0 = no use, 1 = first tertile of the distribution, 2 = second tertile, 3 = third tertile) and tobacco into three categories (0 = no use, 1 = first half of the distribution, 2 = second half of the distribution). Because so few mothers indicated crack or other illegal drug use, these variables were coded dichotomously (0 = no use, 1 = use).

The Composite Score from the Psychiatric Status section of the ASI was used as a measure of maternal psychological functioning. The weighted summary score, a continuous variable ranging from 0 (no problem) to 1 (most severe), is based on self-report of symptom occurrence (yes/no) in the past 30 days (depression, anxiety, hallucinations, trouble understanding/concentrating/remembering, thoughts of suicide, attempted suicide, and prescribed medication for psychological/emotional problem), as well as duration (number of days experiencing distress) and perceived impact (i.e., how bothersome the symptoms and how important treatment, as rated on a scale of 0 to 4) of psychological symptoms in the past 30 days.

The ASI has shown adequate test-retest reliability and good convergent and discriminant validity in a variety of clinical populations (Leonhard, Mulvey, Gastfriend, & Shwartz, 2000; McLellan et al., 1985; Zanis, McLellan, Cnaan, & Randall, 1994). Specifically, the Psychiatric Status Composite Score has been shown to correlate significantly with established measures of psychological symptoms and distress such as the Beck Depression Inventory (BDI; .52–.53) and the Symptom Checklist-90-Revised (SCL-90-R; .47–.66) (McLellan et al., 1985; Zanis et al., 1994). Additionally, internal consistency estimates for the Psychiatric Status Composite Score have ranged from .64 to .89 across several studies (Carey, Cocco, & Correia, 1997; Leonhard et al., 2000; Zanis et al., 1994).

Achenbach Child Behavior Checklist (Achenbach, 1991): The CBCL is a 113-item standardized parent-report measure of behavior problems in children, with norms available for ages 4–18 years. Standardized scores are determined for eight subscales (Withdrawn, Somatic Complaints, Anxious/Depressed, Social Problems, Thought Problems, Attention Problems, Delinquent Behavior, and Aggressive Behavior) and three summary domains (Internalizing, Externalizing, and Total Problems). Higher scores indicate greater behavior problems. We used only the CBCL Internalizing and Externalizing *T* scores.

Statistical Analysis

A MIMIC (multiple indicators, multiple causes) structural equation model, implemented in Mplus Software (Muthén & Muthén, 1999), was used to estimate the impact of prenatal cocaine exposure and maternal behavioral health on child internalizing and externalizing behaviors. Muthén's model, a special case of the LISREL models developed by Jöreskog and Sorbom, accommodates discrete categorical and highly skewed variables. The MIMIC model allowed us to use multiple regression for simultaneous estimation of two response variables, CBCL Internalizing score and Externalizing score, in relation to a latent construct of recent maternal drug use, as well as other dichotomous covariates (e.g., prenatal cocaine exposure, yes/no) and continuous covariates. The simultaneous estimation results in the estimation of effects for internalizing behavior while holding externalizing behavior constant, and vice versa, allowing the intercorrelation between the CBCL measures (r = .65) to be taken into account.

The MIMIC models were specified to address the primary research questions, while considering potential covariates. On conceptual grounds, child sex and age at assessment were included in all models. The following covariates, selected due to their potential confounding

influence, were also investigated: gestational age; birth growth parameters; prenatal exposure to alcohol (# drinks), marijuana (# joints) and tobacco (# cigarettes); child's IQ at age 5; day care (# years); enrollment in Head Start; receipt of developmental/behavioral services; number of caregiver changes in the previous year; and mother's age, marital status, employment, and educational level at the 5-year follow-up visit. A covariate was considered a potential confounder if in preliminary analyses it was related to either CBCL score at $p < .10$, or if its inclusion resulted in a significant shift in estimate (±1 SD) for relationships between indicators of maternal functioning and child behavior, suggesting a confounding influence. In all analyses, the focus was on the estimation of the magnitude of hypothesized relationships and the 95% confidence intervals (CIs), with statistical significance levels reported to aid interpretation.

Results

Descriptive data on the ASI Psychiatric Composite score and the CBCL Internalizing and Externalizing scores are presented in Table I and Table III, respectively. ASI Psychiatric Composite scores did not differ among the study groups. Although mean scores were in the low end of the possible range for the measure (i.e., 0.00 to 1.00), there are no appropriate normative data available for the ASI with which to compare these scores in terms of clinical significance. Mean CBCL *T* scores were in the nonclinical range and were similar for the groups. Additionally, the number of children scoring in the clinical range for the Internalizing and Externalizing scales did not differ. Table IV summarizes recent maternal drug use measured at the 5-year visit.

Model 1

In the first model, the magnitude of the relationship between prenatal cocaine exposure and child behavior problems at 5 years was investigated. Prenatal cocaine exposure was defined dichotomously (yes/no) based on combined self-report and toxicology data. Child behavior was measured by CBCL Internalizing and Externalizing *T* scores. Statistical adjustment for child's sex and age at the time of assessment was made in this analysis, as well as in subsequent models, to protect against the possibility that the *T* scores based on general population reference samples did not adequately capture age- and sex-related variation of CBCL scores in this particular sample. As shown in Table V, prenatal cocaine exposure was not related to internalizing behavior ($\beta = 0.41$; 95% CI = −1.66, 2.48; $p = .696$) or externalizing behavior ($\beta = 0.79$; 95% CI = −1.49, 3.08; $p = .498$). Accordingly, no additional analyses were run to evaluate mediating pathways between prenatal cocaine exposure and child behavior.

Model 2

Model 2 estimated the relationship between recent maternal drug use and the child's levels of internalizing and externalizing behaviors at 5 years. The MIMIC model was used to express recent maternal drug use as a latent construct, as measured by five indicators of drug use assessed at the 5-year visit (each scaled ordinally as described in the measures section): cocaine, crack, marijuana, alcohol, and tobacco. The indicator for other illegal drugs was not included because of its lack of contribution to the measurement of recent maternal drug use. Within this MIMIC model framework, the CBCL Internalizing and Externalizing scores were regressed simultaneously upon the latent maternal drug use construct. Estimates reveal a statistically significant association between recent maternal drug use and mother's report of child behavior under this model. Each standard deviation increase in level of recent maternal drug use was associated with an estimated 1.60 point increase in the level of child internalizing behavior ($\beta = 1.60$; 95% CI = 0.17, 3.03; $p = .028$) and with an estimated 1.76 point increase in level of child externalizing behavior ($\beta = 1.76$; 95% CI = 0.07, 3.45; $p = .041$). These results are shown in Table V, Model 2.

Model 3

In the next step, the above MIMIC model was elaborated to include the ASI Psychiatric Composite score as an indication of maternal psychological functioning. Recent maternal drug use and the ASI Psychiatric Composite score were modestly correlated ($r = .16$), and the MIMIC simultaneous estimation allowed for each measure to be estimated while holding the other constant. Maternal psychological functioning was associated with the child's levels of internalizing and externalizing behaviors. For each unit of increase in maternal psychological distress, there was an estimated 0.13 point increase in child internalizing behaviors ($\beta = 0.13$; 95% CI = 0.07, 0.20; $p < .001$) and, independently, an estimated 0.15 point increase in child externalizing behaviors ($\beta = 0.15$; 95% CI = 0.07, 0.22; $p < .001$). There was a reduction in the magnitude of the estimated relationships between recent maternal drug use and levels of internalizing and externalizing behaviors, once statistical adjustment for psychological distress was included (Table V, Model 3).

Model 4

In Model 4, the dichotomous term for prenatal cocaine exposure was reintroduced to investigate the relationship between prenatal cocaine use and subsequent maternal drug use and psychological functioning at the 5-year follow-up visit, and additional covariates were included to assess potential confounding. Each covariate indicated in the Statistical Analyses description was evaluated and included in the final model if it was related to the CBCL scores or met the "shift in estimate" criterion specified for confounding. Prenatal marijuana exposure (# joints), child IQ at age 5, number of caregiver changes in the previous year, mother's age, mother's education, and mother's employment were significantly related to the Internalizing or Externalizing score and were included along with child sex and age at assessment. No covariates met the shift in estimate criteria for confounding.

Within Model 4, prenatal cocaine use was related to maternal drug use at the 5-year visit ($\beta = 0.73$; 95% CI = 0.41, 1.05; $p < .001$). However, prenatal cocaine use was not associated with level of maternal psychological distress at the 5-year visit ($\beta = 1.50$; 95% CI = −2.94, 5.95; $p = .508$). As presented in Table V, Model 4, the relationship linking maternal behavioral health to child internalizing and externalizing behaviors did not change appreciably with inclusion of prenatal cocaine use and other covariates. Model 4 was also reexamined with internalizing and externalizing behaviors considered in separate models, without statistical control for the influence of one on the other, with no change in results (data not shown in table).

Discussion

The main findings of this study are (1) maternal cocaine use during pregnancy predicts self-reported maternal drug use 5 years postpartum, but does not predict child internalizing or externalizing behavior, as measured by the CBCL; (2) recent maternal drug use and psychological distress are related to child internalizing and externalizing behavior, although the directionality of these relationships cannot be ascertained due to the cross-sectional nature of the data. Maternal psychological distress was related, independent of recent maternal drug use, to maternal report of child internalizing and externalizing behavior. Conversely, the relationship between recent maternal drug use and CBCL behavioral functioning was attenuated once maternal psychological distress was taken into account. Finally, the inclusion of possibly confounding covariates in the model did not influence the interpretation of study results.

The observed lack of association between prenatal cocaine exposure and child behavior in this study is consistent with negative findings by Phelps et al. (1997) when using the CBCL to evaluate cocaine-exposed children. Still, this outcome is somewhat unexpected, considering

evidence suggesting abnormalities in the monoaminergic system as a consequence of *in utero* cocaine exposure (Mayes et al., 1998), as well as other published reports of increased internalizing and externalizing difficulties in cocaine-exposed children (Chasnoff et al., 1998; Richardson, 1998). This study was limited to full-term infants without major medical complications, potentially eliminating the more severely exposed infants. Additionally, we focused on children who remained in the care of their biological mothers. The exclusion of children residing with alternate caregivers may have resulted in the elimination of children whose mothers had more severe drug use. Sample restrictions such as these provide increased covariate control but may have diminished the prenatal cocaine exposure influence.

The CBCL as a measure of child behavior problems may not have been sufficiently sensitive to detect subtle behavioral deficits. In parallel research conducted with teacher-report versions of the CBCL and Conners' behavior rating scales, differences were not detected between children with and without prenatal cocaine exposure; however, behavioral differences were found on an investigator-developed measure designed to tap behaviors thought to be specific to prenatal cocaine exposure (Delaney-Black et al., 1998). Moreover, age 5 may be too early to measure cocaine-related impairments in attentional, emotional, and behavioral regulation. Such deficits may manifest later in childhood, as academic and social demands increase and prefrontal brain structures mature.

Many studies have documented an association between parental psychopathology or psychological symptoms and child behavior problems. In general, these studies suggest that children of parents who experience psychological distress may show a number of difficulties including greater internalizing and externalizing problems (e.g., Rutter & Quinton, 1984; Zahn-Waxler et al., 1988), social incompetence (Hammen et al., 1987), and academic difficulties (Weissman et al., 1987). Evidence for increased risk of behavior problems in children reared by caregivers with substance dependence is accumulating (e.g., Johnson & Leff, 1999; Obot, Wagner, & Anthony, 2001; Stanger et al., 1999). Additionally, other studies have shown an association between continued maternal drug use and child behavior in cocaine-exposed children (Chasnoff et al., 1998; Griffith et al., 1994).

Findings from this study suggest that the influence of ongoing maternal drug use on child behavior should be interpreted within the context of maternal psychological functioning. When maternal drug use and psychological difficulties coexist, it may be difficult to ascertain their relative influence on child behavioral functioning. In this study, self-reported drug use and psychological symptoms were modestly correlated, and both were related to child behavior. When considered together in statistical models, however, the relationship between recent maternal drug use and child behavior was somewhat dampened. The co-occurrence of maternal drug use and psychological distress may further compromise overall behavioral health and parenting behavior. Accordingly, drug-using mothers who also suffer from psychological distress may have a more negative influence on child behavior than drug-using mothers not experiencing psychological distress. This would explain the attenuated relationship observed between recent maternal drug use and child behavior, once maternal psychological functioning was included in the statistical model.

This study has numerous methodological strengths, such as large sample size, excellent retention, prospective enrollment of the infants at birth, and a demographically similar comparison group, but the contribution of this work should be interpreted in light of certain limitations. The most noteworthy limitation is the reliance on mother's report of both maternal and child functioning. Underreporting may have occurred due to the mother's desire to represent the child and herself in the most positive light or as a reflection of increased tolerance for problem behaviors. Alternatively, mothers experiencing psychological difficulties may have overreported problem behaviors due to an excessively negative perception of the child's

behavior. Additionally, the mother may have underreported or inaccurately perceived her own functioning. Self-report of drug use is widely used in research, primarily because of its availability, low cost, and limited intrusiveness compared to biological assays. However, the limitations of self-report data due to underreporting are well recognized (Anthony, Neumark, & Van Etten, 2000). Procedures to encourage valid report from mothers were included in data collection (e.g., using experienced interviewers, a federal certificate of confidentiality protecting research records). Still, the maternal self-report of recent drug use in this research may underestimate to some degree actual drug use, particularly with regard to illicit drugs such as cocaine and crack. Although this study measured many relevant variables, the conceptual model was not exhaustive and may have excluded other caregiving variables that might be important in understanding the behavioral outcomes of children exposed prenatally to cocaine. Additionally, this sample included African American children born full-term and drawn from urban, low-income neighborhoods. Though these inclusion/exclusion criteria were established to control for potential confounders and improve the ability to detect cocaine effects, such restriction limits the generalizability of results beyond the population under study.

In summary, this study adds to our understanding of the influence of prenatal cocaine exposure on child behavioral outcomes and, in particular, emphasizes the importance of the child's postnatal caregiving environment. The groups under study exhibited mean Internalizing and Externalizing CBCL scores within the normal range, with no differences in the percentage of children falling into the clinical range. Importantly, the effect of prenatal cocaine exposure on maternal self-report of child behavioral functioning may have been underrepresented, due to the previously discussed sample restrictions that may have excluded more severely cocaine-exposed children. Future research should focus on continued study of children exposed prenatally to cocaine into the school-age and adolescent years to determine whether behavioral difficulties emerge as the children mature. In addition, more consideration should be given to the influence of the postnatal environment, including factors such as parenting beliefs and behaviors that may mediate the relationship between maternal functioning and child behavior. Within this line of research, inclusion of multiple indicators of each construct drawn from varying sources such as teachers and examiners may yield more reliable and valid measurement of study variables. Finally, alternate conceptual models should be evaluated, including other relevant environmental factors, such as parental social support and family exposure to violence.

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Table I

Sample Description

Characteristic	Cocaine-exposed (*n* = 140) *M* (*SD*)	ATM-exposed (*n* = 61) *M* (*SD*)	Drug-free (*n* = 120) *M* (*SD*)
Child			
% males	50.7%	54.1%	50.8%
Gestational age (wks)	39.4 (1.5)[a]	40.0 (1.4)[b]	39.6 (1.4)
Birth weight (grams)	2,980 (496)[a]	3,240 (477)	3,322 (472)[b]
Full-scale IQ[d]	80.8 (10.6)	82.0 (11.5)	81.0 (11.9)
Age/5-yr visit (mths)	58.8 (3.1)	59.3 (4.1)	59.1 (3.7)
Yrs in day care	1.8 (1.7)	1.5 (1.6)	1.6 (1.4)
Attended Head Start	57.9%	61.0%	72.3%
Received special services	14.4%	8.5%	12.6%
Caregiver change in past yr	3.7%	3.4%	0.8%
Mother			
Age	33.7 (4.8)[a]	29.7 (5.3)[b]	27.7 (5.5)[c]
Never married	75.2%[a]	57.4%[b]	70.8%
HS graduate	41.7%[a]	55.7%	65.8%[b]
Employed	28.3%	41.7%	34.4%
ASI Psychiatric Composite[e]	0.10 (.15)	0.09 (.15)	0.07 (.15)

[a, b, c] Values in the same row with different letters are significantly different at $p < .05$.

[d] Wechsler Preschool Primary Scale-Revised (WPPSI-R), as measured at age 5.

[e] Addiction Severity Index Psychiatric Composite Score.

Table II

Maternal Report of Substance Use During Pregnancy

	Cocaine-exposed (*n* = 140)		ATM-exposed (*n* = 61)	
Substance	**Median (min, max)**	***n* (%)**	**Median (min, max)**	***n* (%)**
Alcohol (# drinks)	74 (1, 3823)	95 (68)	58 (2, 1680)	52 (85)
Tobacco (# cigarettes)*	1992 (2, 8820)	102 (73)	854 (3, 5880)	30 (49)
Marijuana (# joints)	23 (1, 798)	60 (43)	28 (1, 807)	22 (36)
Cocaine/crack (# lines/rocks)	92 (1, 15246)	88 (63)		

Medians and minimum/maximum values include only mothers who admitted use of the substance of interest.

*Significant at $p < .05$.

Table III

Mother-Report Child Behavior Checklist (CBCL) Scores at Age 5 Years

CBCL domain	Cocaine-exp. (*n* = 140)	ATM-exp. (*n* = 61)	Drug-free (*n* = 120)
Internalizing score			
T score	50.7 (9.9)	51.3 (8.7)	50.1 (9.3)
% in clinical range	19	16	17
Externalizing score			
T score	56.2 (10.4)	56.0 (10.8)	55.7 (10.35)
% in clinical range	34	33	33

Clinical range is defined by *T* scores ≥ 60.

Table IV

Maternal Report of Substance Use in Past Year at 5-Year Follow-Up

Substance	Cocaine-exp. (*n* = 140) *n* (%)	ATM-exp. (*n* = 61) *n* (%)	Drug-free (*n* = 120) *n* (%)
Alcohol	96 (70)[a]	54 (89)[b]	65 (54)[c]
Tobacco	90 (66)[a]	32 (53)[a]	10 (8)[b]
Marijuana	52 (37)[a]	23 (38)[a]	7 (6)[b]
Cocaine/crack	43 (32)[a]	5 (8)[b]	0 (0)[c]
Other drugs	8 (6)	3 (5)	3 (3)

Numbers and percentages reflect mothers who admitted use of the substance of interest in the past 12 months.

a, b, c Values in the same row with different letters are significantly different at $p < .05$.

Table V

Estimated Effects of Prenatal Cocaine Exposure and Postnatal Maternal Functioning on Child Behavior

	Internalizing			Externalizing		
Model	**Effect estimate**	**95% CI**	***p***	**Effect estimate**	**95% CI**	***p***
Model 1 (child's sex and age)[a]						
Prenatal cocaine use	0.41	−1.66, 2.48	.696	0.79	−1.49, 3.08	.498
Model 2 (child's sex and age)[b]						
Recent drug use	1.60	0.17, 3.03	.028	1.76	0.07, 3.45	.041
Model 3 (model 2 with mother's psychological functioning)[c]						
Recent drug use	1.13	−0.23, 2.49	.102	1.23	−0.36, 2.82	.129
Psychological distress	0.13	0.07, 0.20	< .001	0.15	0.07, 0.22	< .001
Model 4 (model 3 with prenatal cocaine exp. and covariates; prenatal marijuana exp., child full-scale IQ[d], caregiver changes, mother's age, education, and employment)[e]						
Recent drug use	1.15	−0.13, 2.44	.078	1.12	−0.32, 2.56	.126
Psychological distress	0.12	0.06, 0.17	< .001	0.14	0.07, 0.20	< .001

Child's sex was related to the Internalizing score ($p < .05$) in Models 1–3. Within Model 4, mother's age and education level were related to both internalizing and externalizing scores ($p < .05$).

[a] $n = 318$.

[b] $n = 313$.

[c] $n = 308$.

[d] Wechsler Preschool Primary Scale-Revised (WPPSI-R), as measured at age 5.

[e] $n = 295$.