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Psychological Functioning of Women Taking Illicit Drugs during Pregnancy and the Growth and Development of Their Offspring in Early Childhood

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Abstract

Objective: Assess psychosocial history and psychological functioning in women who use drugs during pregnancy and determine how drug exposure affects child development.

Methods: Pregnant marijuana ($n = 38$), cocaine ($n = 35$), methadone-maintained ($n = 24$), and control ($n = 49$) group women were enrolled and followed every 6 months through 18–24 months postnatally.

Results: There was a significantly higher incidence of mental illness in mothers in the drug groups. Prenatal stress and late-term drug severity scores were significantly higher in the cocaine and methadone mothers, who were also more likely to have abuse and incarceration histories. At 12 months, there were significantly higher rates of drug use in the marijuana group. Anxiety scores were highest in the methadone group. At 18–24 months, the methadone group reported significantly more stress, and methadone and marijuana groups had significantly higher anxiety and depression scores. At birth, methadone and marijuana neonates had significantly smaller head circumferences, with shorter lengths in the marijuana group. At one year, children in the cocaine group had significantly lower Bayley -III Cognitive and Motor scores. At 18–24 months, children in the methadone group had significantly smaller head circumferences and Cognitive scores. Children in the methadone and cocaine groups had a significantly higher incidence of atypical neurological examinations at 6–9 and 18–24 months.

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DISCLOSURES

Dr. Rosen reports no financial relationships with commercial interests.

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Conclusions: Methadone and cocaine group mothers presented with more severe prenatal drug use and psychosocial risk factors relative to women who used primarily marijuana. Children in the cocaine and methadone groups were neurologically atypical relative to others at study end. Mothers in the marijuana group reported chronic drug use as well as anxiety and depression in follow-up. At birth, children in the marijuana group were smaller, but this resolved with time. Similarly, children in the cocaine group had motor and cognitive delays which resolved by age two. Children in the methadone group had persistent growth and cognitive deficits. Their mothers demonstrated more anxiety, depression, and stress, the combination of which left these women and children liable to ongoing psychosocial struggle and psychological distress. Dual interventions for mother and child should be considered in attempting to optimize outcome.

Keywords

Prenatal drug exposure; maternal drug use; child development; psychosocial; socioeconomic status

Introduction

As of 2014, the prevalence of illicit drug use during pregnancy was approximately 5.4% (SAMHSA). Rates of 20–30% were not uncommon, when tested using random urine and meconium toxicology (Schempf, 2007). The prevalence rate was affected not only by self-report bias and method of toxicology, but also catchment area and differing rates of drug metabolism (Behnke & Smith, 2013; Lambert & Bauer, 2012).

Marijuana use during pregnancy has a prevalence rate of 11 – 20% (SAMHSA, 2012), which may now rise with increased acceptance and efforts toward decriminalization and legalization. Conversely, prenatal crack/cocaine use has declined since its peak in the 80's and 90's (Bhuvanewar, Chang, Epstein, & Stern, 2008), but remains prevalent in urban areas. Concomitantly, heroin use has spread to rural and suburban areas, and a handful of states have declared heroin epidemics (Seelye, 2016). This upsurge is partly due to the rise in prescription painkiller use, leading many to turn to heroin as an affordable alternative. For these reasons, prenatal drug abuse is a national public health issue.

Illicit drugs affect the fetus by crossing the placenta in varying amounts, and may permanently affect brain structure and function (Pollard, 2007). Marijuana exposure may modify neuronal structure and function via endocannabinoid receptors, which are widely distributed in the fetal brain (Behnke & Smith, 2013). Cocaine, by interacting with monoaminergic transmitters, alters neuronal growth, development, and cytoarchitecture (Ackerman et al., 2010). Heroin and methadone, which act on opioid receptors, can interfere with DNA synthesis and fetal brain cell mitosis (Konijnenberg & Melinder, 2011).

The neonatal effects of prenatal drug exposure range from deficits in growth to acute withdrawal symptoms. Intrauterine exposure to cocaine, opioids, marijuana, alcohol and tobacco have been associated with growth reduction (Bier, Finger, Bier, Johnson, & Coyle, 2015; Gray et al., 2010; Shankaran et al., 2004). One review reported that marijuana is not generally associated with growth reduction, but is accompanied by an increased startle response and tremors (Behnke & Smith, 2013). Abnormal neurobehavior secondary to neonatal abstinence syndrome is commonly described in opioid exposed neonates (Stephen,

Whitworth & Cox, 2014), and in cocaine exposed infants, who demonstrate irritability, poor alertness, and orientation (Behnke & Smith, 2013).

Risk factors associated with prenatal drug use include a history of mental illness, childhood history of abuse, and environmental stressors (Moylan, Jones, Haug, Kissin, & Svikis, 2001; Tuten, Jones, Svikis, 2003). Women who use drugs during pregnancy tend to experience higher rates of anxiety, depression, and violence compared to the general population (Nair, Schuler, Black, Kettinger, & Harrington, 2003; Stein, Leslie, Nyamathi, 2002; Tuten, Jones, Tran, & Svikis, 2004). Drug use, depression, and domestic violence have all been linked to psychosocial stress during pregnancy (Tuten et al., 2004; Woods, Melville, Guo, Fan, & Gavin, 2010).

There are very few recent follow-up studies in this field, and many have methodological problems. Findings on long-term effects of prenatal drug exposure on growth are inconsistent across study and drug type. A review of more recent prenatal drug studies shows no long-term growth effects (Ackerman et al., 2010; Behnke & Smith, 2013) for cocaine and marijuana exposed children. Some report persistently smaller head circumferences and heights in children of methadone-maintained mothers (Bier et al., 2015; Chasnoff, Rosen & Johnson, 1982; Wilson et al., 1981). Neuropsychological deficits, in attention, learning, memory and executive function have been described for marijuana and cocaine exposed children (Ackerman et al., 2010; Goldschmidt, Richardson, Willford, & Day, 2008; Savage et al., 2005). Hyperactivity, delayed language development, and poor school performance have been described in children exposed to opiates and cocaine (Behnke & Smith, 2013; Levine et al., 2008; Rosen & Johnson, 1985). Finally, no studies to date have adequately explored maternal psychosocial histories of women who use drugs during pregnancy and the impact on neonates and children.

In sum, despite the major contributions made in research on prenatal drug abuse, this research has rarely focused on the psychosocial history and psychological functioning of pregnant women who use drugs of abuse. Moreover, the effects of these drugs on child growth and development are often contradictory across studies. Therefore, additional research is necessary to corroborate findings and to direct future research. We report here the results of a longitudinal study aimed to assess psychosocial functioning in a cohort of high risk, pregnant women who used illicit drugs during pregnancy, and to assess physical, neurological, and skill development in a sample of children with prenatal exposure to these substances. Specifically, we hypothesized that:

1. Women who used drugs during pregnancy would report increased stress, anxiety, depression, and a history of abuse, mental illness, and incarceration compared to controls.
2. Children with prenatal illicit drug exposure would exhibit growth deficits at birth, and that children in the methadone group would have smaller head circumferences and lengths in follow-up compared to controls.
3. Children with prenatal drug exposure would have skill deficits in the areas of language, motor, and cognition in follow-up, and these findings would be associated with aberrant maternal psychosocial functioning.

Methods

Sample and Participants

This is a longitudinal study conducted from 2004–2010 investigating the effects of prenatal illicit drug exposure on child development. Participants were seen every 6 months until 36 months of age. We report here our 6–9, 12, and 18–24 month findings. This study was approved by the Institutional Review Boards of New York Presbyterian Hospital and the New York State Psychiatric Institute at Columbia University Medical Center.

Pregnant women were recruited from prenatal clinics and treatment programs in New York City or via advertisements. Inclusion criteria were prenatal consumption of illicit drugs during pregnancy and/or methadone maintenance. Control group mothers were referred from the prenatal clinics of New York Presbyterian Hospital. These mothers had a history of healthy pregnancies and of no substance use during the current pregnancy in their medical records and by urine toxicology. Exclusion criteria included a history of alcohol use > 2oz/day, other medications known to affect neonatal development, chronic medical conditions such as HIV/AIDS, seizure disorder, malignancy, and/or diabetes mellitus, neonatal complications, < 37 weeks gestational age, and major congenital anomalies and syndromes during the current pregnancy/delivery. If eligible upon screening, and after a complete discussion of the study details, verbal and written consents were obtained.

A total of 210 subjects were enrolled and 64 (31%) were excluded due to criteria above, resulting in a final sample of 146 participants ranging in age from 18–43 years old. The final population included marijuana ($n = 38$), cocaine ($n = 35$), heroin with methadone maintenance ($n = 24$), and control ($n = 49$) groups. Attrition rates were substantial throughout follow-up.

Methadone doses during pregnancy ranged from 40–260 mgs/day ($M = 75.30$, $SD = 40.30$) with dose adjustments made by the treatment program. Poly-drug use was present in 36% of the participants enrolled in the drug groups. In this case, group assignment was based on the drug most frequently and emphatically used; if a mother in the cocaine group used crack/cocaine daily and smoked marijuana occasionally, she was assigned to the cocaine group. Self-reported maternal drug use or lack thereof, was confirmed by chart review and random urine toxicology. A Certificate of Confidentiality was obtained to discourage inaccurate reporting. Masters level research assistants were trained to ensure reliability in the administration and scoring of all study measures. A Spanish-speaking research assistant was available as needed for translation at study visits.

We experienced a substantial attrition rate throughout follow up, but no new participants were added to the sample. From the initial sample with prenatal data ($N = 146$), in follow-up there was available data for 87 (60%) mother-child pairs at the 6–9 month visit, 90 (62%) at the 12 month visit, and 85 (58%) at the 18–24 month visit.

Assessments and Measures

Psychosocial History—Psychosocial histories were collected prenatally, by interviewing mothers with a questionnaire compiled for use in prior follow up studies by the principal

investigator (Fiks, Johnson, & Rosen, 1985; Lewis, Misra, Johnson, & Rosen, 2004; Rosen & Johnson, 1982). The particular items used in this research were age, race/ethnicity, years of education, and occupation type. In addition, mothers were asked directly about their history of mental illness, for example, "Have you ever received a formal mental health diagnosis from a mental health professional?". A Hollingshead (1975) score was calculated as a metric for determining socioeconomic status.

A brief stress scale reported on in our prior studies (Fiks, Johnson, & Rosen, 1985; Johnson, Nusbaum, Bejarano, & Rosen, 1999; Rosen & Johnson, 1982) was administered to our subjects at each visit. This measure was originally adapted from Cochrane and Roberston (1973), and instructs individuals to rate their magnitude of stress from 0 "*not at all stressed*" to 3 "*stressed most of the time*" in relation to common social problems, "*Within the past year, rate how often you have experienced stress relating to the following issues: finances, housing, childcare, and relationships?*". Overall scores range from 0 (*minimum*) to 12 (*maximum*). Cronbach alphas ranged from .78 to .82 across measurement points suggesting good internal consistency.

The Clinician Administered PTSD Scale for DSM-IV (Blake et al., 1995) was administered prenatally to assess for trauma history. We specifically coded for instances of physical or sexual abuse or assault (0 = *not present*, 1 = *present*). This scale is the gold standard in measures of posttraumatic stress disorder and has been shown to have excellent reliability as well as convergent and discriminant validity (Weathers, Keane, & Davidson, 2001).

The 14-item Hamilton Anxiety (HAM-A) and 24-item Depression (HAM-D) rating scales (Hamilton, 1959; Hamilton, 1960) were used to assess anxiety and depressive symptoms in our subjects at each visit. These scales inquire about mood, anhedonia, somatic symptoms, and overall functioning for the past two weeks. Item-level scores range from 0 to 4 for both versions. A maximum possible score on the HAM-A is 56 and 76 for the HAM-D. Maier et al. (1988) demonstrated reliability and concurrent validity for the HAM-A. The HAM-D has adequate internal reliability, convergent validity and discriminant validity (Bagby, Ryder, Schuller, & Marshall, 2004). Cronbach alphas ranged from .82 to .85 for the HAM-A and from .86 to .88 for the HAM-D across measurement points, suggesting good internal consistency.

Substance use data were collected at each visit using a questionnaire developed from our prior research (Datta-Bhutada, Johnson, & Rosen, 1997), and based on a review of the literature. Pattern of use was inquired for all substances (crack, cocaine, marijuana, heroin, methadone, alcohol, and cigarettes). Methamphetamine use was also inquired, but no participants endorsed using this drug. Participants were asked about the last time each substance was used and the frequency (daily, a few times per week, once per week, or occasionally) and quantity of their use.

At the prenatal visit, mothers were asked to report on drug use for each trimester separately. Prior research has demonstrated considerably greater reliability and validity of prenatal compared with postnatal reports of drug use during pregnancy (Jacobson, Chiodo, Sokol, Jacobson, 2002). In addition to the administration of the drug use questionnaire, urine

toxicology screens (for amphetamines, marijuana, opiates and benzodiazepines) were conducted during pregnancy, and for the study infant's urine within 24 hours of birth, if available.

A drug scoring system was used to evaluate severity of drug use during pregnancy (see Table 1). This rubric was used in our previous studies (Datta-Bhutada, Johnson, & Rosen, 1997; Johnson & Rosen, 1990) and was adapted from Streissguth et al., 1991. Severity scores were calculated for each drug used, based on amount and/or frequency of use, and summed per trimester for a total drug use severity score. Drug neurotoxicity for fetal development was considered when determining severity score ranges. Methadone, cigarettes, and alcohol were excluded from drug severity calculations. Cigarette and alcohol use were summed across trimesters, and divided by total days of gestation, to derive a crude estimate of daily use. If positive screens were observed for urine toxicologies collected with no corroborating self-report, this was scored as 'occasional' use for that drug type and that trimester of pregnancy.

Obstetrics and Neonatal Data—Medical records were reviewed for each study participant to ensure that they met eligibility criteria with no confounding maternal or neonatal medical conditions. Neonatal records were reviewed for mode of delivery, 5 minute Apgar score, growth parameters (weight, head circumference, and length), and gestational age and incidence of neurobehavioral symptoms.

Child Growth and Development—Follow-up visits included a physical and neurological exam conducted by a neonatologist (T.R.) who was blinded to group assignment. Measurements of length, weight, and head circumference were taken at each examination. The neurological exam assessed for cranial nerve function, tone, gross and fine motor coordination, normal and abnormal reflexes, and developmental milestones, to determine if any abnormalities were present.

The Bayley Scales of Infant Development – Third Edition (Bayley-III; Bayley, 1993) was administered at the 12 and 18–24 month visits. This measure is an interactive assessment of a child's cognitive ability, and development in expressive and receptive language and fine and gross motor skills. Items increase in complexity with age and individual skill level. Reliability estimates and validity are considered appropriate for clinical use (Weiss, Oakland, & Aylward, 2010).

Analysis Plan

Analyses of Variance were used to examine continuous variables across groups, such as maternal age. A Scheffe's post-hoc test was used to test significance where appropriate, as indicated. Multiple regression models were conducted with dummy coding for group contrasts as independent predictors of socioeconomic status, (for which Hollingshead scores served as a proxy), while partialing the effects of maternal age and ethnicity. Logistic regression models were conducted with dummy coded groups as independent predictors of maternal histories of mental illness, abuse, and incarceration, while partialing for the effects of maternal age and race/ethnicity. Multiple linear regressions were conducted with group contrasts as independent predictors of maternal anxiety, depression, and stress prenatally and in follow-up. For birth analyses, multiple regression analyses were conducted with dummy

coding for group contrasts as independent predictors of mode of delivery, gestational age, 5-minute Apgar score, and gender. For regression analyses conducted with child growth parameters at birth, gestational age, alcohol, and tobacco exposures were controlled for and for growth parameters at 12 and 18–24 months, prenatal alcohol and tobacco exposure were controlled for. Logistic regression analyses were conducted with group status as independent predictors of: drug use (0 = *no*, 1 = *yes*), history of physical/sexual abuse (0 = *no*, 1 = *yes*), and neurological examination findings (0 = *typical*, 1 = *atypical*). Multiple regression models were run with dummy coding for group contrasts as independent predictors of Bayley scores partialing for the effect of socioeconomic status, for which Hollingshead scores served as a proxy.

RESULTS

Perinatal visit

Demographics—Analyses of Variance found significant age differences among the groups [$F(3, 145) = 10.53, p = .001$]; a follow-up Scheffe test indicated methadone group participants were older than other participants ($p = .003$). A Chi Square analysis showed significant differences in maternal race/ethnicity in the control group compared to the drug groups [$\chi^2(12) = 47.22, p < .001$]. A follow-up Scheffe test revealed no significant differences in race/ethnicity for marijuana and cocaine ($p = .31$), marijuana and methadone ($p = .98$), and methadone and cocaine ($p = .70$) mothers. There were more Hispanic women in the control group than the drug groups, reflecting Washington Heights catchment area; the drug group women were mostly Black. A multiple regression model evaluating socioeconomic status by group was significant [$F(3, 142) = 4.96, p = .03, R^2 = 0.31$], with significantly lower Hollingshead scores for the cocaine ($B = -8.02, SE = 2.01, p < .001$) and methadone ($B = -7.60, SE = 2.25, p = .001$) groups compared to controls.

Psychosocial History—Logistic regression models were conducted to evaluate whether a history of abuse, mental illness, and incarceration differed by group. The model testing whether rates of mental illness differed by group while partialing for the effects of age and race/ethnicity was significant [$\chi^2(5) = 31.49, p < .001$]. Compared to controls, a history of mental illness was 12 times more likely for participants in the marijuana group [$Exp(B) = 11.98, SE = 0.69, p < .001$], 14 times more likely for the cocaine group [$Exp(B) = 2.69, SE = 0.73, p < .001$], and almost 30 times more likely for methadone group participants [$Exp(B) = 3.33, SE = 0.78, p < .001$]. A history of physical or sexual abuse or assault was significantly different across groups [$\chi^2(5) = 23.72, p < .001$]. Mothers in the cocaine [$Exp(B) = 4.89, SE = 0.66, p = .02$] and methadone [$Exp(B) = 21.10, SE = 0.97, p = .002$] groups reported a higher incidence of abuse compared to controls. The model evaluating incarceration rates by group resulted in significant differences [$\chi^2(5) = 33.97, p < .001$]. Mothers in the cocaine and methadone groups were more likely to have been in jail [$Exp(B) = 27.50, SE = 0.86, p < .001$; $Exp(B) = 20.59, SE = 0.95, p = .001$, respectively].

Maternal Functioning—Multiple regression models evaluated maternal ratings of stress, anxiety, and depression by group. Stress scores were significantly different by group [$F(3, 106) = 5.15, p = .002$], with significantly higher stress scores in the cocaine ($B = 2.71, SE =$

1.02, $p = .01$) and methadone ($B = 3.50$, $SE = 1.16$, $p = .003$) groups compared to other groups. The overall models evaluating group differences for HAM-A [$F(3, 128) = .41$, $p = .75$] and HAM-D [$F(3, 126) = 1.10$, $p = .35$] were not significant, and none of the individual predictors were significant.

Multiple regression models evaluated drug severity scores by group per trimester. These models were significant, for the 1st ($F(3, 145) = 91.80$, $p < .001$), 2nd ($F(3, 145) = 19.78$, $p < .001$) and 3rd ($F(3, 143) = 8.01$, $p < .001$) trimesters of pregnancy. In the 1st trimester, marijuana ($B = 4.42$, $SE = 1.58$, $p = .006$), cocaine ($B = 21.34$, $SE = 1.62$, $p < .001$), and methadone ($B = 23.21$, $SE = 1.83$, $p < .001$) groups had significantly elevated drug severity scores compared to controls. For the 2nd and 3rd trimesters, cocaine ($B = 13.03$, $SE = 2.09$, $p < .001$; ($B = 3.83$, $SE = 1.19$, $p = .002$, respectively) and methadone ($B = 13.67$, $SE = 2.35$, $p < .001$; ($B = 5.88$, $SE = 1.34$, $p < .001$, respectively) group mothers had significantly higher drug severity scores relative to marijuana and control groups. Poly-drug use was prominent in the cocaine and methadone groups.

Multiple regression models were conducted to evaluate group differences in cigarette and alcohol use. There were significant group differences in cigarette use [$F(3, 118) = 29.53$, $p < .001$, $R^2 = 0.44$]. Cocaine ($B = 567.21$, $SE = 78.40$, $p < .001$) and methadone ($B = 712.94$, $SE = 94.69$, $p < .001$) group participants smoked significantly more cigarettes than the marijuana and control groups. There were significant group differences in alcohol use [$F(3, 128) = 3.13$, $p = .03$, $R^2 = 0.26$], with cocaine group participants reporting significantly more alcohol consumption than the other groups ($B = 12.95$, $SE = 4.69$, $p = .007$).

Obstetrics and Delivery—A Chi Square analysis showed no significant differences in delivery type by group [$\chi^2(18) = 19.96$, $p = .36$]. A regression analysis evaluating group differences in gestational age was not significant [$F(3, 145) = .83$, $p < .48$, $R^2 = 0.02$], nor was the model evaluating group differences in Apgar scores at 5 minutes [$F(3, 129) = .92$, $p = .43$, $R^2 = 0.02$]. A logistic regression evaluating group differences in gender was not significant [$\chi^2(3) = 0.85$, $p = .84$].

Multiple regression models evaluated group differences in infant growth parameters while controlling for alcohol and tobacco. There were significant group differences in head circumference [$F(6, 109) = 6.61$, $p < .001$, $R^2 = 0.28$], with smaller head circumferences in the marijuana ($B = -0.83$, $SE = 0.33$, $p = .01$) and methadone ($B = -1.27$, $SE = 0.50$, $p = .01$) groups. The model evaluating birth weight was significant [$F(6, 110) = 2.70$, $p = .02$, $R^2 = 0.14$], reflecting significantly lower birth weights for children in the marijuana group compared to other groups ($B = -218.48$, $SE = 108.19$, $p = .05$). Length was not significantly different by group [$F(5, 110) = 2.06$, $p = .08$, $R^2 = 0.90$]. 6–9 month visit

Maternal Functioning—Regression models evaluating group differences in maternal stress [$F(3, 86) = 0.43$, $p = .73$, $R^2 = 0.02$], anxiety [$F(3, 76) = 0.45$, $p = .72$, $R^2 = 0.02$], and depression [$F(3, 77) = 0.95$, $p = .42$, $R^2 = 0.04$], were all not significant. There were no significant group differences in drug use [$\chi^2(3) = 5.14$, $p = .16$].

Child Growth and Development—Regression models evaluating growth parameters by group revealed non-significant differences in length [$F(5,71) = 1.19, p = .32, R^2 = 0.08$], head circumference [$F(5,71) = 0.81, p = .55, R^2 = 0.06$], and weight [$F(5,71) = 0.81, p = .55, R^2 = 0.06$]. The overall logistic regression model evaluating neurological examinations was not significant [$\chi^2(3) = 5.14, p = .16$]; regression coefficients indicated a higher incidence of atypical findings in the methadone [$Exp(B) = 0.09, SE = 1.43, p = .04$] and cocaine [$Exp(B) = 0.06, SE = 1.18, p = .04$] groups. 12 month visit

Maternal Functioning—Multiple regression models evaluated group differences in anxiety, depression, stress. Anxiety scores were significantly different across groups [$F(3,77) = 3.49, p = .02, R^2 = 0.12$]; there were higher HAM-A scores in the methadone group ($B = 4.23, SE = 1.41, p < .001$). There were no significant differences in depression [$F(3,79) = 1.74, p = .17, R^2 = 0.06$] or stress [$F(3,73) = 1.68, p = .18, R^2 = 0.07$] scores. A logistic regression analysis of drug use by group was significant [$\chi^2(1) = 15.90, p = .001$], revealing more drug use for the marijuana group relative to other groups [$Exp(B) = 30.38, SE = 1.13, p = .002$].

Child Growth and Development—A logistic regression model examining group differences in neurological examination findings did not produce significant results [$\chi^2(3) = 5.36, p = .15$]. Regression analyses examined growth parameters partialing for the effects of alcohol and cigarettes. There were no significant differences in weight [$F(5,71) = 0.81, p = .55, R^2 = 0.06$], head circumference [$F(5,71) = 0.81, p = .55, R^2 = 0.06$], or length [$F(5,71) = 1.19, p = .32, R^2 = 0.08$].

Regression analyses evaluating group differences in Bayley-III scores while controlling for socioeconomic status was significant for cognitive [$F(4,80) = 2.97, p = .03, R^2 = 0.14$] and motor [$F(4,79) = 3.16, p = .02, R^2 = 0.14$] scores. Specifically, children in the cocaine group had significantly lower scores for cognitive ($B = -14.00, SE = 4.35, p < .01$) and motor ($B = -10.70, SE = 3.60, p < .01$) domains compared to other groups. No other significant differences in Bayley-III scores emerged. 18–24 month visit

Maternal Functioning—Regression analyses evaluated group differences in anxiety, depression, stress, and drug use. There were significant group differences in HAM-A [$F(3,70) = 5.39, p < .001, R^2 = 0.19$] and HAM-D [$F(3,70) = 5.49, p < .001, R^2 = 0.20$] scores, with higher HAM-A and HAM-D scores observed in the methadone ($B = 4.52, SE = 1.53, p = .004$; $B = 3.77, SE = 1.12, p = .001$, respectively) and marijuana ($B = 7.87, SE = 2.25, p = .001$; $B = 4.97, SE = 1.65, p = .004$, respectively) groups. The overall model evaluating maternal stress by group was not significant [$F(3,75) = 1.63, p = .19, R^2 = 0.06$]. Regression coefficients were significant for mothers in the methadone group ($B = 2.46, SE = 1.2, p = .04$), indicating higher stress scores compared to other groups. The overall logistic regression model evaluating drug use by group was statistically significant [$\chi^2(3) = 33.30, p < .001$], but none of the individual predictors were significant.

Child Growth and Development—Multiple regression models evaluated group differences in growth while controlling for prenatal alcohol and tobacco exposures. No significant differences in length [$F(5,66) = 1.45, p = .22, R^2 = 0.11$] or weight [$F(5,66) =$

0.36, $p = .87$, $R^2 = 0.29$] emerged. The overall model evaluating group differences in head circumferences was not significant [$F(5,66) = 1.72$, $p = .14$, $R^2 = 0.12$]. Regression coefficients were significant for the methadone group, indicating smaller head circumferences for children in the methadone group compared to other groups ($B = -26.30$, $SE = 12.10$, $p = .03$).

Regression analyses evaluated Bayley-III scores by group while partialing for socioeconomic status. The overall model evaluating Bayley-III cognitive scores was not significant [$F(4,71) = 1.10$, $p = .36$, $R^2 = 0.06$], but regression coefficients indicated lower scores for children in the methadone group compared to other groups ($B = -13.80$, $SE = 4.90$, $p < .01$). No other significant differences in Bayley-III scores emerged.

The overall logistic regression model evaluating neurological examination findings was significant [$\chi^2(3) = 9.07$, $p = .03$]. There was a higher incidence of atypical neurological examination findings in methadone [$Exp(B) = 6.60$, $SE = 0.86$, $p = .03$] and cocaine [$Exp(B) = 3.90$, $SE = 0.60$, $p = .02$] groups.

DISCUSSION

Psychosocially, we found that there was a significantly higher rate of self-reported, lifetime mental illness in a longitudinal sample of women who used illicit drugs during pregnancy. Pregnant women in the cocaine and methadone groups were of a lower socioeconomic status, and were significantly more likely to have a history of abuse and of incarceration, relative to other groups. Cocaine and methadone group participants reported more prenatal stress, and severe poly-drug use as well as tobacco use throughout pregnancy compared to the marijuana group. Mothers in the methadone group reported significantly more stress compared to other groups at the 18–24 month visit. Participants in the marijuana and methadone groups demonstrated more symptoms of anxiety and depression at 18–24 months compared to mothers in the cocaine and control groups. Children in the cocaine and methadone groups exhibited neurological abnormalities and developmental delays compared to controls. In many instances, children with prenatal drug exposure caught up to control group children in growth and development. Specific findings varied by group.

At birth, we found that children in the marijuana and methadone groups not only had smaller head circumferences, but head sizes remained significantly smaller for children in the methadone group at 18–24 months. There are contradictory findings on small head circumferences for children exposed to marijuana and methadone (Behnke & Smith, 2013; Bier et al., 2015; Chasnoff, Rosen & Johnson, 1982; Wilson et al., 1981). Since our attrition rate was considerable (40%) and participants who were compliant with study visits were much more functional, these results warrant additional replications to confirm.

Given the conflicting reports in the literature on growth and development of children with prenatal drug exposure, the present study produced novel and important findings. For instance, despite reports to the contrary (see Behnke & Smith, 2013), we found that children in the marijuana group had smaller head circumferences and birth weights compared to controls, but caught up in growth by 6–9 months. In follow-up, their growth parameters did

not differ from controls, although this is due in part to controlling for tobacco and alcohol exposures. When the confounding effects of these variables were not controlled for, marijuana exposed children had significantly shorter lengths at 12 months compared to other groups. Conflicting results could be due to differences in confounds controlled for across studies.

At 6–9 months, children in the methadone and cocaine groups had a higher incidence of neurologic abnormalities compared to controls. This may be due to other substances they were exposed to in utero in addition to methadone, including illicit drugs, alcohol, and tobacco (see Bier et al., 2015; Gray et al., 2010; Shankaran et al., 2004). Further, these mothers had more psychosocial risk factors compared to the marijuana and control groups, including a lower socioeconomic status, which has been shown to influence child brain development (Hackman & Farah, 2009). Neurological soft signs in early childhood are indicative of later cognitive and psychiatric problems (Breslau et al., 1999), and at 18–24 months, methadone group children had significantly lower cognitive scores compared to other groups. Future studies should evaluate whether improved socioeconomic status can be protective against these effects in children with prenatal drug exposure.

Children in the cocaine group had lower cognitive and motor scores compared to other groups at one year, which was not observed at 18–24 months. This likely reflects a developmental delay, although research suggests these children are at risk for cognitive problems in later development. For example, inattention, disinhibition, and memory problems have been described (Ackerman et al., 2010; Bennett, Bendersky, & Lewis, 2008; Savage et al., 2005), which correspond with the maturation of prefrontal areas (Shankaran et al., 2004). An alternative possibility is that this sample of children with prenatal cocaine exposure are at an advantage due to their seemingly resilient mothers. Mothers in the cocaine group appeared to be functioning well overall; rates of anxiety, depression, and stress were not significantly different from controls in follow-up. Comparatively, mothers in the methadone group shared multiple risk factors with mothers in the cocaine group (i.e., history of mental illness, incarceration, and abuse, low socioeconomic status, and severe prenatal poly-drug use). Mothers on methadone-maintenance reported significantly more stress prenatally, and anxiety, depression, and stress in follow-up, which may have affected their children's outcome. Methadone group children had significantly lower cognitive scores at 18–24 months relative to other groups. Maternal stress has been known to adversely affect child cognitive development (Talge, Neal, & Glover, 2007), and these data suggest stress may compound the effects of prenatal drug exposure in a sample of children exposed to methadone with and without illicit substances.

One year postnatally, mothers in the marijuana group continued using marijuana. At 18–24 months, this group had higher rates of anxiety and depression, and this is consistent with results in an adolescent population showing both prenatal marijuana exposure and maternal depression are risk factors for drug use (Day, Goldschmidt, & Thomas, 2006). Moreover, marijuana use postnatally might be attributed to the mothers self-treating their emotional distress with marijuana (Nair, Schuler, Black, Kettinger, & Harrington, 2003). Learning whether a therapeutic intervention would provide benefit in this setting would be useful.

In conclusion, we found that maternal psychosocial and psychological functioning influence the outcomes of children exposed to drugs of abuse in utero. Our study manifested a high attrition rate, and therefore, these results should be interpreted with caution. Moreover, our findings may reflect a subsample of drug exposed mothers and children, who were functional enough to comply with study visits and to retain custody of their children. Regardless of these caveats, these mothers and children have specific needs that warrant intervention on a psychosocial and systemic level. Long-term follow-up is encouraged because some compromised neurobehavioral outcomes may not emerge until school age or adolescence due to the delayed maturation of brain regions affected by prenatal drug exposure such as the dopaminergic and serotonergic pathways, which are sensitive to the effects of *in utero* drug exposure (Fried, 2002; Fried & Smith, 2001; Harvey, 2004).

Limitations

This paper may reflect a distinct population of drug abusing mothers and children, and the conclusions made should be accepted as tentative, and awaiting additional corroborating research. Our catchment area was limited to New York City, and therefore cannot be generalized to other populations, especially those in rural areas, or to mothers of a higher socioeconomic status. This study manifested a substantial loss rate; therefore, this report is limited to a subgroup of mothers and infants, specifically those who were functional enough to comply with study visits and to retain custody of their children. Heavier drug users were more likely to be lost in follow-up, due to foster care placement of their infants, homelessness, or possibly relapse. Our ability to detect group differences may have been affected by our modest numbers in follow-up and the composition of our control group. Finally, our control group of mothers and children were from a lower SES, which can result in ambiguous findings attributable to the effects of poverty (Messinger et al, 2004; Pulsifer et al, 2004).

With regard to methodology: our cocaine and methadone groups had high rates of poly-drug use, a common issue in studies of drug-abusing populations (Bauer et al., 2002; Bergin et al., 2001; Thaithumyanon, Limpongsanurak, Praisuwanna & Punnahitanon, 2005). However, our drug severity score continuum allows for across group comparison. Another potential limitation of this study was the utilization of self-reported psychiatric histories and drug histories in follow-up. We found most participants to be candid and open about revealing this information since we established a long-term rapport with the study family; thus trust was developed. Nonetheless, this is a high-risk population of women and children who do not have regular access to good quality health care or mental health services, which likely impacted the detection, accuracy of diagnoses provided and in turn, the reliability of their disclosures.

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Table 1.**Drug Severity Score Rubric.**

Marijuana = 2 (minimum) to 8 (maximum)
Crack/Cocaine = 4 (minimum) to 20 (maximum)
Heroin = 5 (minimum) to 20 (maximum)
<i>Note:</i> severity scores are not inclusive of methadone, alcohol, or cigarettes.
Marijuana coding:
Mild = 30-60 joints per month (1-2 daily); score assigned: 2
Moderate = 60-90 joints per month (2-3 daily); score assigned: 4 to 6
Severe = > 90 joints per month (3+ daily); score assigned: 8
Crack/Cocaine coding:
Mild = occasional i.e., < 1 – 3 grams per month; score assigned: 4
Moderate = several times per month: 4 to 8
Severe = few times per week, range: 9 to 12
Very severe = 16 (daily use) to 17-20 (daily crack use, severity dependent on quantity)
Heroin coding:
Mild = occasional (1-3 times per month); score assigned: 5
Moderate = once or twice per week; 6 (minimum) to 10 (maximum)
Severe = a few times per week = 15
Very severe = daily or nearly daily = 16 to 20

Table 2.

Sample Demographics.

	Control (n = 49)	Cocaine (n = 35)	Marijuana (n = 38)	Methadone (n = 24)	Total (N = 146)
Maternal					
Age	25.90 ± 5.60	28.80 ± 5.90	23.90 ± 4.90	31.20 ± 4.90 *	27.00 ± 6.00
Ethnicity					
White	1.00 (2%)	4.00 (11%)	1.00 (3%)	4 (18%)	10.00 (7%)
Hispanic	44.00 (90%) *	10.00 (29%)	23.00 (61%)	4 (18%)	42.00 (29%)
Black	4.00 (8%)	20.00 (57%)	14.00 (37%)	15 (59%)	90.00 (63%)
Other	0.00 (0%)	1.00 (3%)	0.00 (0%)	1 (5%)	2.00 (1%)
Education	12.60 ± 2.50	10.70 ± 1.80	11.70 ± 1.50	11.60 ± 2.20	11.80 (2%)
Abuse hx	11.00 (26%)	19.00 (63%) *	20.00 (55%)	14.00 (82%) *	51.00 (51%)
Psych hx	3.00 (7%)	14.00 (42%) *	16.00 (42%) *	13.00 (54%) *	46.00 (32%)
Jail history	2.00 (9%)	23.00 (72%) *	9.00 (24%)	12.00 (63%) *	46.00 (41%)
Family					
Hollingshead	34.20 ± 1.50	27.50 ± 7.40 *	30.90 ± 6.40	28.50 ± 7.20 *	30.87 ± 8.70

Note: Data are presented as $M \pm SD$, n (%). Education = in years; hx = history; Psych hx = psychiatric history based on self-reported history of a mental health diagnosis; M = Mean; SD = Standard deviation. Percentages shown are based on the number of participants with applicable data per variable and group.

*
 $p < .05$

Table 3.**Prenatal Psychosocial History and Functioning.**

	Control (n = 44)	Cocaine (n = 30)	Marijuana (n = 36)	Methadone (n = 24)	Total (N = 134)
HAM-A	4.90 ± 6.50	5.10 ± 5.50	6.50 ± 7.20	5.70 ± 6.60	5.50 ± 6.50
HAM-D	5.50 ± 7.20	6.10 ± 5.60	7.40 ± 7.70	8.90 ± 8.60	6.60 ± 7.20
Stress Scale	4.90 ± 3.50	7.70 ± 3.70 *	5.50 ± 3.40	8.40 ± 3.60 *	6.60 ± 3.70
Drug Sev. 1 st	0.00 ± 0.00	21.30 ± 9.30 *	4.40 ± 2.80 *	23.20 ± 13.80 *	10.10 ± 12.40
Drug Sev. 2 nd	0.00 ± 0.00	13.00 ± 14.10 *	2.80 ± 2.70	13.70 ± 15.70 *	6.10 ± 11.10
Drug Sev. 3 rd	0.00 ± 0.00	3.80 ± 7.60 *	1.20 ± 1.90	5.90 ± 9.30 *	2.20 ± 5.75
Illicit drugs					
Cocaine	0.00 (0%)	12.00 (40%) *	3.00 (8%)	4.00 (25%) *	35.00 (24%)
Crack	0.00 (0%)	21.00 (70%) *	0.00 (0%)	7.00 (38%) *	28.00 (21%)
Marijuana	0.00 (0%)	15.00 (51%) *	36.00 (100%) *	1.00 (8%)	38.00 (26%)
Heroin	0.00 (0%)	3.00 (9%)	0.00 (0%)	10.00 (63%) *	13.00 (10%)
Poly	0.00 (0%)	15.00 (51%) *	3.00 (8%)	14.00 (83%) *	32.00 (24%)
Methadone	0.00 (0%)	0.00 (0%)	0.00 (0%)	24.00 (100%) *	24.00 (16%)
Cigarettes	0.00 ± 0.00	2.10 ± 1.50 *	0.52 ± 0.75	2.64 ± 2.22 *	1.07 ± 1.89
Alcohol	0.00 ± 0.00	0.05 ± 0.14 *	0.01 ± 0.03	0.00 ± 0.01	0.02 ± 0.08

Note: Data are presented as $M \pm SD, n(\%)$. Note: HAM-A = Hamilton Anxiety Scale; HAM-D = Hamilton Depression Scale; Sev. = severity; Poly = poly drug use; Cigarettes = average number smoked per day; alcohol = average number of drinks per day; M = Mean; SD = Standard deviation. Percentages shown are based on the number of participants with applicable data per variable and group.

*
 $p < .05$

Table 4.**Maternal Obstetrics and Neonatal Growth.**

	Control (n = 48)	Cocaine (n = 35)	Marijuana (n = 36)	Methadone (n = 21)	Total (N = 140)
Maternal					
Delivery type					
Vaginal	33.00 (70%)	25.00 (76%)	24.00 (69%)	13.00 (57%)	95.00 (69%)
Cesarean	10.00 (21%)	6.00 (18%)	11.00 (31%)	10.00 (44%)	37.00 (27%)
Forceps	2.00 (4%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	2.00 (1%)
Breech	2.00 (4%)	2.00 (6%)	0.00 (0%)	0.00 (0%)	4.00 (3%)
Child	(n = 48)	(n = 35)	(n = 36)	(n = 21)	(N = 140)
Apgar	9.00 ± 0.20	9.00 ± 0.30	9.00 ± 0.30	9.00 ± 0.50	9.05 ± 0.30
Male	29.00 (61%)	22.00 (64%)	20.00 (55%)	13.00 (62%)	88.00 (61%)
Gest. Age	39.20 ± 1.30	38.90 ± 1.50	38.80 ± 1.50	39.20 ± 1.30	39.10 ± 1.40
Growth					
Weight	3.35 ± 0.50	3.10 ± 0.47	3.10 ± 0.46 *	3.10 ± 0.60	3.20 ± 0.50
Head circ.	34.30 ± 1.30	33.90 ± 1.50	33.80 ± 1.50 *	32.90 ± 1.50 *	33.70 ± 1.50
Length	50.70 ± 2.60	48.90 ± 5.90	49.10 ± 2.50	48.70 ± 2.70	49.50 ± 3.70

Note: Data are presented as $M \pm SD, n (\%)$. Note: Apgar = score at the 5-minute interval; Gest. = gestational; circ. = circumference; M = Mean; SD = Standard deviation. Weight is reflected in kilograms, length and head circumference are in centimeters. Percentages shown are based on the number of participants with applicable data per variable and group.

*
 $p < .05$

Table 5.

6–9 Month Visit.

	Control	Cocaine	Marijuana	Methadone	Total
Maternal	(<i>n</i> = 28)	(<i>n</i> = 25)	(<i>n</i> = 21)	(<i>n</i> = 13)	(<i>N</i> = 87)
HAM-A	4.10 ± 4.90	2.90 ± 3.50	4.70 ± 7.60	4.30 ± 5.60	3.90 ± 5.30
HAM-D	6.50 ± 8.20	3.80 ± 4.20	5.30 ± 5.90	7.30 ± 8.20	5.40 ± 6.50
Stress Scale	3.40 ± 3.40	3.20 ± 2.90	4.00 ± 2.50	4.20 ± 4.00	3.60 ± 3.10
Illicit drugs	0.00 (0%)	4.00 (21%)	9.00 (47%)	1.00 (8%)	14.00 (16%)
Cocaine	0.00 (0%)	3.00 (15%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
Marijuana	0.00 (0%)	2.00 (11%)	9.00 (47%)*	0.00 (0%)	11.00 (13%)
Heroin	0.00 (0%)	0.00 (0%)	0.00 (0%)	1.00 (8%)	1.00 (1%)
Methadone	0.00 (0%)	0.00 (0%)	0.00 (0%)	9.00 (82%)*	9.00 (10%)
Child	(<i>n</i> = 30)	(<i>n</i> = 26)	(<i>n</i> = 20)	(<i>n</i> = 8)	(<i>N</i> = 84)
Growth					
Weight	66.70 ± 26.40	63.20 ± 22.60	58.40 ± 9.30	57.20 ± 22.70	62.70 ± 25.50
Head circ.	41.10 ± 26.60	59.30 ± 21.80	40.70 ± 25.80	26.30 ± 23.70	45.20 ± 26.40
Height	48.80 ± 31.90	41.70 ± 26.70	35.40 ± 32.30	38.90 ± 25.50	42.40 ± 29.80
Neuro. Exam.					
Typical	18.00 (58%)	8.00 (35%)	9.00 (45%)	2.00 (22%)	37.00 (44%)
Atypical	13.00 (42%)	15.00 (65%)*	11.00 (55%)	7.00 (78%)*	46.00 (55%)

Note: Data are presented as $M \pm SD$, *n* (%). HAM-A = Hamilton Anxiety Scale; HAM-D = Hamilton Depression Scale; Coke = cocaine; circ. = circumference; Neuro. = neurological; Exam. = examination; Cocaine = cocaine and/or crack; *M* = Mean; *SD* = Standard deviation. Growth parameters are percentiles based on age and gender. Percentages shown are based on the number of participants with applicable data per variable and group.

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p .05

Table 6.

12 Month Visit.

	Control	Cocaine	Marijuana	Methadone	Total
Maternal	(<i>n</i> = 27)	(<i>n</i> = 20)	(<i>n</i> = 21)	(<i>n</i> = 10)	(<i>N</i> = 78)
HAM-A	2.10 ± 3.00	2.30 ± 2.70	3.60 ± 4.60	6.30 ± 5.50	3.10 ± 4.00
HAM-D	4.10 ± 4.80	3.90 ± 3.80	6.60 ± 6.20	7.10 ± 7.10	5.10 ± 5.40
Stress Scale	4.00 ± 3.60	3.50 ± 3.40	5.80 ± 3.40	4.80 ± 3.30	4.40 ± 3.50
Illicit drugs	0.00 (0%)	3.00 (16%)	9.00 (53%)*	3.00 (21%)	15.00 (19%)
Cocaine	0.00 (0%)	2.00 (11%)	0.00 (0%)	0.00 (0%)	2.00 (3%)
Marijuana	0.00 (0%)	3.00 (16%)	9.00 (53%)*	1.00 (7%)	13.00 (17%)
Heroin	0.00 (0%)	0.00 (0%)	0.00 (0%)	2.00 (14%)	2.00 (3%)
Methadone	0.00 (0%)	0.00 (0%)	0.00 (0%)	8.00 (62%)	8.00 (10%)
Child	(<i>n</i> = 37)	(<i>n</i> = 20)	(<i>n</i> = 22)	(<i>n</i> = 11)	(<i>N</i> = 90)
Growth					
Weight	61.10 ± 28.30	56.80 ± 29.10	59.20 ± 32.00	58.00 ± 30.00	58.00 ± 30.00
Head circ.	51.70 ± 27.00	63.80 ± 25.10	51.10 ± 34.40	39.20 ± 30.00	52.70 ± 29.20
Height	44.70 ± 28.30	43.60 ± 27.80	28.10 ± 25.50*	30.90 ± 28.80	38.70 ± 28.80
Neuro. Exam.					
Typical	33.00 (94%)	14.00 (70%)	16.00 (76%)	7.00 (70%)	70.00 (78%)
Atypical	4.00 (6%)	6.00 (30%)	6.00 (24%)	4.00 (30%)	20.00 (22%)
Bayley					
Cognitive	102.60 ± 2.90	91.00 ± 3.20*	100.90 ± 1.90	95.40 ± 3.90	98.60 ± 14.80
Language	86.90 ± 2.30	80.40 ± 2.20	83.10 ± 2.60	82.90 ± 5.80	84.10 ± 13.00
Exp.	8.30 ± 0.48	7.50 ± 0.46	7.80 ± 0.62	8.70 ± 1.50	8.00 ± 2.90
Rec.	7.20 ± 0.48	5.80 ± 0.49	6.30 ± 0.72	5.60 ± 0.87	6.40 ± 2.60
Motor	101.40 ± 1.70	90.20 ± 3.20*	94.50 ± 2.80	95.00 ± 2.10	96.60 ± 12.10
Fine	9.10 ± 0.42	8.10 ± 0.58	8.00 ± 0.58	9.50 ± 1.00	8.70 ± 2.60
Gross	11.30 ± 0.43	8.50 ± 0.70*	10.10 ± 0.67	8.90 ± 1.10	10.00 ± 3.00

Note: Data are presented as $M \pm SD$, n (%). HAM-A = Hamilton Anxiety Scale; HAM-D = Hamilton Depression Scale; circ. = circumference; Neuro. = neurological; Exam. = examination; Exp. = expressive (language); Rec. = receptive (language); Cocaine = cocaine and/or crack; M = Mean; SD = Standard deviation. Growth parameters are shown as percentiles based on age and gender. Bayley scores are represented as standard and scaled scores. Percentages shown are based on the number of participants with applicable data per variable and group.

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 $p < .05$

Table 7.

18–24 Month Visit.

	Control	Cocaine	Marijuana	Methadone	Total
Maternal	(<i>n</i> = 37)	(<i>n</i> = 20)	(<i>n</i> = 22)	(<i>n</i> = 11)	(<i>N</i> = 90)
HAM-A	1.20 ± 1.50	2.00 ± 1.90	5.00 ± 4.70 *	6.00 ± 8.50 *	3.30 ± 4.10
HAM-D	2.10 ± 2.60	4.00 ± 6.40	7.10 ± 5.70 *	12.60 ± 10.40 *	5.40 ± 6.10
Stress scale	3.90 ± 3.50	4.10 ± 2.50	4.50 ± 3.10	6.30 ± 4.80 *	4.60 ± 3.30
Illicit drugs	0.00 (0%)	5.00 (31%)	14.00 (67%)	4.00 (29%)	23.00 (26%)
Cocaine	0.00 (0%)	2.00 (13%)	1.00 (5%)	4.00 (29%)	7.00 (8%)
Marijuana	0.00 (0%)	4.00 (25%)	14.00 (67%)	2.00 (14%)	20.00 (22%)
Heroin	0.00 (0%)	0.00 (0%)	0 (0%)	2.00 (14%)	2.00 (2%)
Methadone	0.00 (0%)	0.00 (0%)	0 (0%)	9.00 (64%)	9.00 (10%)
Child	(<i>n</i> = 33)	(<i>n</i> = 22)	(<i>n</i> = 20)	(<i>n</i> = 11)	(<i>N</i> = 86)
Growth					
Weight	65.20 ± 27.30	66.80 ± 24.80	62.90 ± 28.20	59.80 ± 36.70	64.40 ± 27.80
Head circ.	55.20 ± 23.60	64.60 ± 27.50	43.30 ± 29.00	31.60 ± 25.80 *	51.80 ± 27.90
Height	56.10 ± 26.10	51.80 ± 21.40	48.40 ± 27.90	33.60 ± 29.80	50.30 ± 26.40
Neuro Exam.					
Typical	19.00 (59%)	6.00 (27%)	7.00 (35%)	2.00 (18%)	34.00 (40%)
Atypical	13.00 (41%)	16.00 (73%) *	13.00 (65%)	9.00 (82%) *	51.00 (59%)
Bayley					
Cognitive	97.60 ± 10.90	92.30 ± 11.00	92.50 ± 14.70	83.30 ± 16.40 *	93.60 ± 13.20
Language	85.80 ± 13.60	90.10 ± 10.70	79.30 ± 19.80	78.30 ± 16.10	84.40 ± 15.30
Exp.	7.90 ± 2.60	9.40 ± 2.10	8.30 ± 2.70	6.40 ± 2.80	8.20 ± 2.60
Rec.	7.20 ± 2.60	7.10 ± 2.50	6.10 ± 1.90	6.10 ± 2.90	6.80 ± 2.40
Motor	98.80 ± 12.50	93.90 ± 9.40	90.20 ± 21.70	97.00 ± 11.90	95.60 ± 14.80
Fine	10.80 ± 3.20	9.60 ± 1.90	9.80 ± 3.00	9.60 ± 3.30	10.20 ± 2.90
Gross	8.80 ± 2.50	8.30 ± 2.10	8.50 ± 1.60	9.40 ± 2.20	8.70 ± 2.20

Note: Data is presented as $M \pm SD$, *n* (%). HAM-A = Hamilton Anxiety Scale; HAM-D = Hamilton Depression Scale; circ. = circumference; Neuro Exam. = neurological examination; Exp. = expressive (language); Rec. = receptive (language); Cocaine = cocaine and/or crack; *M* = Mean; *SD* = Standard deviation. Growth parameters are shown as normative percentiles for age and gender. Bayley scores are represented as standard and scaled scores. Percentages shown are based on the number of participants with applicable data per variable and group.

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 $p < .05$