

Brief Report: Frequency of Maternal Cocaine Use During Pregnancy and Infant Neurobehavioral Outcome

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Objective: To examine the effects of frequency of prenatal maternal cocaine use on infant neurobehavioral outcome beyond the immediate postpartum period, controlling for other substance use.

Methods: At 2 weeks postpartum, the Brazelton Neonatal Behavioral Assessment Scale (BNBAS) was administered to infants ($N = 55$) and their mothers were asked about their prenatal drug use. Mother/infant dyads were placed in one of two groups based on the number of days of reported cocaine use during pregnancy: high frequency ($n = 23$, $>75^{\text{th}}$ percentile reported days of use) or low frequency ($n = 32$, $<75^{\text{th}}$ percentile).

Results: Infants in the high frequency cocaine group had worse BNBAS excitability scores than infants in the low frequency cocaine group, when other substance use was controlled statistically.

Conclusions: High frequency of maternal cocaine use during pregnancy is associated with poorer infant neurobehavioral outcome beyond the early postpartum period, when other substance use is controlled.

Key words: *neurobehavioral outcome; Brazelton Neonatal Behavioral Assessment Scale; cocaine-exposed infants.*

As the number of infants exposed prenatally to cocaine has increased, researchers have compared the neurobehavioral outcome of cocaine-exposed infants to those who were not exposed. The Brazelton Neonatal Behavioral Assessment Scale (BNBAS) (Brazelton, 1984) is frequently used to assess the effects of prenatal cocaine exposure on neurobehavioral development immediately after birth (Black, Schuler, & Nair, 1993; Delaney-Black et al., 1996), and later in the postpartum period (Black et al., 1993; Coles, Platzman, Smith, James, & Falek,

1992). However, cocaine-using women often use other substances including cigarettes, alcohol, and marijuana, which are associated with worse scores on the BNBAS (Coles et al., 1992; Delaney-Black et al., 1996). Yet most investigators have not controlled for other substance use when studying the effects of cocaine on infant neurobehavioral outcome beyond the early postpartum period. In one of the few exceptions, high frequency of maternal cocaine use was still associated with poorer state regulation and higher excitability on the BNBAS at 3 weeks postpartum, even when other substance use was controlled (Tronick, Frank, Cabral, Mirochnick, & Zuckerman, 1996).

The purpose of this study was to determine if infants exposed to a high frequency of prenatal ma-

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ternal cocaine use had poorer neurobehavioral outcomes (as measured by the BNBAS) at 2 weeks postpartum than infants exposed to a low frequency of maternal cocaine use, when other substance use was controlled.

Method

Participants

Participants were a subset of mother/infant dyads participating in an ongoing longitudinal research project. Women were eligible for recruitment if they had a prenatal history of drug use, or if they or their infants had a positive urine toxicology screen at birth. Infants with serious developmental or congenital problems or who were not being discharged into the care of their mothers were not eligible for the study.

The BNBAS was administered to 115 infants. None of the mothers refused to allow the Brazelton to be administered to their infant. Data from 55 infants were included in the present study. The losses were due to the following: the infants were less than 37 weeks gestational age ($n = 26$) (the BNBAS is recommended for infants >36 weeks); mothers were on methadone ($n = 8$); mothers reported no cocaine use ($n = 7$); missing data on maternal drug use ($n = 9$); and the infant was never in the appropriate state to administer the BNBAS ($n = 10$). For these 10 infants who were never in the appropriate state, 5 mothers reported using cocaine during the pregnancy, and 5 mothers reported no cocaine use during the pregnancy.

Measures

Drug Screening. Infant and maternal urine samples were collected at birth and analyzed through the usual hospital procedures. None of the infants or mothers in this study had a positive screen for benzodiazepenes, amphetamines, alcohol, hallucinogens, or THC. Eighty-nine (89%) of the mothers and/or their infants had a positive urine screen for cocaine at birth.

Frequency of Maternal Drug Use. To assess maternal drug use, the mothers were asked how frequently they had used cigarettes, alcohol, heroin, cocaine, marijuana, tranquilizers, amphetamines, barbiturates, or methadone during the prenatal pe-

riod. Frequency was coded on an 8-point scale (1 = daily, 8 = one day during the pregnancy).

Infant Neurobehavioral Assessment. The clustering technique for the BNBAS (Lester, Als, & Brazelton, 1982) was used to form the following seven clusters: habituation, orientation, motor, range of state, regulation of state, autonomic stability, and number of abnormal reflexes. A clustering technique devised for use with cocaine-exposed infants was also used to compute two additional cluster scores: depression and excitability (Lester, Freier, & LaGasse, 1995). The habituation cluster was dropped before any analyses were done because the four behaviors used to form this cluster were not scoreable. These behaviors must be scored when the infant is asleep and the majority of the infants were awake when they got to clinic.

Procedure

Eligible mothers were approached in the nursery soon after giving birth. All mothers who agreed to participate in the longitudinal study signed a consent form approved by the university's Institutional Review Board, completed a demographic form, and were given an appointment for the initial research visit at 2 weeks postpartum. At this 2-week visit, conducted in a pediatric clinic, the BNBAS was administered by a certified examiner who was blind to maternal drug history and the results of the urine toxicology screens. Then the mothers were asked about substance use during pregnancy. Data on neonatal course, measurements, and urine toxicology screen results were collected through medical chart review.

Group Classification. Using the data on self-reported days of cocaine use, we placed the dyads into one of two groups: high frequency of cocaine use ($n = 23$) or low frequency of cocaine use ($n = 32$). High frequency of cocaine use was defined as using more than 41 days ($>75^{\text{th}}$ percentile of self-reported days of use) during the pregnancy ($M = 175.7$ days, range = 80–280). Low frequency of cocaine use was defined as using less than 41 days during the pregnancy ($M = 15.3$ days; range = 1–40). This method of using the 75th percentile to define high versus low use has been used previously by Tronick et al. (1996).

Coding of Other Maternal Substance Use. To reduce the number of covariates, we recoded cigarette, alcohol, marijuana, and heroin use before any analy-

Table I. Demographic and Perinatal Data as a Function of the Frequency of Prenatal Maternal Cocaine Use

Variables	High frequency (<i>n</i> = 23) <i>M</i> (<i>SD</i>)	Low frequency (<i>n</i> = 32) <i>M</i> (<i>SD</i>)
Maternal		
Age (yrs)	25.9 (4.0)	26.8 (4.6)
Education	10.5 (1.4)	10.8 (1.4)
No. of children	3.4 (1.4)	3.2 (1.4)
African American (%)	91.3	100
Single (%)	95.7	100
Substance use (%)		
Cigarette	78.3	71.9
Alcohol	65.2	65.6
Marijuana	47.8	34.4
Heroin	52.2	53.1
Infant		
Birthweight (gms)	2,930.0 (276.0)	2,914.3 (362.4)
Head circum. (cms)	33.2 (1.2)	33.3 (1.4)
Birth length (cms)	48.4 (2.3)	48.8 (2.4)
Gestational age (wks)	39.4 (1.5)	39.8 (1.0)
1-min Apgar	8.1 (0.9)	8.2 (0.6)
5-min Apgar	8.9 (0.4)	8.9 (0.5)

ses were run. Since 89% of the women who smoked were using cigarettes daily, cigarette use was coded as 1 = daily and 0 = less than daily. Alcohol, marijuana, and heroin use were coded as 1 = used and 0 = did not use.

Results

Maternal and Infant Characteristics

As Table I shows, there were no significant differences between the high and low frequency cocaine groups in maternal substance use, or on any perinatal or demographic variable.

BNBAS Cluster Scores

Using cigarette, alcohol, marijuana, and heroin use as covariates, we ran two multivariate analyses of covariance (MANCOVAs). In the first MANCOVA, the dependent variables were six original BNBAS cluster scores: orientation, motor, range of state, regulation of state, autonomic stability, and number of abnormal reflexes. Since the overall multivariate analysis was not significant, $F(5, 45) = 1.3, p > .05$, the univariate analyses were not examined. In

Table II. Brazelton Cluster Means at 2 Weeks Postpartum as a Function of the Frequency of Prenatal Maternal Cocaine Use

	High frequency (<i>n</i> = 23) <i>M</i> (<i>SD</i>)	Low frequency (<i>n</i> = 32) <i>M</i> (<i>SD</i>)
Orientation	4.9 (1.8)	5.2 (1.8)
Motor	4.5 (0.7)	4.8 (0.8)
Range of state	3.7 (0.7)	3.5 (0.9)
Regulation of state	4.1 (1.3)	4.5 (1.3)
Autonomic stability	5.9 (1.4)	6.8 (1.4)
Abnormal reflexes ^a	5.0 (1.8)	4.9 (2.0)
Depression ^a	0.24 (0.2)	0.19 (0.2)
Excitability ^a	0.25 (0.2)	0.13 (0.2)*

^aHigher scores indicate worse performance.

* $p < .05$.

the second MANCOVA, the dependent variables were the depression and excitability clusters. Since the overall multivariate analysis was significant, $F(2, 48) = 3.2, p < .05$, the univariate analyses were examined. Infants in the high frequency cocaine group scored significantly poorer on the excitability cluster than infants in the low frequency cocaine group, $F(1, 49) = 6.2, p < .05$ (see Table II).

Discussion

Infants exposed to a high frequency of cocaine use (>41 days) during the pregnancy had worse scores on the BNBAS excitability cluster than infants exposed to a low frequency of cocaine use (<41 days), even after other maternal drug use was controlled statistically. This difference occurred at 2 weeks after birth, suggesting that the problems in neurobehavioral development among infants exposed to frequent cocaine use in utero do not resolve quickly. A high BNBAS excitability score indicates that the infant has poor tone and motor movement, is hard to console and irritable, and has difficulties self-quieting. Given the clinical challenges of these cocaine-exposed infants, they may be at higher risk for child abuse and neglect. Interventions with these mothers might include participation in parenting classes where techniques to deal with these behavioral problems (such as the use of swaddling, etc.) could be demonstrated.

These results must be interpreted with caution because groups were small and frequency of drug use was based on maternal report. The validity of using maternal report of drug use has been ques-

tioned by other researchers (Zuckerman et al., 1989). In addition, the infants most vulnerable to the effects of cocaine may have been excluded (e.g., infants with serious medical problems or who never achieved an alert state during the BNBAS). Finally, using the 75th percentile of self reported days of cocaine use to determine a cutoff for group classification is a sample bound approach, which means the cutoff will vary from study to study. However, despite different cutoffs in the Tronick et al. (1996) study ($n = 61$ days) and this study ($n = 41$ days), the BNBAS scores in both are similar.

Finding differences in infant neurobehavioral outcome based on frequency of prenatal maternal cocaine use among the healthiest infants when exposure to other substances is controlled raises con-

cerns about the effects of frequency of cocaine use on more vulnerable infants. More longitudinal research needs to be done to determine if these neurobehavioral problems will persist and how they influence later outcome.

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