

Mental Health Outcomes of Cocaine-Exposed Children at 6 Years of Age

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Objective To assess 6-year-old cocaine- and noncocaine-exposed children's mental health outcomes controlling for potential confounders. **Methods** The sample consisted of 322 children [169 cocaine exposed (CE) and 153 noncocaine exposed (NCE)] enrolled in a longitudinal study since birth. At age 6, children were assessed for mental health symptoms using the Dominic Interactive (DI), a child self-report measure, and the Child Behavior Checklist (CBCL), a caregiver report of behavioral problems. **Results** CE children were more likely to self-report symptoms in the probable clinical range for oppositional defiant disorder (ODD) and attention deficit hyperactivity disorder (ADHD). In contrast, prenatal cocaine exposure was not related to child behavior based on the CBCL. After control for exposure, CE children in adoptive or foster care were rated as having more problems with aggression, externalizing behaviors, and total behavioral problems than NCE children and CE children in maternal or relative care. Also, CE children in adoptive or foster care self-reported more externalizing symptoms than CE children in maternal or relative care and NCE children. Findings could not be attributed to caregiver intelligence or depressive symptoms, or to the quality of the home environment. **Conclusions** CE children report more symptoms of ODD and ADHD than nonexposed children. Adoptive or foster caregivers rated their CE children as having more behavioral problems than did maternal or relative caregivers of CE children or parents of NCE children. Although further studies are needed to understand the basis for the more negative ratings by adoptive or foster caregivers of their CE children, the self-report of CE children indicates a need for psychological interventions.

Key words ADHD; adoptive or foster care; CBCL; Dominic Interactive; mental health outcomes; oppositional defiant disorder; prenatal cocaine exposure.

An epidemic of cocaine use in the late 1980s spawned a body of research exploring the teratogenic effects of cocaine use during pregnancy on child development. One area of inquiry has examined the effect of prenatal cocaine exposure on mental health outcomes. This topic of interest arises from potential risks due to prenatal cocaine exposure, as well as multiple risks in the prena-

tal (e.g. other drug exposure and poor prenatal care) and postnatal environments (e.g. caregiver drug use, caregiver psychopathology, and foster care placement). Specifically, prenatal cocaine exposure has been assumed to negatively affect the development of the brain monoamine systems that regulate behavior, including the child's ability to inhibit impulses (Bendersky & Lewis, 1998b)

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Journal of Pediatric Psychology 31(1) pp. 85–97, 2006

doi:10.1093/jpepsy/jsj020

Advance Access publication March 31, 2005

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and to regulate behavior under stressful or challenging situations (Mayes, 1999). Thus, prenatal cocaine exposure is hypothesized to influence the development of mental health problems, with postnatal environmental factors also assumed to increase or modify prenatal effects.

Recent studies have explored mental health outcomes of cocaine-exposed (CE) children at school age based on parent and teacher report and have produced equivocal results. Several studies indicate no direct prenatal cocaine exposure effects on children's behavioral outcomes (Accornero, Morrow, Bandstra, Johnson, & Anthony, 2002; Bennett, Bendersky, & Lewis, 2002; Phelps, Wallace, & Bontrager, 1997; Richardson, Conroy, & Day, 1996), but instead point to postnatal caregiving factors, such as maternal psychological distress and drug use, as important predictors of children's behavioral outcomes (Accornero et al., 2002; Bennett et al., 2002).

In contrast, other studies have documented negative effects of prenatal cocaine exposure on child behavioral outcomes (Chasnoff et al., 1998; Richardson, 1998). Using teachers' reports on the Child Behavior Checklist (CBCL), a standardized measure widely used to document children's behavioral difficulties, a 6 year follow-up of CE boys found they exhibited more externalizing and delinquent behaviors than nonexposed boys (Delaney-Black et al., 2000).

These studies highlight several important issues in the evaluation of children's behavioral outcomes. First, it is important to control for the child's current demographic and environmental status, including the quality of the home environment, parent psychopathology, and current parental drug use, because these factors are commonly related to child outcome (Accornero et al., 2002; Singer, 1999). Second, it appears critical to consider informant effects. Because maternal reports of child behavior problems are influenced by maternal psychological distress (Briggs-Gowan, Carter, & Schwab-Stone, 1996; Chilcoat & Breslau, 1997), it is important to assess children's behavior by multiple informants, including the child, as each reporter may contribute unique information (Phares, Compas, & Howell, 1989). Finally, the caregiving environment may influence current behavioral functioning. In general, adopted youth have been shown to exhibit greater externalizing behavior problems (Simmel, Brooks, Barth, & Hinshaw, 2001) and more psychological distress (Miller, Fan, Christensen, Grotevant, & van Dulmen, 2000) than non-adopted youth. In CE populations, factors associated with the adoptive or foster caregiving environment, such

as parental intelligence and the quality of caregiving, have been shown to predict CE children's IQ scores at age 4 (Singer et al., 2004). Additionally, at age two, CE children in nonparental care were found to have higher developmental scores as measured by the Bayley and an interaction task compared with CE children in biologic care (Brown, Bakeman, Coles, Platzman, & Lynch, 2004).

This study evaluated mental health outcomes of CE and noncocaine-exposed (NCE) 6-year-olds using the Dominic Interactive (DI), a child self-report measure of symptoms based on disorders in the Diagnostic and Statistical Manual for Mental Disorders, fourth edition (DSM-IV; American Psychiatric Association, 1994), and a commonly used parent report, the CBCL (Achenbach, 1991). As part of a prospective longitudinal study (Singer, Arendt, Minnes, Farkas, & Salvator, 2000), multiple confounding risk factors were evaluated in relation to the child outcome measures, including caregiver psychological distress, quality of the home environment, and type of caregiver (adoptive or foster vs. maternal or relative). It was hypothesized that CE children would have greater symptom endorsement as measured by the DI compared to NCE children and that CE children would be rated by caregivers as having more behavior problems on the CBCL than NCE children.

Method

Participants

This study included 322 6-year-old children (169 CE and 153 NCE) recruited at birth for a longitudinal prospective study (Singer, Arendt et al., 2002; Singer, Salvator et al., 2002). Children had been previously assessed at birth, and at 6, 12, 24, and 48 months of age. Participants were recruited from a local, county hospital, which routinely screens high-risk patients for drug use. A positive response on any of the following measures identified the child as CE: infant meconium or urine, maternal urine positive for cocaine, and maternal self-report to hospital staff or during a clinical interview. Information regarding the meconium screening procedures can be obtained from a prior publication (Singer et al., 2004).

Four hundred fifteen (218 CE and 197 NCE) of the 647 mothers approached at childbirth agreed to participate. Of the 209 women not enrolled in the study, 155 refused, and 54 were excluded for various reasons (e.g. low maternal IQ, Down syndrome, HIV status, fetal alcohol syndrome, and maternal age). An additional 23 (9 CE and 14 NCE) did not attend the enrollment visit.

Since birth, 11 children died (8 CE and 3 NCE), and causes of death including sudden infant death syndrome, cardiopulmonary arrest, pneumonia, accidental asphyxia, and respiratory distress syndrome.

Procedure

At the birth visit, the biological mothers of infants were interviewed regarding use of drugs in the month prior to pregnancy and during each trimester (Singer, Arendt et al., 2002). At each assessment point, this drug interview was re-administered with the child's current caregiver to obtain an assessment of recent postnatal caregiver drug use.

Children were seen at the developmental laboratory for approximately 5 hours, with all tests administered by examiners unaware of drug exposure status. The caregiver concurrently completed an assessment battery that included an updated drug use interview, vocabulary testing, and behavior rating scales that targeted both caregiver and child behaviors. For children in nonmaternal care, measures were obtained from the child's current caregiver, and the biological mother was seen at a separate visit. All caregivers were given a monetary stipend for participation, and lunch and transportation costs were also provided. The Institutional Review Boards of the participating hospitals approved the study. Written consent was obtained from the mother or caregiver. A writ of confidentiality (DA-98-91) was also obtained from the Department of Health and Human Services.

Measures

Dominic Interactive

The Dominic Interactive (DI; Valla, 2000) is a standardized, computerized assessment of symptoms of seven DSM-IV diagnostic categories (American Psychiatric Association, 1994) in children ages 6–11. The diagnostic categories include specific phobias, separation anxiety disorder, generalized anxiety disorder, major depression or dysthymia, oppositional defiant disorder, conduct disorder, and attention deficit hyperactivity disorder. Each question is presented with colorful pictures and a voiceover that reads each question aloud. The child responds yes or no to 91 questions that ask whether the child engages in the behavior that the character demonstrates. The DI is specific to the child's sex and race (Caucasian or African-American). Scores correspond to the seven diagnostic categories, as well as to three summary scores (internalizing, externalizing, and total score). Clinical ranges are determinable only for the seven diagnostic categories. These scales have two cutpoints for

moderate and severe clinical symptomatology dependent upon the number of symptoms endorsed. In this study, the two cutpoints were collapsed into one group reflective of a probable clinical range because of the low incidence of children in the severe cutpoints on the scales.

An earlier paper and pencil version of the DI (the Dominic-R) has been shown to have good reliability and adequate validity based on a number of studies (Bidaut-Russell, Valla, Thomas, Bergeron, & Lawson, 1998; Murphy, Cantwell et al., 2000; Murphy, Marelich, & Hoffman, 2000; Valla, Bergeron, & Smolla, 2000; Valla, Bergeron, Bidaut-Russell, St-Georges, & Gaudet, 1997); however, limited published data are available for the DI (Valla et al., 2002). The psychometric characteristics of the DI for this sample were investigated prior to these analyses (Linares, Short, Singer, Russ, & Minnes, in press). Internal consistency was in the moderate to excellent range for both CE and NCE children (range .63–.92). DI scores were correlated with parent report on the CBCL (1991), and in general were modest, with statistically significant relationships among those scales assessing externalizing symptoms (Linares et al., 2005). For CE children, the DI ODD scale was positively related to the CBCL aggression scale ($r = .22, p < .01$) and the CBCL delinquency scale ($r = .22, p < .01$); however, these same comparisons among the NCE group were low and nonsignificant ($r = .09, p < .28$; $r = .07, p < .37$). Most correlations were low (i.e. .20's); nonetheless, their magnitudes are consistent with other studies which show modest parent and child agreement on behavior checklists (Achenbach, McConaughy, & Howell, 1987).

The Child Behavior Checklist

The Child Behavior Checklist (CBCL; Achenbach, 1991) is a commonly used parent report composed of 118 questions designed to assess problem areas in child behavior. The CBCL provides 8 narrow band scores (withdrawn, somatic complaints, anxious or depressed, social problems, thought problems, attention problems, delinquent behavior, and aggressive behavior) and 3 broadband scores (internalizing, externalizing, and total problems).

Substance Abuse Interview

This interview consists of a series of close-ended, forced choice questions pertaining to timing and frequency of drug use (Singer et al., 2000; Singer, Arendt et al., 2002). The interview includes questions regarding date of last use and ends with an interviewer rated scale of perceived validity. At the newborn visit, biologic mothers were asked to recall frequency and amount of drug use

for the month prior and for each trimester of the pregnancy. Frequency of use was recorded on a Likert scale ranging from 0 (not at all) to 7 (daily use) and converted to reflect the average number of days per week a drug was used. Frequency was multiplied by the amount used per day to compute a severity score for the month prior to pregnancy and for each trimester. This score was then averaged to yield a total score for the prenatal exposure for each drug. This measure was administered at the 6-year visit to quantify postnatal drug use based on the child's current caregiver usage.

The Brief Symptom Inventory

This self-report, 53-item questionnaire, taps a range of psychiatric symptom patterns (Derogatis, 1992). It measures somatic complaints, obsessive-compulsive behavior, depression, anxiety, phobic anxiety, paranoid ideation, hostility, and psychoticism, and yields a summary score (Global Severity Index; GSI) as a measure of overall psychological distress.

Caregiver Intelligence Assessments

The Peabody Picture Vocabulary Test-Revised (PPVT-R; Dunn & Dunn, 1981) and two subscales [Block Design (BD) and Picture Completion (PC)] of the Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler, 1989) were employed to assess caregiver intelligence.

Home Observation for Measurement of the Environment

The home observation for measurement of the environment (HOME-Preschool, Caldwell & Bradley, 1984) was administered in an interview format to assess the quality of the caregiving environment. This scale yields one global score, which summarizes ratings of the following categories: learning materials, language stimulation, physical environment, responsiveness, academic stimulation, modeling, variety, and acceptance. The use of the scale in interview format has been supported based on correlations between cognitive outcomes and the HOME score compared to samples using in-home observations (Barnard, Bee, & Hammond, 1984; Jacobson, Jacobson, Sokol, Martier, & Ager, 1993). In the current sample, the HOME-Infant score using this format was positively related to 2-year cognitive outcome, $r = .37, p < .001$ (Singer, Arendt et al., 2002) and 4-year prorated IQ on the Wechsler Primary and Preschool Scale of Intelligence-Revised, $r = .35, p < .001$ (Singer et al., 2004).

Statistical Analysis

Prior to analyses, several variables were normalized by a $\log_e(x + 1)$ transformation, including the Global Severity

Index, current caregiver drug variables, and biologic drug use (trimesters and month prior) variables. Data were evaluated based on cocaine status (yes vs. no) and on type of caregiver (adoptive or foster vs. maternal or relative). Analyses based on severity of cocaine exposure (none, light, and heavy) revealed nonsignificant pattern differences from those conducted based on cocaine status (yes vs. no), thus only the cocaine status analyses will be presented.

Comparison between CE and NCE children on demographic, birth, and maternal characteristics employed t tests, ANOVA models, or Wilcoxon rank sum tests for continuous data and Pearson's χ^2 or Fisher's exact tests for categorical variables. Spearman rank order correlations were used to assess the relationship of prenatal and concurrent drug exposure measures to child outcomes. Variables significantly associated with outcomes ($p < .20$) and different by cocaine status ($p < .20$) were entered into the model stepwise. If upon entry covariates were significant at $p < .10$, they remained in the model. The order of entry was as follows: demographic and prenatal factors were considered first, followed by caregiving, environmental, and drug exposure variables as follows: HOME score, gender, race, maternal age, parity, number of prenatal care visits, maternal years of education, marital status, socioeconomic status, maternal and current caregiver PPVT-R, WAIS-R BD, PC scores, and GSI, maternal and current caregiver psychological distress and prenatal as well as current caregiver measures of cigarette, alcohol, marijuana use, and caregiver status (adoptive or foster vs. maternal or relative), all prior to cocaine exposure. This was followed by the inclusion of an interaction between caregiver status and cocaine exposure. Since there were only 6 NCE children in adoptive or foster care they were pooled with the NCE children in maternal or relative care. Therefore, a new variable was created representing CE children in maternal or relative care, CE children in adoptive or foster care, and NCE children. Comparisons among these three groups were conducted.

The DI and the CBCL data were dichotomized based on those reaching an established clinical range versus those who did not. The DI clinical ranges, taken from the manual, were established when the number of questions endorsed passed a threshold based on clinical and statistical rules, with the CBCL clinical ranges based on T-scores = 67 for subscales and T-scores = 60 for broadband scales (i.e. internalizing, externalizing, and total scores). Logistic regression models were used to assess effects of cocaine on the odds of DI and CBCL scores in

the probable clinical ranges. Associations with cocaine exposure and other predicted factors were expressed as odds ratios and corresponding 95% percent confidence intervals. Because there were a priori hypotheses that cocaine exposure would be related to an increase in behavioral problems, one-tailed tests were conducted on behavioral outcomes.

The second set of analyses involved the continuous data from the DI and CBCL for only the broadband scores on each measure using multiple linear regressions. All analyses initially examined the effect of caregiving environment upon outcomes; interactions between caregiving environment and cocaine status were conducted when significant caregiver effects were obtained.

On the DI, the internalizing and total summary scores were normally distributed, while the externalizing score required a $\log_e(x + 1)$ transformation prior to assuming a normal distribution. On the CBCL, the externalizing and total summary scores were normally distributed, while the internalizing score required a $\log_e(x + 1)$ transformation prior to assuming a normal distribution. Estimated means and standard errors (SE) are presented for each subscale. The Delta Method (Bishop, Fienberg, & Holland, 1975) was used to estimate SE's on the original scale for the transformed outcomes. This technique is commonly used for calculating asymptotic distributions, means, and variances of transformed variables via a Taylor series expansion. All analyses were performed using SAS (v 8.2, SAS Institute Inc., Cary, NC).

Results

Sample Characteristics

When children were 6 years of age, 93% ($n = 377$) of living children were evaluated. However, a total of 55 children were not included in the present analyses. Children with a WPPSI-R prorated IQ of less than 70 ($n = 21$) were excluded from the analyses due to cognitive limitations in children's ability to self-report on their mental health symptoms. An additional 34 children did not receive the DI based on time limitations at their visit. No demographic differences emerged between the subsamples of children excluded from these analyses ($n = 34$; $n = 21$) and those included in the present investigation ($n = 322$).

Characteristics of the current sample are found in Table I representing 322 children with self-report data from the DI and parent report data from the CBCL. At birth, CE children were of lower weight, length, and smaller head circumference compared to NCE children. The sample was approximately half male (45%), primarily African-American (81%), and of low socioeconomic status (98%). The majority of CE children (82%) and NCE children (91%) received some prenatal care. CE children had lower WPPSI-R full scale IQs compared to NCE children ($p < .05$). CE children had biologic mothers who were older, less likely to be married or employed, had less than a high school education, and reported higher psychological distress than the NCE group. Cocaine using mothers reported greater use of alcohol, marijuana, and tobacco throughout pregnancy than did noncocaine using mothers (Table II).

Table I. Maternal and Infant Characteristics at Birth

	Cocaine ($n = 169$)			Noncocaine ($n = 153$)			p
	Mean	SD	n (%)	Mean	SD	n (%)	
Infant birth characteristics							
Gender (male)	–	–	77 (46%)	–	–	69 (45%)	.93
Race (nonwhite)	–	–	139 (82%)	–	–	122 (78%)	.57
Gestational age (weeks)	37.8	3		38.5	3		.02
Birth weight (grams ^a)	2721.6	623		3106.0	682		<.0001
Birth length (cm ^a)	47.4	4		49.1	4		<.0001
Head circumference (cm ^a)	32.2	2		33.5	2		<.0001
WPPSI-R FSIQ (6 years of age)	90.3	12		93.6	13		.02
Maternal characteristics at birth							
Age (years)	29.6	5		25.8	5		<.0001
Global severity index	.81	.8		.48	.5		<.0001
Years of education	11.58	1.7		12.07	1.4		.005
Maternal employment	–	–	9 (5%)	–	–	36 (24%)	<.0001
Low socioeconomic status	–	–	164 (98%)	–	–	149 (97%)	.89
Married	–	–	13 (8%)	–	–	30 (20%)	.002
Received prenatal care	–	–	138 (82%)	–	–	139 (91%)	.018

^aComparison adjusted for prematurity.

Table II. Maternal Self-Report of Drug Use During Pregnancy (Reported at Child's Birth)

Self-reported maternal drug use during pregnancy	Cocaine (<i>n</i> = 169)			Noncocaine (<i>n</i> = 153)		
	Mean	<i>SD</i>	<i>n</i> (%)	Mean	<i>SD</i>	<i>n</i> (%)
Cigarettes per day ^a	11.6	11	141 (87%)	4.0	8**	57 (39%)*
Alcohol drinks per week ^a	9.0	17	140 (86%)	1.1	3**	95 (65%)*
Marijuana joints per week ^a	1.1	3	79 (49%)	0.6	4**	18 (12%)*
Cocaine rocks per week	25.7	48	–	0	–	–

^a*t* test performed on the logged transformed scale.

**p* < .001.

***p* < .0001.

Characteristics of the children's current caregivers are reported in Table III. The majority of the current caregivers for NCE children were biologic mothers (92%); the remainder (8%) were in adoptive care (*n* = 6) or relative care (*n* = 6). Within the CE group, the maternal or relative care group was comprised of 133 children [68% with biologic parents (*n* = 91) and 32% in relative care (*n* = 42)], and the adoptive or foster care group was comprised of 36 children. For the 36 children who were adopted or placed in foster care, 50% (*n* = 18) were in their current homes for 72 months, 22% (*n* = 8) between 48 and 69 months, 14% (*n* = 5) for 24–47 months, 6% (*n* = 2) between 12 and 23 months, and 8% (*n* = 3) for <12 months. Caregivers of CE children in maternal or relative care had lower PPVT-R scores, and greater cigarette use than caregivers of CE children in adoptive or foster care and NCE children. Also, caregivers of CE children in maternal or relative care had higher psychological distress than adoptive or foster caregivers of CE children. All three groups differed on the HOME score, with the highest HOME score reported for CE children in the adoptive or foster care group, followed by NCE children,

and finally the HOME score for CE children in maternal or relative care.

Cocaine Effects on the Dominic Interactive and the CBCL

Analyses involving dichotomous classification on the DI revealed cocaine effects. Table IV presents the percentages of children with scores in the probable clinical ranges. Cocaine exposure was related to the proportion of children achieving scores in the probable clinical range for oppositional defiant disorder (OR = 2.15; *p* < .05) and attention deficit hyperactivity disorder (ADHD) (OR = 2.09; *p* < .05). Thus, CE children were twice as likely to report ODD and ADHD symptoms in the probable clinical range as NCE children. No cocaine effects were obtained on the continuous broadband scores from the DI.

The DI scales were collapsed into a probable clinical range because of the low incidence of children in the severe clinical range of scores. Analyses based on only children in the severe clinical range did not reveal any group differences. Severe clinical range prevalence was

Table III. Current Caregiver Characteristics (Reported at Child Age 6)

	Cocaine				Noncocaine		<i>p</i>
	Group I (maternal or relative, <i>n</i> = 133)		Group II (adoptive or foster, <i>n</i> = 36)		Group III (nonexposed, <i>n</i> = 153)		
	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>	
PPVT-R score	75.8	15	88.9	17	78.9	15	<.001 ^{a,b}
WAIS-R BD Score	6.8	2	7.3	3	7.2	2	.25
WAIS-R PC score	6.9	2	7.7	3	6.9	2	.23
GSI (6 years) ^d	.43	.4	.2	.2	.36	.4	.010 ^a
Home score (6 years)	40.1	7	45.6	7	42.5	7	<.001 ^{a,b,c}
Cigarettes per day ^d	8.4	11	2.3	6	3.7	6	<.001 ^{a,c}
Alcohol drinks per week ^d	2.4	6	0.5	2	1.8	4	.09
Marijuana joints per week ^d	0.4	3	0	0	.15	.9	.36
Cocaine rocks per week	0.7	7	–	–	–	–	–

^aGroup I differs from Group II.

^bGroup II differs from Group III.

^cGroup I differs from Group III.

^dANOVA performed on the logged transformed scale.

Table IV. Percent of Children Reaching Probable DI Clinical and Adjusted Odds Ratios and DI Mean Broadband Scores

Clinical ranges—diagnostic categories	Cocaine (<i>n</i> = 169)	Nonco.caine (<i>n</i> = 153)	Odds ratio	One-tailed 95% CI	One-tailed <i>p</i>
Separation anxiety	74 (44%)	77 (50%)	0.79	OR > 0.54	.86
Generalized anxiety ^b	30 (18%)	30 (20%)	1.04	OR > 0.64	.45
Specific phobias ^a	65 (39%)	60 (39%)	1.04	OR > 0.75	.33
Major depression or dysthymia ^c	30 (18%)	25 (16%)	1.01	OR > 0.61	.49
Oppositional defiant disorder	28 (17%)	13 (9%)	2.15	OR > 1.20	.02
Conduct disorder	24 (14%)	14 (9%)	1.65	OR > 0.92	.08
ADHD ^b	20 (12%)	11 (7%)	2.09	OR > 1.08	.03
Broadband scores	M ± SE	M ± SE		<i>t</i>	One-tailed <i>p</i>
Internalizing	19.2 ± .72	19.6 ± .76	–	–.38	.65
Externalizing ^{b,d}	8.18 ± .55	7.99 ± .67	–	.27	.39
Total score	28.1 ± 1.11	27.3 ± 1.17	–	.46	.32

^aAdjusted for caregiver WAIS-R picture completion score and caregiving status.

^bAdjusted for caregiving status.

^cAdjusted for caregiver PPVT score.

^dStandard errors estimated using the Delta Method.

similar for CE and NCE children for each scale, specific phobias (11 vs. 12%), separation anxiety disorder (29 vs. 32%), generalized anxiety disorder (8 vs. 9%), major depression disorder (5 vs. 5%), oppositional defiant disorder (3% vs. 0), conduct disorder (5 vs. 3%), and attention deficit hyperactivity disorder (2 vs. 3%). Indeed, the prevalence of children in the severe clinical range is lower than the ranges shown in Table IV, which reflects the combination of the severe and moderate clinical ranges on the DI scales.

In contrast, CE children did not differ from NCE children on the percentage of children in the clinical ranges based on the caregiver report using the CBCL, or on broadband scores from the CBCL.

Effects of Adoptive or Foster Care Status

Because caregiver status (adoptive or foster vs. maternal or relative) and other environmental confounding factors (maternal PPVT-R, HOME score, GSI, and WAIS-R score) were found to relate to child mental health outcomes independent of cocaine effects, further analyses were conducted to assess the direction of the relationships between mental health symptoms and caregiver type.

On the DI clinical range analyses, no significant effects of caregiver status were found. When DI broadband scores (e.g. internalizing, externalizing, and total) were analyzed using the continuous data (see Table IV), a main effect for caregiving status was found for the externalizing score. Follow-up comparisons showed that CE children in adoptive or foster care self-reported more externalizing symptoms than NCE children (9.98 vs. 7.06, $p < .05$) and CE children in maternal or relative

care (9.98 vs. 7.03, $p < .05$). Neither the total nor the internalizing score was different.

Results of the CBCL clinical range analyses by caregiver type are presented in Table V. Significant caregiver effects were obtained for withdrawn, aggression, internalizing, externalizing, and total scores. However, comparisons between the three groups revealed nonsignificant effects for withdrawn and internalizing scales. CE children in adoptive or foster care were five to six times more likely to be reported by their caregivers to be in the clinical range for aggressive behaviors than CE children in maternal or relative care (OR = 6.09, 95% CI: 1.35, 27.41, $p < 0.02$) and NCE children (OR = 4.58, 95% CI: 1.28, 16.36, $p < 0.02$). CE children in adoptive or foster care were rated as having more externalizing problems than CE children in maternal or relative care (OR = 5.41, 95% CI: 2.27, 12.91, $p < 0.001$) and NCE children (OR = 4.62, 95% CI: 2.02, 10.59, $p < 0.001$). Finally, CE children in adoptive or foster care had approximately six times the odds of overall scores in the clinical range compared to that of CE children in maternal or relative care (OR = 6.48, 95% CI: 2.41, 17.40, $p < 0.001$) and four times the odds of NCE children (OR = 4.14, 95% CI: 1.66, 10.37, $p < 0.01$).

Analyses of the CBCL continuous broadband scores also revealed significant caregiver effects. On the internalizing score, CE children in adoptive or foster care were rated as displaying more internalizing problems than CE children in maternal or relative care (49.22 vs. 43.99, $p < .05$). On the externalizing score, CE children in adoptive or foster care were rated as having more externalizing behavior problems than CE children in maternal or relative care (57.50 vs. 48.79, $p < .0001$) and

Table V. Percentage of Children Reaching Probable Clinical Range Based on the CBCL by Caregiver Group

CBCL scale	Group I, cocaine exposed (maternal or relative, <i>n</i> = 131)	Group II, cocaine exposed (adoptive or foster, <i>n</i> = 34)	Group III, noncocaine exposed (<i>n</i> = 153)	Chi-square ^a	<i>p</i>
Withdrawn ^c	5 (3.8%)	1 (2.9%)	8 (5.3%)	4.03	.05
Somatic ^c	15 (11.4%)	2 (5.9%)	7 (4.6%)	.02	.87
Anxious or depressed social ^d	1 (0.8%)	1 (2.9%)	2 (1.3%)	.61	.44
Thought ^e	6 (4.6%)	1 (2.9%)	6 (4.0%)	.15	.70
Attention ^c	9 (6.9%)	1 (2.9%)	13 (8.5%)	.00	.99
Delinquency ^f	6 (4.6%)	2 (5.9%)	9 (5.9%)	2.68	.10
Aggression ^g	8 (6.1%)	5 (14.7%)	7 (4.6%)	.47	.49
Internalizing ^c	6 (4.6%)	6 (17.6%)	10 (6.6%)	4.94	.03
Externalizing ^g	12 (9.2%)	4 (11.8%)	18 (11.8%)	5.32	.02
Total score ^{b,c}	15 (11.4%)	14 (41.2%)	20 (13.2%)	19.87	.0001
	19 (14.6%)	11 (32.3%)	26 (17.2%)	19.58	.0001

Of the 322 with valid Dominic data, only 317 have CBCL data.

^aChi-square and *p* values represent the overall test of caregiver type on the outcome.

^bMissing scores on total for CE Maternal/relative (*n* = 2) and NCE (*n* = 1).

^cAdjusted for log (GSI + 1) of current caregiver.

^dAdjusted for prenatal exposure to marijuana (average use during pregnancy).

^eAdjusted for log (GSI + 1) of current caregiver, maternal education at child's birth.

^fAdjusted for maternal/relative mother PPVT score, current caregiver PPVT score.

^gAdjusted for log (GSI + 1) of current caregiver, current caregiver PPVT score.

NCE children (57.50 vs. 48.75, $p < .0001$). On the total CBCL score, CE children in adoptive or foster care were rated as having more behavior problems overall than CE children in maternal or relative care (51.65 vs. 46.71, $p < .05$) but did not differ from NCE children (48.53).

Other Environmental Factors

On the DI, the incidence of specific phobias was related to lower maternal WAIS-R Picture Completion scores, (OR = .89, 95% CI = .80–.99, $p < .03$). On the CBCL, caregiver GSI score was inversely related to incidence on the withdrawn ($p < .12$), somatic, thought, attention (p 's $< .02$), aggression ($p < .08$), and internalizing, externalizing, and total scores (all p 's $< .0001$). Lower biological maternal education is related to thought disorder incidence ($p < .06$) and higher caregiver vocabulary scores were related to incidence of delinquency ($p < .05$), aggression ($p < .007$) and externalizing scores ($p < .056$). Greater prenatal exposure to marijuana was related to higher incidence of socialization difficulties ($p < .07$).

Discussion

This study compared the mental health symptoms in CE and NCE children of similar race and socioeconomic status at 6 years of age, using child self-report and caregiver report. CE children reported more symptoms of oppositional defiant disorder (ODD) and attention deficit hyperactivity disorder (ADHD) than NCE children.

There were no differences based on prenatal cocaine exposure when caregiver report on the CBCL was used.

CE children report more mental health symptoms than NCE children, supporting several lines of evidence suggesting a link between cocaine exposure and symptoms consistent with ODD and ADHD. First, CE animals have been found to be more reactive to environmental stressors (Molina, Wagner, & Spear, 1994; Spear et al., 1989). This reactivity may lead to impulsivity if regulation of the child's reaction to stress is impaired. Greater reactivity, combined with stressed living conditions may interact to increase the likelihood that CE children will have difficulty managing their behavior (Mayes, Grillon, Granger, & Schottenfeld, 1998). Second, research on animal populations has shown significant monoaminergic deficits and behavioral changes as a consequence of prenatal cocaine exposure (Glatt, Bolanos, Trksak, & Jackson, 2000; Johns et al., 1998; Johns, Lubin, Lieberman, & Lauder, 2002; Kosofsky & Wilkins, 1998). Monoaminergic deficits in humans have been linked to impairments in arousal and attention regulation (Mayes et al., 1998). Finally, cocaine exposure has been linked to poor attention in infants (Singer et al., 1999; Singer et al., 2000), and preschoolers, (Noland, Singer et al., to press) as well as generalized cognitive deficits (Singer et al., 2004; Singer, Arendt et al., 2002) in children. Poor attention and low IQ have been shown to be related to the development of ODD and CD (Loeber, Burke, Lahey, Winters, & Zera, 2000). Longitudinal follow-up studies have further demonstrated impulsivity in older infants, toddlers, and

school age children exposed to cocaine (Bendersky & Lewis, 1998a,b; Leech, Richardson, Goldschmidt, & Day, 1999). These latter studies are consistent with the finding of CE children's report of difficulties with attention and irritability.

Consistent with some recent reports (Accornero et al., 2002; Bennett et al., 2002), caregiver report of child behavior was unrelated to prenatal cocaine exposure after control for confounding variables. Effects of adoptive or foster care status, however, were noted on both child report and parent report, most notably for CE children in adoptive or foster care on scales that assess externalizing behaviors. On a number of behaviors, adoptive or foster caregivers rated their CE children more negatively than did maternal or relative caregivers of CE children or mothers of NCE children.

Several reasons may account for these findings. First, CE adopted or foster care children may actually exhibit more behavior problems than CE children in maternal or relative care and NCE children. Some studies have supported the hypothesis that in general adopted children experience more adjustment difficulties than nonadopted children (Miller et al., 2000; Sharma, McGue, & Benson, 1998), specifically externalizing behavior problems (Simmel et al., 2001). An alternative explanation is that CE children in adoptive or foster care may have caregivers who are more sensitive to adjustment difficulties (Miller et al., 2000), with this increased sensitivity accounting for the elevated rates of behavior problems. Furthermore, these caregivers may also be involved with clinical services or have better resources to obtain services and education regarding mental health problems. Research has shown that adopted children are referred for and utilize services at a greater rate than nonadopted children (Warren, 1993). Finally, it may be that the adoptive or foster placement itself had a disruptive effect on children's adjustment because of loss of significant attachment figures. In an effort to address this issue, we investigated the correlation between length of placement in the adoptive or foster care home and the rate of externalizing symptoms and the relationship was not significant.

Our findings do not indicate adoption or foster care is necessarily a negative event for CE children. Indeed, recent research has shown that adjustment of adopted drug-exposed children is similar to that of adopted non-exposed children (Barth & Needell, 1996). Further, in this sample, we previously found that adoptive or foster care status was protective for cognitive outcomes at age 4. That is, CE children in adoptive or foster care demonstrated performance on a standardized IQ test similar to

NCE children (Singer et al., 2004). However, despite living in more cognitively stimulating home environments, CE children in adoptive or foster care in this analysis did not show the same protective effect on mental health outcomes that was seen for cognitive outcomes.

It may be that adoptive or foster homes provide greater structure and rules. As such, children's violations of those rules may lead to parent and child conflict, which appears logically related to ODD and externalizing behaviors. Alternatively, it is possible that adoptive or foster caregivers may have higher standards than the biological caregivers of CE children. Still another possibility is that adoptive or foster caregivers have developed an expectancy of more negative behavioral outcomes in CE children based on media reports. Although some effects of the adoptive or foster caregiver environment on children's mental health outcomes were mediated by characteristics such as maternal psychological distress and IQ, which differed by caregiver status, there were independent effects of adoptive or foster care status on child outcomes beyond these characteristics.

In this sample, the percentage of children in the probable clinical range for specific phobias and separation anxiety was high. Additionally, the rates of ODD and CD in this sample were higher than population based studies which have found diagnostic prevalence rates of 2–8% (Loeber, Farrington, Stouthamer-Loeber, & Van Kammen, 1998). However, as noted, child self-reports are not equivalent to diagnostic classification and are not comparable to epidemiologic studies that establish a diagnosis. Moreover, children in both groups of this sample were at very high psychosocial risk from birth, and the rates of mental health problems reported here are not markedly discrepant from those reported in other urban low income, primarily single parent families with parental drug and alcohol abuse as well as mental health difficulties (see Qi & Kaiser, 2003). Also, because the DI is a new assessment, it will be important to continue to validate its use with populations other than its normative sample, especially in underrepresented minority populations.

Several limitations of this study should be noted. Maternal drug use was evaluated based on retrospective reports. While the infant's meconium was collected at birth and used for classification purposes, estimation of drug use prior to pregnancy and throughout the pregnancy was based on maternal report at the child's birth; therefore, these retrospective reports may underestimate or overestimate actual drug use. The DI measure used in this study has not received extensive psychometric testing, and the results may be affected by unknown

psychometric characteristics of this test. Caution has been raised regarding the use of DSM-based assessments with children (Cantwell, 1996) and the issue of whether the reporting of these symptoms are stable should be investigated in future studies. Nonetheless, studies have shown young children's self-report to be predictive of later mental health and academic outcomes (Ialongo, Edelsohn, & Kellam, 2001) and despite problems associated with categorical approaches to diagnosis, efforts to validate the use of DSM-based diagnostic measures are extensive (Shaffer et al., 1996; Silverman, Saavedra, & Pina, 2001). Another limitation is that too few NCE children were placed in adoptive or foster care to assess the effects of caregiving status on parental report, except within the cocaine group. Thus, our findings must be restricted to CE children. Nevertheless, our findings could not be attributed to other factors, which differentiated the groups, such as caregiver distress, IQ, the home environment, and severity of cocaine exposure.

It will be important to continue to assess mental health outcomes in CE populations. Obtaining the child's self-report will be an important dimension to consider as symptom presentations, as demonstrated here, may vary based on the informant (child or parent). It will continue to be of interest to assess caregiving status in relation to child outcome. Future studies with independent ratings of CE children's behavioral and mental health symptoms should help differentiate whether adoptive or foster caregivers' perceptions of their CE children are based on unrealistic standards, negative expectations from media stereotypes, or reflect true behavioral differences. In all cases, caregiver support and counseling may be necessary, in so far as CE children at 6-years of age self-reported more symptoms of oppositional defiant disorder and attention deficit hyperactivity disorder. Replication of these findings may shed insights into effective intervention strategies for use with drug-exposed children and their parents.

Acknowledgments

Thanks are extended to the participating families and the Cuyahoga County Department of Children's Services. We also thank Paul Weishampel, Laurie Ellison, Selena Cook, and Terri Lotz-Ganley. This research was supported by the National Institute of Health (NIH) National Institute on Drug Abuse (NIDA) (RO1 DA 07285 and 07957, PI: L.T. Singer), and NIDA Research Supplement for Underrepresented Minorities (DA 07957 P.I.:

L.T. Singer, trainee: T.J. Linares), and General Clinical Research Center Grant RR00080.

Received March 1, 2005; accepted March 1, 2005

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