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Serial Pediatric Symptom Checklist Screening in Children with Prenatal Drug Exposure

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Abstract

Objective—To examine screening results obtained by serial annual behavioral assessment of children with prenatal drug exposure.

Method—The Maternal Lifestyle Study enrolled children with prenatal cocaine exposure (PCE) at birth for longitudinal assessments of developmental, behavioral, and health outcomes. At 8, 9, 10, 11, and 12 years of age, caregivers rated participants on the Pediatric Symptom Checklist (PSC). Serial PSC results were compared to an established broad-based behavioral measure at 9, 11, and 13 years. PSC results were analyzed for 1,081 children who had at least 2 annual screens during the 5-year time span. Most subjects (87%) had 4 or more annual screens rated by the same caregiver (80%). PSC scores (and Positive screens) over time were compared at different time points for those with and without PCE. Covariates, including demographic factors and exposures to certain other substances, were controlled.

Results—Children with PCE had significantly higher scores overall, with more Positive screens for behavior problems than children without PCE. Children with PCE had more externalizing behavior problems. Children exposed to tobacco pre- and post-natally also showed higher PSC scores. Over time, PSC scores differed slightly from the 8-year scores, without clear directional trend. Earlier PSC results predicted later behavioral outcomes.

Conclusion—Findings of increased total PSC scores and Positive PSC screens for behavioral concerns in this group of children with prenatal substance exposure support the growing body of evidence that additional attention to identification of mental health problems may be warranted in this high-risk group.

Keywords

Behavior disorder; child behavior; mental health; screening; prenatal cocaine exposure; Pediatric Symptom Checklist

BACKGROUND

Psychosocial and mental health problems occur frequently in children and adolescents.¹ Even when concerned, parents may not always seek mental health services for their children, and mental health needs go unmet.^{2,3} Effective screening for emotional and behavioral problems is a critical component in identifying the children who may benefit from additional evaluation and treatment.⁴ Earlier identification and appropriate treatment may help ameliorate some long-term sequelae compared to an expectant approach.⁵ Even subtle mental health issues may benefit from attention, and in fact may respond more readily to intervention, thereby preventing adverse outcomes.

While various entities including school and community service agencies may assist in identifying difficulties in children with or at risk for psychosocial problems, the primary care physician may assume much of this responsibility. The American Academy of Pediatrics (AAP) recommends that regular health maintenance visits with a Pediatrician or Family Physician include developmental, mental health, and behavioral screens in addition to basic medical care.⁶ After more frequent visits during infancy and early childhood, ongoing health maintenance visits are recommended annually beginning at 3 years of age, continuing through middle childhood and adolescence. Primary care clinicians are encouraged to provide a “Medical Home” in which all aspects of care are addressed, including identification and treatment of developmental and behavioral disorders.⁷ A recent policy statement from the American Academy of Pediatrics emphasizes the need for ongoing attention to mental health issues within the Medical Home.⁸

The Pediatric Symptom Checklist (PSC) is a well-known and frequently utilized screen of psychosocial functioning for children 4–18 years of age.^{9,10} The standard version is a questionnaire consisting of 35 items reflecting caregiver impression of the child’s psychosocial functioning. A score at or beyond the established cutoff score of 28 (for age, with slightly lower cutoff score for younger children at 4–5 years) is not diagnostic itself, but indicates the need for further evaluation. Subscales may be assessed clinically (though no cutoff score provided) for internalizing, externalizing, and attention problems.¹¹ The PSC has high sensitivity (80–95%) in detecting behavior problems, though some variation in specificity (68–100%) has been noted.^{10,12–14}

The PSC has been compared to a number of more in-depth diagnostic measures of psychological status, including the well-established Child Behavior Checklist (CBCL), with which it has a good correlation.^{15,16} The CBCL itself is one of the most commonly used measures of child psychopathology, designed to obtain caregiver’s reports of children’s behavior characteristics (both positive and negative).¹⁷ The CBCL, which is frequently used in both clinical and research settings because of its strong psychometric properties and broad clinical utility, was normed by age and gender on a national sample and has evidence for content, construct, and criterion-related validity.^{4,17}

While the PSC has been studied extensively and validated in numerous populations in outpatient and inpatient settings, studies have generally evaluated results at a single point in time, rather than with repeated measures assessments.^{10,12–14} One recent study did evaluate the stability and change of PSC scores over an approximate one-year period in an outpatient

primary care setting, with general stability noted over this time frame.¹⁸ The PSC has been used in circumstances other than for routine periodic health maintenance assessments. Children presenting for illness or injury related medical visits (compared to preventive care medical contacts) have been shown to have higher rates of Positive screens on a brief version of the PSC (the PSC-17 screen contains a subset of items found in the full scale),¹⁹ and the PSC has been useful in helping identify children with behavioral concerns during hospitalization for acute medical conditions.²⁰

While universal screening has the advantage of reaching a larger number of children, additional targeted screening for behavior problems may also be effective when those potentially at greater risk for clinical problems are identified. Prior research has found greater frequency of behavior problems in certain high-risk populations, and those with prenatal cocaine exposure (PCE) have been hypothesized to be at greater risk. Behavioral correlates of PCE are usually subtle and not always consistent across measures and ages of measurement²¹, but outcomes at older ages (school age) have shown more consistent reports of particular behavior issues, such as deficits in attention and self-regulation.^{22,23} Even within our own cohort of the Maternal Lifestyles Study (MLS) that includes children with PCE (and comparison subjects without PCE) who have been followed for behavioral outcomes since recruitment at birth (between 1993–1995), findings regarding behavioral outcomes have differed somewhat. When children were assessed with the Behavioral Rating Scales (component of the Bayley Scales of Infant Development) at 1, 2, and 3 years of age, there were no significant increases in behavior problems attributable to PCE.²⁴ We did, however, find a significant and sustained effect associated with PCE on the trajectory of behavior problems as measured by the CBCL at 3, 5, and 7 years,²⁵ and on later assessment, including by teacher report, at 7, 9, and 11 years.²⁶ Recent investigation has evaluated longer-term outcomes as cohorts of infants exposed to substances in-utero are aging into late childhood and adolescence.

In reviews of findings in multiple cohort studies examining both early outcomes as well as those completed more recently with older subjects, a variety of factors in the postnatal environment have been implicated as having significant impact on behavioral manifestations.^{22,27,28} Studies have understandably varied in terms of subjects, methods, and outcomes, all of which may hinder comparison. A current focus has also been to delineate organic factors as correlates to specific clinical findings, such as difficulties with attention and response inhibition.²⁹ Underlying susceptibility by hereditary and/or medical mechanisms may be responsible for some of the differences that have been detected between children exposed to intrauterine substances versus those not exposed. Many facets of prenatal substance exposure outcomes have been incompletely evaluated and research is ongoing.

For this study, we hypothesized that children prenatally exposed to cocaine would have more behavioral problems identified by a commonly used screen for behavioral problems, the Pediatric Symptom Checklist (PSC). Three questions are addressed with the current study: (1) Do children with PCE (Some or High level) have higher PSC scores than controls? Additional analyses are provided for other drug exposure. (2) Are PSC scores consistent over time? (3) Do the scores obtained on the PSC screening instrument predict later outcomes as measured by a broad-based behavioral measure?

METHODS

The Maternal Lifestyle Study enrolled 1,388 subjects between 1993–1995 for longitudinal developmental, behavioral, and health outcomes at four collaborating sites (Brown University, University of Tennessee Health Science Center, University of Miami, and

Wayne State University). Sites maintained ongoing Institutional Review Board research approvals as well as Certificates of Confidentiality from the National Institute on Drug Abuse. Mother-infant dyads were initially enrolled in the MLS cohort at the birth hospital and assigned to an exposure group based on maternal self-report of cocaine use during pregnancy and/or by toxicology assay positive for cocaine in the infant's meconium. We categorized PCE into High, Some, and no exposure based on a detailed maternal interview at the first follow-up visit. High PCE referred to ≥ 3 times per week use in the first trimester; any other use indicated Some cocaine use (Some PCE). Both groups contained infants with exposure to tobacco, alcohol, marijuana, and/or opiates. We expressed prenatal tobacco use as the average number of cigarettes per day, prenatal alcohol use as number of ounces of absolute alcohol per day, marijuana use as the number of joints per day, and prenatal opiate use as a yes or no variable. The control group without cocaine exposure was composed of infants matched on gestational age, sex, and race/ethnicity. Demographic characteristics are shown in Table 1. Specific selection criteria have been previously reported.^{30,31}

Ongoing annual assessments have included psychological and medical health measures. Caregivers have rated MLS subjects on the PSC annually since 8 years of age, with data used for this study through 12 years of age. Our final analytic sample for this study included 1,081 children (101 with High PCE and 209 with Some PCE) who had at least two PSC valid screens (four or fewer items omitted by the rater, per scoring instructions)^{9,10} during the 5-year time span (overall subject retention rate of approximately 78%). Most of the subjects in the final sample (87%) had 4 or more screens completed (5% of subjects had 2 screens only, 8% had 3 screens, 18% had 4 screens, and 69% had screens in all 5 years). Caregivers reporting on the children's behavior remained fairly stable with a total of 870 (80%) of the 1,081 children having the same caretaker at each visit from 8 to 12 years. Among the remainder, 133 (12%) had one caretaker change, 67 (6%) had 2 caretaker changes, and 11 (1%) had 3 caretaker changes. Caretaker changes may have included care by other family members or custodial care (state or other non-relative).

Demographic characteristics for the 1,081 children in the analysis are shown by level of prenatal cocaine exposure in Table 1. Children with cocaine exposure had older mothers with less education but higher SES and were more likely to be exposed to other types of drugs (Table 1). In comparison to the 1,081 children in the sample, the 307 children lost to follow-up were less likely to be black ($p < .001$) and more likely to be exposed to opiates ($p=.005$). There were no significant differences between the two groups by gender ($p=.234$), maternal age ($p=.193$), maternal education ($p=.941$), and prenatal cocaine ($p=.516$), tobacco ($p=.155$), alcohol ($p=.839$), and marijuana ($p=.774$) exposure.

The standard version of the PSC consists of 35 questions regarding behavioral characteristics that are rated by the caregiver as occurring "never", "sometimes", and "often" (numeric response values are assigned "0, 1, and 2" respectively.) For the age group included in this study, scores for PSC screening are Positive if they meet or exceed 28 for the total.¹⁶ Besides total behavior scores, behaviors can be further subdivided in to subscales for Attention (e.g., fidgets, has trouble concentrating), Internalizing (e.g., feels sad or hopeless, worries), and Externalizing (e.g., fights, teases, steals) categories. Behavior patterns may have clinical significance if a preponderance of one or more types is identified within the positive responses, though specific cutoff scores are not utilized for this purpose.¹¹ Research on clinical use of the subscales has been relatively limited in comparison to that of the total PSC.

Two approaches were used to examine change in the PSC for this large, high-risk group over a span of 5 years. The first explored change in PSC scores (continuous measures) and

the other explored change in Positive screens (dichotomous categorical measures) over time. Mean PSC scores over time and correlations between scores at different time points were computed. Regression models using generalized estimating equations (GEE) models were conducted to examine changes in PSC scores over time by PCE level, controlling for the following variables which were considered to be significantly related to clinically important behavior outcomes: clinic, gender, race, socioeconomic status, maternal age at delivery, maternal education level, other prenatal substance exposure (opiate, marijuana, alcohol, and tobacco), caregiver postnatal substance use (marijuana, alcohol, and tobacco), caregiver depression scores, and domestic violence exposure. These models allow us to account for correlated errors between repeated measurements over time. Similar analyses were conducted for the Positive screens; however, logistic regression models using GEE were used instead to account for the dichotomous outcome variable (i.e., Positive screen vs. not).

The following variables were available at multiple time points and were included as time-varying covariates in the models: socioeconomic status, postnatal substance use (marijuana, tobacco, and alcohol), caregiver depression, and domestic violence. Socioeconomic status (SES) was assessed using Hollingshead ratings and caregiver depression was based on scores on the Beck Depression Inventory (multiple choice self-report inventory, with higher scores suggesting, but not diagnostic for, depression).³² Domestic violence exposure included reports of abuse of the child and/or caretaker.

PSC results at each time point were used to predict subsequent outcomes as measured by the CBCL at 9, 11, and 13 years and Teacher's Report Form (TRF) at 9 and 11 years. The Teacher's Report Form is a companion CBCL rating form designed specifically for teachers.¹⁷ The CBCL was administered verbally to the parent or caretaker by a trained research interviewer to ensure uniform administration across four sites to all caretakers regardless of literacy level. We derived the T scores for outcomes internalizing, externalizing, and total behavior problems, using a computer scoring system. For this study, PSC Positive screens were compared to CBCL results with T scores at or greater than 60 (indicative of "borderline" and "clinical" findings).

RESULTS

Children with High PCE had significantly higher scores than those with no PCE on the total PSC and each of the subscales across time (except internalizing at 8, 10, and 12 years) (Table 2). Children with Some PCE had significantly higher scores than those with no PCE on the total PSC and the externalizing scale for all years except year 8 and on the attention and internalizing scales at year 10 only (Table 2).

After controlling for socio-demographic factors and other types of prenatal and postnatal drug exposure as listed, differences according to High and Some PCE (vs. no PCE) remained significant for the total PSC and externalizing scale (Table 3). In addition, those with High PCE had significantly higher scores for attention problems than those with no PCE. As suggested by the parallel trajectories for the groups shown in Figure 1, while children with any PCE had more problems at each age, the patterns of change in overall PSC scores over time tended to be similar across the groups with a non-significant interaction between time and prenatal cocaine exposure ($F(8,33)=0.53, p=.836$).

While not the focus of this investigation, other factors emerged as significant predictors of PSC scores. Male gender was associated with significantly higher scores on all scales except internalizing (Table 3). Those with younger (< 25 years of age at delivery) and less educated mothers (< high school) had higher externalizing scores. Black race and having a mother with a high school education (vs. more than high school) were associated with lower

internalizing scores while higher SES was associated with higher PSC and attention problem scores after controlling for the other variables. Children with greater postnatal tobacco exposure scored significantly higher on the total PSC as well as on all three behavioral subscales while postnatal marijuana exposure was only associated with higher overall PSC and externalizing scores. Children whose caregivers had higher depression scores had higher scores on all PSC scales and those who experienced domestic violence in their households had higher scores on the overall PSC as well as the externalizing and internalizing subscales.

More prenatal tobacco exposure was associated with higher scores on the total PSC and the externalizing, and internalizing scales, after controlling for other factors (Table 3). Similar to PCE, children with greater prenatal tobacco exposure had higher overall PSC scores at each time point, but seemed to follow similar trajectories over time (Figure 1); the interaction between time and prenatal tobacco exposure was non-significant ($F(4,29)=0.22$, $p=.928$).

In addition, we explored the possible role of number of caretaker changes as a mediator of the impact of PCE on PSC scores. If number of caretaker changes is a mediator, the direct effect of cocaine exposure on PSC scores should decrease when number of caretaker changes is included as a mediator in the model. We used a bootstrapped Sobel test of mediation with 10,000 bootstrapped resamples.³³ Number of caretaker changes was a significant mediator of the impact of High PCE (vs. no exposure) on total PSC scores for 3 of the years and marginally significant for a 4th year: 8 years ($p=.334$), 9 years ($p=.058$), 10 years ($p=.006$), 11 years ($p=.035$), and 12 years ($p=.005$). It also appears to be a mediator of Some cocaine exposure (vs. no exposure) on total PSC scores for 3 years: 8 years ($p=.169$), 9 years ($p=.014$), 10 years ($p < .001$), 11 years ($p=.114$), and 12 years ($p < .001$).

For the total PSC, as well as the individual scales (internalizing, externalizing, and attention), there was significant variation in scores over time ($p < .001$). Over time, PSC scores differed slightly (though at a statistically significant level), from the 8-year scores (ranging from -2.62 to $+0.21$ points), without clear directional trend. However, scores on the total PSC and externalizing and attention scales were significantly lower at older ages (11 and 12 years) than at 8 years (Table 3).

As may be expected from higher scores overall, children with High cocaine exposure were significantly more likely to have a Positive screen than controls at all but 10 and 12 years of age (Figure 1). Children with Some cocaine exposure were at increased risk for a Positive screen at 9 and 10 years. After controlling for other factors in a mixed model similar to Table 1, the difference between children with High PCE and no PCE remained significant across time (adjusted OR (95% CI) = 1.61 (1.08, 2.41), $p=.020$); the difference between children with Some vs. no PCE was no longer significant after accounting for other factors (adjusted OR (95% CI) = 1.30 (0.95, 1.77), $p=.097$). The percentage of children with a Positive PSC screen also varied significantly over time controlling for other factors ($p < .001$), ranging from a low of 10% (average between PCE and non-PCE groups) at 11 years to a high of 16% (average) at 10 years (Figure 1).

Figure 1 also displays the number of Positive screens by prenatal tobacco exposure. For easier readability, we divided children into three tobacco exposure groups: None (47%), Some (≤ 5.5 cigarettes per day; 26%), and High (> 5.5 cigarettes per day; 26%). We used a median split to classify children with tobacco exposure into two categories, Some vs. High exposure. Children with High tobacco exposure were at increased risk for Positive screens at each age as were those with Some tobacco exposure at 10 and 12 years (Figure 1). Conducting similar analyses to those for level of cocaine exposure, the differences between those with High vs. no tobacco exposure (adjusted OR (95% CI) = 1.44 (0.97–2.13), $p=.069$)

and Some vs. no tobacco exposure (adjusted OR (95% CI) =1.10 (0.77–1.56, $p=.598$) were no longer significant after controlling for other factors.

To investigate the persistence of behavioral problems, we examined the relationship between Positive screens over time. As shown in Table 4, children who screened Positive on the PSC at an earlier age had significantly higher odds of a Positive screen at later ages with this relationship appearing to be strongest at the later ages. For example, a Positive screen at 10 years of age was associated with 18 times the odds of a Positive screen at 11 years and 12 years of age.

To explore the relationship between the PSC and other outcome measures, we examined whether PSC Positive screens would be predictive of Positive screens on two other measures, parent-reported CBCL and teacher-reported CBCL TRF, at later ages. Controlling for other factors, the relationship between the PSC and TRF was significant for all comparisons except 9-year PSC Positive screen as a predictor of 11-year TRF Positive screen (Table 4). For example, children with a Positive screen on the parent-reported PSC at 8 years had 3 times the odds of having a Positive screen based on the teacher-reported TRF at 11 years. There was a strong significant relationship between the two parent-reported measures (PSC and CBCL) for all comparisons (Table 4). For example, children who had a Positive PSC screen at 8 years had six times the odds of having a Positive screen on the CBCL at 13 years.

DISCUSSION

Prenatal substance exposure has frequently been hypothesized to convey a risk status to those affected. Children with PCE have been suggested in prior studies to have greater risks for certain behavioral problems. While there was an overall minority of children with Positive behavioral screenings in this study, the consistent relative elevation of PSC scores and Positive screens in those with PCE compared to those not exposed prenatally to cocaine (particularly those with High levels of exposure) further supports additional attention to screening children known or suspected to have been so exposed. While it is beyond the scope of this study to address specific behavioral or mental health diagnoses, the increased rates of reported behavior problems overall on this screening measure provide additional support that children with past history of prenatal substance exposure may be at increased risk for such diagnoses. Further evaluation would be needed to confirm specific diagnoses. This study provides information on the association of this risk status, but does not attempt to determine causality. The higher incidence of externalizing behavior problems reported is also consistent with prior findings within the MLS cohort (behavior ratings completed by the caregiver on the CBCL at alternate annual MLS assessments also showed an increase in externalizing behavior problems in an earlier age range, extending to 11 years).^{25,26}

Though our initial focus for this investigation was regarding children with PCE, the finding of increased reported behavior problems was found to be strong for those with pre- and post-natal tobacco exposure as well. Though prenatal tobacco exposure has also been hypothesized to be associated with adverse behavioral outcomes, prior research has been somewhat conflicting as it has been with PCE, with issues of multiple confounding variables interfering with interpretation of results.^{34–36}

Since both total scores as well as Positive screens were analyzed, the issue of appropriate cutoff score for a high-risk population (as has been suggested by some researchers)³⁷ was not a critical factor in evaluating the trends. It is unclear why there are aberrant 11-year results showing decreased PSC scores in both the PCE and control groups. (Table 3) No known systemic assessment change was made during this time period.

An important strength of this cohort is the large number of subjects with excellent retention over time. With the repeated measures of the PSC, multiple screens were available for comparison. The 5-year time span over which the measures were utilized represents a substantial duration for study, and affords a unique opportunity to evaluate serial screening. However, due to the nature of the observational longitudinal cohort study design, the subjects were assessed during the course of annual follow-up visits for a broader study of developmental, behavioral, and health outcomes rather than in a naturalistic setting where such screening may typically occur (such as a preventive health maintenance visit with a primary care clinician). We therefore lack the ability to evaluate important characteristics of a therapeutic relationship, such as whether referrals and/or services may have been made secondary to failed screenings. Interventions made at earlier times may (and ideally would) impact future screening results.

Additional study limitations include that many of the subjects for the MLS cohort were recruited from impoverished urban areas, and racial/ethnic mix is notably limited. These and other basic demographic factors may convey separate risk status. Though there are matched controls for the subjects with PCE and common significant confounders are controlled, this investigation does not attempt to control for several other potential confounders to behavior outcomes, including certain environmental variables as well as medical and heritability factors. Therefore, findings in this study of this high-risk group (both as established by prenatal drug exposure, as well as other socioeconomic risks as described) may not be easily generalized to the broader population.

It is readily recognized that multiple and likely additive negative factors may play roles in shaping an individual's specific behaviors. Conversely, factors may be present in individuals or other populations that may provide resiliency to adverse effects, and these are not reviewed in this study. While our large sample size, matched control group, and incorporation of select variables into our statistical models do help to minimize some of these concerns as we attempt to differentiate those children with and without PCE, it remains possible that other environmental factors may account for some differences seen in behavioral outcomes. Some of these potential confounding variables may relate directly or indirectly to risks associated with early PCE, such as caregiver instability or exposure to violence, which may exacerbate behavioral problems. While some of our subjects were discharged from the nursery to caretakers other than their mother because of PCE, and had changes in caregiver, child placement was not included in the model because of collinearity. We have previously found that the child placement (parental versus non-parental care) was a mediator of the relationship between PCE and behavioral outcomes at 7 years of age.²⁵ Likewise, number of caregiver changes was shown to be a mediator of the effect of both High and Some PCE in the current sample.

Because prior research has shown inherent difficulty in interpretation of child behavior in the presence of caregiver depression,³⁸ we controlled for this variable in the analysis. Higher caregiver depression scores (by self-rating) were found to be associated with increased PSC scores, but those children with PCE had more behavior problems present even when caregiver depression was controlled. Specific diagnosis for caregiver depression was not attempted. The caregivers' ratings of subjects reflect only the types of behaviors noted in the caregivers' presence and may not accurately reflect behaviors in all settings. Teacher reports used to help identify behavior issues outside the home setting provided general corroboration for caregiver reports.

CONCLUSION

Findings of increased PSC scores and Positive PSC screens in this group of children who were exposed to cocaine in-utero support the growing body of evidence that such children constitute a high-risk population and who may benefit from identification and treatment of behavioral problems. Children pre- and post-natally exposed to tobacco also had increased identification of behavior problems. Specific mechanisms of these relationships are beyond the scope of this study. It will be important to continue to monitor high-risk individuals within the scope of preventive health care as recommended by the AAP as well as to maintain research efforts to examine the broad scope of short- and long-term outcomes for infants with intrauterine substance exposure. This study provides evidence that serial use of behavioral screening, with an instrument such as the PSC, would be helpful in prediction of later behavioral outcomes. While the continued use of periodic universal screening for all children is certainly recommended, consideration for the additional use of such screens in settings other than “well” care visits and/or traditional primary care clinics may be helpful to provide screening on even more occasions. Further research is recommended to provide more information, specifically with regard to diagnostic and predictive capacity of serial behavioral screens, with consideration of optimal frequency and setting for identification of children who would benefit from additional evaluation and/or services.

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Figure 1.
Positive PSC Screens by Prenatal Cocaine and Tobacco Exposure

Table 1**Demographic Characteristics by Level of Prenatal Cocaine Exposure**

Variable	All	High	Some	None	Significant difference $p < .05$
Male...N (%)	557 (52)	54 (53)	107 (51)	316 (52)	
Maternal age at delivery...N (%)					H-N, S-N
> 35 years	119 (11)	11 (11)	29 (14)	54 (9)	
26–35 years	569 (53)	71 (70)	149 (71)	248 (41)	
≤ 25 years	393 (36)	19 (19)	31 (15)	303 (50)	
Black...N (%)	858 (79)	85 (84)	175 (84)	475 (79)	
Maternal education...N (%)					H-N, S-N
More than high school	228 (21)	20 (20)	31 (15)	149 (25)	
High school	429 (40)	30 (30)	79 (38)	268 (44)	
Less than High school	422 (39)	51 (51)	99 (47)	187 (31)	
Socioeconomic status ...mean (SD)	3.6 (1.0)	3.8 (0.9)	3.7 (1.0)	3.4 (1.0)	H-N, S-N
Prenatal tobacco use (cigarettes)...mean (SD)	5.9 (9.4)	11.5 (11.1)	10.7 (10.7)	3.4 (7.4)	H-N, S-N
Prenatal alcohol use (ounces)...mean (SD)	0.3 (0.9)	0.8 (1.6)	0.6 (1.2)	0.1 (0.4)	H-N, S-N
Prenatal marijuana use (joints)...mean (SD)	0.1 (0.3)	0.3 (0.6)	0.1 (0.4)	0.0 (0.2)	H-N, S-N, H-S
Prenatal opiate exposure...N (%)	79 (7)	11 (11)	17 (8)	37 (6)	
Postnatal tobacco use (cigarettes)...mean (SD)	5.9 (9.4)	7.0 (9.4)	8.7 (10.2)	4.9 (8.9)	H-N, S-N
Postnatal alcohol use (ounces)...mean (SD)	0.2 (0.6)	0.3 (0.9)	0.3 (0.8)	0.1 (0.5)	S-N
Postnatal marijuana use (joints)...mean (SD)	0.0 (0.2)	0.0 (0.2)	0.0 (0.2)	0.0 (0.3)	
Domestic violence...N (%)	44 (4)	6 (6)	12 (6)	23 (4)	
Caregiver depression (BDI score)...mean (SD)	6.8 (7.5)	6.8 (7.6)	7.5 (8.6)	6.8 (7.0)	

Note: H=High, S=Some, N=none; SD=standard deviation. Comparisons of children by cocaine exposure are based on analyses of variance for continuous variables and chi-square tests for categorical variables.

Table 2

Mean Total PSC and Subgroup Scores by Prenatal Cocaine Exposure and Year

Variable	All Mean (SD)	High Mean (SD)	Some Mean (SD)	None Mean (SD)	Significant difference $p < .05$
Scores					
PSC total					
8 years	16.62 (10.43)	19.16 (11.07)	17.21 (10.22)	15.97 (10.26)	H-N
9 years	15.99 (9.50)	19.63 (11.39)	17.34 (9.23)	14.83 (8.99)	H-N, S-N
10 years	16.88 (9.91)	18.99 (10.49)	18.61 (10.15)	15.64 (9.45)	H-N, S-N
11 years	14.15 (9.95)	16.16 (11.59)	15.03 (9.06)	13.17 (9.66)	H-N, S-N
12 years	15.35 (10.12)	17.27 (10.35)	16.08 (9.73)	14.29 (9.86)	H-N, S-N
Attention					
8 years	3.86 (2.51)	4.54 (2.66)	3.99 (2.52)	3.69 (2.43)	H-N
9 years	3.59 (2.42)	4.16 (2.61)	3.79 (2.42)	3.42 (2.33)	H-N
10 years	3.77 (2.48)	4.29 (2.71)	4.03 (2.51)	3.58 (2.43)	H-N, S-N
11 years	2.97 (2.55)	3.52 (2.70)	3.13 (2.48)	2.74 (2.49)	H-N
12 years	3.29 (2.52)	3.67 (2.74)	3.40 (2.56)	3.08 (2.46)	H-N
Externalizing					
8 years	4.05 (2.94)	4.90 (3.08)	4.21 (2.78)	3.81 (2.93)	H-N
9 years	3.82 (2.72)	4.90 (2.83)	4.39 (2.54)	3.44 (2.67)	H-N, S-N
10 years	4.00 (2.90)	4.83 (3.21)	4.46 (2.83)	3.61 (2.77)	H-N, S-N
11 years	3.32 (2.80)	4.02 (2.94)	3.71 (2.65)	2.96 (2.70)	H-N, S-N
12 years	3.50 (2.84)	3.96 (2.77)	3.82 (2.69)	3.19 (2.83)	H-N, S-N
Internalizing					
8 years	1.22 (1.58)	1.29 (1.68)	1.21 (1.60)	1.20 (1.52)	
9 years	1.34 (1.58)	1.63 (1.85)	1.38 (1.52)	1.25 (1.53)	H-N
10 years	1.53 (1.76)	1.52 (1.75)	1.69 (1.81)	1.39 (1.64)	S-N
11 years	1.27 (1.64)	1.57 (2.09)	1.20 (1.39)	1.18 (1.60)	H-N
12 years	1.50 (1.77)	1.62 (1.69)	1.53 (1.83)	1.41 (1.70)	

Note: H=High, S=None; SD=standard deviation. Comparisons of children by cocaine exposure are based on analyses of variance.

Table 3

Regression Models of PSC Scores by Year, Demographic, and Clinical Characteristics

Variable	PSC Coeff (SE)	Attention Coeff (SE)	Externalizing Coeff (SE)	Internalizing Coeff (SE)
Year				
12 years	-1.43 (0.48)**	-0.60 (0.12)***	-0.56 (0.14)***	0.27 (0.08)**
11 years	-2.53 (0.48)***	-0.89 (0.12)***	-0.75 (0.14)***	0.05 (0.08)
10 years	0.21 (0.35)	-0.06 (0.09)	-0.05 (0.10)	0.29 (0.07)***
9 years	-0.59 (0.35)	-0.26 (0.09)**	-0.18 (0.10)	0.13 (0.06)*
8 years	REF	REF	REF	REF
Gender				
Male	2.46 (0.38)***	0.91 (0.10)***	0.62 (0.11)***	0.04 (0.06)
Female	REF	REF	REF	REF
Maternal age at delivery				
> 35 years	REF	REF	REF	REF
26–35 years	0.94 (0.62)	0.17 (0.16)	0.13 (0.17)	0.03 (0.10)
≤ 25 years	1.09 (0.65)	0.22 (0.17)	0.41 (0.19)*	0.01 (0.11)
Race				
Black	-0.03 (0.61)	-0.01 (0.14)	0.30 (0.17)	-0.44 (0.10)***
Not black	REF	REF	REF	REF
Maternal education				
More than high school	REF	REF	REF	REF
High school	0.04 (0.51)	0.03 (0.13)	0.23 (0.14)	-0.21 (0.08)*
Less than HS	0.43 (0.58)	0.07 (0.15)	0.39 (0.16)*	-0.16 (0.09)
Socioeconomic status...mean (SD)	0.46 (0.19)*	0.12 (0.05)*	0.06 (0.06)	-0.03 (0.03)
Prenatal exposure to cocaine				
High	2.33 (0.74)**	0.46 (0.19)*	0.91 (0.21)***	0.19 (0.11)
Some	1.06 (0.52)*	0.16 (0.13)	0.51 (0.14)***	0.08 (0.08)
None	REF	REF	REF	REF
Prenatal tobacco use...mean (SD)	0.07 (0.02)**	0.01 (0.01)	0.02 (0.01)**	0.01 (0.00)*
Prenatal alcohol use...mean (SD)	0.08 (0.21)	0.10 (0.07)	0.07 (0.06)	-0.05 (0.04)
Prenatal marijuana use...mean (SD)	0.31 (0.76)	0.28 (0.17)	0.18 (0.21)	-0.12 (0.10)
Prenatal opiate exposure				
Exposed	-0.45 (0.77)	-0.23 (0.20)	-0.21 (0.22)	0.03 (0.12)
Not exposed	REF	REF	REF	REF
Postnatal tobacco use...mean (SD)	0.09 (0.02)***	0.02 (0.01)***	0.02 (0.01)**	0.01 (0.00)**
Postnatal alcohol use...mean (SD)	-0.01 (0.26)	-0.08 (0.06)	-0.01 (0.07)	0.02 (0.04)
Postnatal marijuana use...mean (SD)	1.10 (0.46)*	0.04 (0.13)	0.35 (0.16)*	0.12 (0.10)
Domestic violence				
Yes	3.59 (1.01)***	0.39 (0.24)	0.86 (0.26)**	0.67 (0.18)***

Variable	PSC Coeff (SE)	Attention Coeff (SE)	Externalizing Coeff (SE)	Internalizing Coeff (SE)
No	REF	REF	REF	REF
Caregiver depression (BDI score)... mean (SD)	0.35 (0.03)***	0.06 (0.01)***	0.06 (0.01)***	0.06 (0.01)***

*
p < .05,

**
p < .01,

p < .001

Note: Coeff=regression coefficient; SE=standard error; SD=standard deviation; REF=reference category (continuous variables lack REF category). Models also control for research center.

Table 4
Odds of Positive Screens on the PSC, CBCL, and TRF at Later Ages based on Positive PSC Screens at Earlier Ages

Outcome	Positive Screen on PSC					
	8 years		9 years		10 years	
	Adjusted OR (95% CI)		Adjusted OR (95% CI)		Adjusted OR (95% CI)	
PSC (Parent)						
9 years	10.22 (5.74, 18.20) ***					
10 years	9.07 (5.19, 15.87) ***		11.05 (6.38, 19.15) ***			
11 years	5.53 (2.91, 10.50) ***		9.75 (5.02, 18.91) ***		17.69 (8.68, 36.08) ***	
12 years	10.50 (5.77, 19.12) ***		9.84 (5.47, 17.70) ***		17.54 (9.51, 32.35) ***	16.95 (9.20, 31.26) ***
TRF (Teacher)						
9 years	3.16 (1.81, 5.51) ***					
11 years	2.97 (1.59, 5.54) ***		1.60 (0.89, 2.90)		2.34 (1.32, 4.16) **	
CBCL (Parent)						
9 years	8.19 (4.87, 13.75) ***					
11 years	6.35 (3.88, 10.37) ***		5.51 (3.31, 9.18) ***		10.25 (6.15, 17.08) ***	
13 years	6.36 (3.88, 10.44) ***		5.11 (2.99, 8.73) ***		9.09 (5.41, 15.29) ***	8.39 (4.32, 16.28) ***

**
p < .01;

p < .001;

Note: Odds ratios adjusted for clinical center, child gender, maternal age at delivery, education, race, socioeconomic status, prenatal cocaine, opiate, tobacco, alcohol, and marijuana exposure, postnatal tobacco, alcohol, and marijuana use, caregiver depression scores, and domestic violence.