

Associations Between Adverse Childhood Experiences and ADHD Diagnosis and Severity

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ABSTRACT

OBJECTIVE: Although identifying adverse childhood experiences (ACEs) among children with behavioral disorders is an important step in providing targeted therapy and support, little is known about the burden of ACEs among children with attention deficit–hyperactivity disorder (ADHD). We described the prevalence of ACEs in children with and without ADHD, and examined associations between ACE type, ACE score, and ADHD diagnosis and severity.

METHODS: Using the 2011 to 2012 National Survey of Children's Health, we identified children aged 4 to 17 years whose parents indicated presence and severity of ADHD, and their child's exposure to 9 ACEs. Multivariate logistic regression was used to estimate associations between ACEs, ACE score, and parent-reported ADHD and ADHD severity, adjusted for sociodemographic characteristics.

RESULTS: In our sample ($N = 76,227$, representing 58,029,495 children), children with ADHD had a higher prevalence of each ACE compared with children without ADHD. Children who

experienced socioeconomic hardship (adjusted odds ratio [aOR], 1.39; 95% confidence interval [CI], 1.21–1.59), divorce (aOR, 1.34; 95% CI, 1.16–1.55), familial mental illness (aOR, 1.55; 95% CI, 1.26–1.90), neighborhood violence (aOR, 1.47; 95% CI, 1.23–1.75), and incarceration (aOR, 1.39; 95% CI, 1.12–1.72) were more likely to have ADHD. A graded relationship was observed between ACE score and ADHD. Children with ACE scores of 2, 3, and ≥ 4 were significantly more likely to have moderate to severe ADHD.

CONCLUSIONS: Children with ADHD have higher ACE exposure compared with children without ADHD. There was a significant association between ACE score, ADHD, and moderate to severe ADHD. Efforts to improve ADHD assessment and management should consider routinely evaluating for ACEs.

KEYWORDS: adverse childhood experiences; adverse childhood experiences score; attention deficit–hyperactivity disorder

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WHAT'S NEW

Children with attention deficit–hyperactivity disorder (ADHD) have a greater prevalence of adverse childhood experiences compared with children without ADHD. There is a significant association between adverse childhood experience score, having an ADHD diagnosis, and moderate to severe ADHD.

ATTENTION DEFICIT–HYPERACTIVITY DISORDER (ADHD) is the most common neurobehavioral disorder of childhood, and there has been a significant increase in parent-reported ADHD prevalence over the past decade.¹ There has also been a concomitant increase in stimulant medication use—expenditures on prescription medications for ADHD exceeded 2 billion dollars in 2007, accounting for more than 8% of all treatment expenditures for children ages 5 to 17 years.²

Optimizing evaluation methods to improve diagnostic accuracy and management of ADHD is a central part of ef-

orts to enhance the quality of ADHD care delivered in pediatric primary care settings and reduce related expenditures. Current ADHD clinical practice guidelines and the Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition) recommend evaluating for and/or excluding other potential conditions with manifestations similar to those of ADHD, such as exposure to psychosocial or environmental stressors.^{3,4} There is growing evidence showing that repeated or sustained exposure to adverse childhood experiences (ACEs)—defined as traumatic occurrences before the age of 18 years that are experienced as physically or emotionally harmful or threatening—increases a child's risk for toxic levels of stress, which in turn might impair neurodevelopment, behavior, and overall physical and mental health.^{5–7} Studies have shown associations between parental psychopathology,^{8,9} marital discord,¹⁰ low socioeconomic status,^{11,12} and presence and severity of ADHD. Although it has been shown that children exposed to ACEs can manifest many of the disruptive behaviors, impulsivity,

and executive dysfunction characteristic of ADHD, comprehensive evaluation for traumatic stressors is not routinely performed during ADHD assessment.^{13,14}

Pediatric primary care providers often rely on parent and teacher rating scales to screen for and diagnose ADHD, and there is wide variability in adherence to clinical practice guidelines that call for comprehensive examination of other factors that might contribute to ADHD symptom onset and progression.¹⁵ Current rating scales and checklists focus primarily on presenting behaviors and do not query about psychosocial and environmental factors, such as exposure to traumatic stress, which might play an important role in ADHD symptom onset and progression and if identified, can help clinicians determine helpful components of multimodal therapy.^{16,17} A recent study on whether general pediatricians routinely ask about ACEs in their practice revealed that approximately one-third did not usually ask about any ACEs, and only 4% reported usually asking about all of the ACEs measured.¹⁸ If clinicians are not routinely identifying ACEs, particularly among children with behavioral concerns such as ADHD, there might be a heightened risk of missing an underlying trauma history or misattributing some of the symptoms of traumatic stress as solely those of ADHD. Existing population-based studies on traumatic stressors among children with ADHD have primarily focused on child maltreatment as the traumatic exposure, or the experience of a single institution.^{19,20} Consequently, there is a gap in knowledge about population-level estimates of a variety of ACEs among children with ADHD, which might help to inform the types of ACEs clinicians should consider as part of differential diagnoses or wider contextual factors during ADHD evaluations. In addition, associations between ACE type, ACE score, and ADHD diagnosis and severity have not previously been described in a nationally representative sample of children.

A better understanding of the types and prevalence of ACEs among children with ADHD and of associations between ACE type, ACE score, and ADHD diagnosis and severity might help enhance the manner in which providers evaluate for and consider traumatic stress during routine ADHD assessment and treatment planning. We sought to describe the prevalence of ACEs in a national sample of children with parent-reported ADHD compared with children without ADHD, and to determine whether associations exist between number and specific types of ACEs and parent-reported ADHD diagnosis and severity. We hypothesized that the prevalence of ACEs would be higher among children with ADHD compared with children without ADHD, and that there would be significant associations between select ACEs, ACE score, and parent-reported ADHD diagnosis and severity.

METHODS

DATA SOURCE AND STUDY SAMPLE

Data were obtained from the 2011/2012 National Survey of Children's Health. The National Survey of Children's Health is a cross-sectional telephone survey that queries

parents or other primary caregivers about a selected child's health, family characteristics, and need for, and use of, health services.²¹ The study sample consisted of children aged 4 to 17 years whose parent responded to queries about ADHD, ADHD severity, and their child's exposure to 9 ACEs (socioeconomic hardship, divorce, death, domestic violence, neighborhood violence, substance abuse, incarceration, familial mental illness, and discrimination). We excluded children younger than 4 years of age because of the low likelihood of an ADHD diagnosis.²²

OUTCOME VARIABLES

The outcomes of interest were: 1) parent-reported ADHD; and 2) parent-rated severity of ADHD. ADHD symptoms were defined for respondents as "problems paying attention or sitting still...[that] may cause a child to be easily distractible." Parent-reported ADHD was ascertained with the following questions: 1) "Has a doctor or nurse ever told you that the child has attention deficit disorder or ADHD, even if he/she doesn't have the condition now?" and 2) "Does the child currently have the condition?" A child was defined as having parent-reported ADHD if the respondent answered 'yes' to both queries and not having ADHD if the respondent answered 'no' to either query. ADHD severity was assessed by asking parents: "Would you describe his/her condition as mild, moderate, or severe?" We dichotomized responses as moderate or severe versus mild.

KEY INDEPENDENT VARIABLES

The primary independent variables of interest were type of ACE exposure (ACE type) and ACE score: that is, the total number of ACEs to which the child was exposed. Parents responded to queries about their child's exposure to 9 ACEs, 4 of which were developed on the basis of a review of childhood stressors by a multidisciplinary Technical Expert Panel (socioeconomic hardship, death of a parent, neighborhood violence, racial/ethnic discrimination)²¹ and the remainder of which were adapted from the Behavioral Risk Factor Surveillance System ACE module.²³ Respondents were asked the following questions: 1) "How often has it been very hard to get by on your family's income?" (termed 'socioeconomic hardship' and dichotomized as very often/somewhat often vs rarely/never); 2) "Did the child ever live with a parent or guardian who got divorced after the child was born?"; 3) "Did the child ever live with a parent or guardian who died?"; 4) "Did the child ever live with a parent or guardian who served time in jail or prison after the child was born?"; 5) "Did the child ever see or hear any parents, guardians, or other adults in his/her home slap, hit, kick, punch, or beat each other up?"; 6) "Was the child ever a victim of violence or witness any violence in his/her neighborhood?"; 7) "Did the child ever live with anyone who was mentally ill or suicidal or severely depressed for more than a couple of weeks?"; 8) "Did the child ever live with anyone who had a problem with alcohol or drugs?"; and 9) "Was the child ever treated or judged unfairly because of his/her race or ethnic group?"

Consistent with previous studies, we calculated a summary ACE score, with a potential range of 0 to 9, which we then categorized as 0, 1, 2, 3, or ≥ 4 ACEs.^{24,25}

CLINICAL AND SOCIODEMOGRAPHIC COVARIATES

To control for potential confounding, we adjusted for child sociodemographic characteristics—sex, age, race (white, non-Hispanic; black, non-Hispanic; Hispanic; multiracial/other, non-Hispanic), and insurance status (private, public, uninsured), reported in previous studies to be related to our outcomes and our primary independent variable of interest.^{26,27} With respect to insurance status, children with private insurance or Medicaid are more likely to be diagnosed with ADHD than uninsured children.²⁸ In addition, although uninsured children and those with Medicaid confront poverty as an ACE, they are also at higher risk of experiencing many of the ACEs measured in this analysis including familial mental illness, familial incarceration, and neighborhood violence.²⁹

STATISTICAL ANALYSIS

Our analysis proceeded in 3 steps. First, we compared children with and without parent-reported ADHD by the distributions of our sociodemographic variables and ACE categories. Second, we conducted bivariate and multivariable logistic regression analyses to examine the association between ACE type, ACE score, and parent-reported ADHD. Third, we restricted our sample to children with parent-reported ADHD, and conducted logistic regression analyses to examine associations between ACE score and parent-rated ADHD severity.

All analyses were conducted using SAS version 9.4 (SAS Institute Inc, Cary, NC). Weighted point estimates and variances were calculated using SAS survey procedures to account for the complex sample design.

The Albert Einstein College of Medicine Institutional Review Board found this study exempt from human subject review.

RESULTS

DESCRIPTION OF THE SAMPLE

The final sample size was 76,227, representing an estimated 58,029,495 children in the United States (Table 1). Children with parent-reported ADHD comprised 8.8% of our sample. Compared with children without parent-reported ADHD, children with parent-reported ADHD tended to be male (69.6% vs 49.3%; $P < .001$), ages 12 to 17 years (53.3% vs 42.4%; $P < .001$), and non-Hispanic white (63.1% vs 52.3%; $P < .001$). Children with parent-reported ADHD had a significantly higher prevalence of ACE scores of 2 (15.6% vs 11.5%; $P < .001$), 3 (11.9% vs 6.0%; $P < .001$), and ≥ 4 (17.5% vs 6.6%) compared with children without parent-reported ADHD.

Children with parent-reported ADHD had a higher prevalence of each type of ACE compared with children without ADHD (Fig). Children with parent-reported ADHD had a higher prevalence of socioeconomic hardship (37.2% vs 24.7%; $P < .001$), parent/guardian divorce

Table 1. Descriptive Characteristics of Children With and Without Parent-Reported ADHD*

Characteristic	n	No ADHD, %	ADHD, %	P
All participants	76,227	91.2	8.8	
Sex				<.001
Male	39,194	49.3	69.6	
Female	36,646	50.7	30.4	
Age, years				<.001
4–5	10,521	15.6	3.7	
6–11	30,975	43.0	44.0	
12–17	34,439	42.4	53.3	
Race/ethnicity				<.001
White, non-Hispanic	49,327	52.3	63.1	
Black, non-Hispanic	7,137	13.8	14.9	
Hispanic	9,661	23.8	14.2	
Multi-racial/other, non-Hispanic	7,969	10.1	7.8	
Insurance status				<.001
Private	51,432	59.8	49.9	
Public	20,247	33.9	47.2	
Uninsured	3,373	6.2	2.9	
ACE score				<.001
0	40,095	50.2	30.1	
1	17,716	25.6	24.9	
2	7,862	11.5	15.6	
3	4,182	6.0	11.9	
4 or more	5,157	6.6	17.5	

ADHD indicates attention deficit–hyperactivity disorder; ACE, adverse childhood experience.

*Ns might not sum to total because of missing values.

(36.3% vs 22.3%; $P < .001$), family substance abuse (22.6% vs 8.4%; $P < .001$), familial mental illness (19.5% vs 9.9%; $P < .001$), neighborhood violence (20.1% vs 9.5%; $P < .001$), familial incarceration (17.0% vs 6.9%; $P < .001$), and domestic violence (15.2% vs 6.4%; $P < .001$) compared with children without parent-reported ADHD.

ASSOCIATIONS BETWEEN ACE TYPE, ACE SCORE, AND PARENT-REPORTED ADHD

Of the 9 ACEs examined, children with socioeconomic hardship (adjusted odds ratio [aOR], 1.39; 95% confidence interval [CI], 1.21–1.59), parent/guardian divorce (aOR, 1.34; 95% CI, 1.16–1.55), familial mental illness (aOR, 1.55; 95% CI, 1.26–1.90), neighborhood violence (aOR, 1.47; 95% CI, 1.23–1.75), and familial incarceration (aOR, 1.39; 95% CI, 1.12–1.72) were significantly more likely to have parent-reported ADHD. A graded relationship between ACE score and parent-reported ADHD was observed (Table 2). Children with ACE scores of 1 (aOR, 1.60; 95% CI, 1.38–1.87), 2 (aOR, 2.16; 95% CI, 1.81–2.57), 3 (aOR, 3.09; 95% CI, 2.46–3.88), and ≥ 4 (aOR, 3.97; 95% CI, 3.29–4.80), were more likely to have parent-reported ADHD compared with children with no ACEs.

ASSOCIATIONS BETWEEN ACE TYPE, ACE SCORE, AND PARENT-RATED ADHD SEVERITY

In adjusted analyses on associations between ACE type and parent-rated ADHD severity among children with

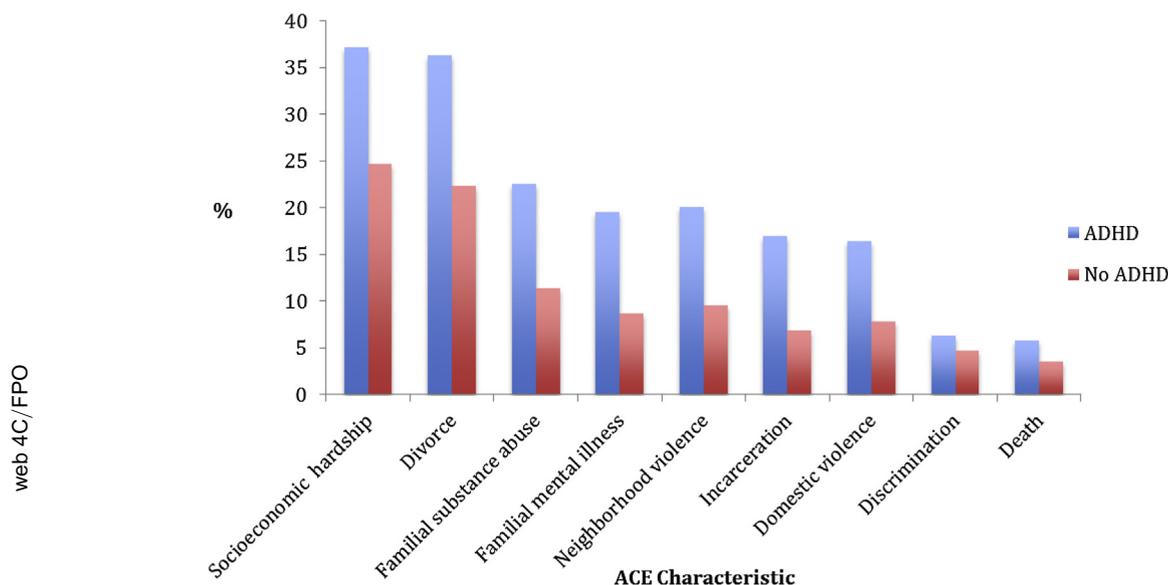


Figure. Prevalence of adverse childhood experiences (ACEs) among children with and without parent-reported attention deficit-hyperactivity disorder (ADHD). ACEs include socioeconomic hardship, divorce, familial substance abuse, familial mental illness, neighborhood violence, incarceration, domestic violence, and death: $P < .001$; discrimination: $P < .01$.

ADHD, only 2 ACE variables were significant. Children with socioeconomic hardship (aOR, 1.47; 95% CI, 1.14–1.89) and parental mental illness (aOR, 1.57; 95% CI, 1.12–2.21) were significantly more likely have parent-rated moderate to severe ADHD compared with mild ADHD (Table 3). Examination of ACE score and parent-rated ADHD severity revealed a trend toward a graded relationship. Children with an ACE score of 1 (aOR, 1.27; 95% CI, 0.95–1.71) had higher odds of reporting moderate to severe ADHD versus mild ADHD, but this was not statistically significant. However, children with ACE scores of 2 (aOR, 1.65; 95% CI, 1.21–2.26), 3 (aOR, 1.73; 95% CI, 1.15–2.59), and ≥ 4 (aOR, 1.63; 95% CI, 1.14–2.33) were significantly more likely to have parent-rated moderate to severe ADHD compared with children with no ACEs.

DISCUSSION

Our national study showed that children with parent-reported ADHD had a significantly higher prevalence of ACEs across all ACE categories compared with children without ADHD. After adjusting for child sociodemographic categories, we found associations between specific ACE types and parent-reported ADHD diagnosis and moderate to severe ADHD. We also observed a graded relationship between ACE score and parent-reported ADHD diagnosis, and a trend toward a graded relationship between ACE score and parent-rated moderate to severe ADHD.

Despite evidence that suggests that specific psychosocial risks and accumulation of risk factors exert strong influence on child development and behavior, the family and social context of ADHD has not been well studied.³⁰ Psychosocial factors that have been shown to act as unique influences on ADHD symptoms include lower

household income, less stimulating and supportive home environments, and maternal depression.³¹ There is a paucity of data on the frequency and extent to which pediatric providers gather social, environmental, and family histories as part of ADHD assessments and treatment plans. Moreover, evidence suggests that general pediatricians have poor knowledge about ACEs generally, with only 2% reporting regular use of an ACEs screening tool, and almost half reporting that they had never heard of the ACEs screening tool.¹⁸ Failure to

Table 2. Association Between ACE Type, ACE Score, and Parent-Reported ADHD (N = 76,227)[†]

Characteristic	ADHD (vs No ADHD), aOR (95% CI)
ACE Type	
Socioeconomic hardship	1.39*** (1.21–1.59)
Divorce	1.34** (1.16–1.55)
Familial substance abuse	1.19 (0.97–1.46)
Familial mental illness	1.55*** (1.26–1.90)
Neighborhood violence	1.47*** (1.23–1.75)
Incarceration	1.39** (1.12–1.72)
Domestic violence	1.13 (0.92–1.40)
Discrimination	1.21 (0.93–1.56)
Death	1.16 (0.89–1.51)
ACE score	
0	Reference
1	1.60*** (1.38–1.87)
2	2.16*** (1.81–2.57)
3	3.09*** (2.46–3.88)
4 or more	3.97*** (3.29–4.80)

ACE, indicates adverse childhood experience; ADHD, attention deficit-hyperactivity disorder; aOR, adjusted odds ratio; and CI, confidence interval.

** $P < .01$.

*** $P < .001$.

[†]Adjusted for child sociodemographic characteristics (gender, age, race, insurance status).

Table 3. Association Between ACE Type, ACE Score and Parent-Rated ADHD Severity, Among Children with Parent-Reported ADHD (N = 6,723)[†]

Characteristic	Moderate to Severe ADHD (vs Mild) OR (95% CI)
ACE type	
Socioeconomic hardship	1.47** (1.13–1.89)
Divorce	1.05 (0.81–1.35)
Familial substance abuse	1.13 (0.83–1.55)
Familial mental illness	1.57** (1.12–2.21)
Neighborhood violence	0.94 (0.69–1.28)
Incarceration	0.89 (0.61–1.29)
Domestic violence	0.83 (0.58–1.19)
Discrimination	1.04 (0.65–1.67)
Death	1.18 (0.73–1.92)
ACE score	
0	Reference
1	1.27 (0.95–1.71)
2	1.65** (1.21–2.26)
3	1.73** (1.15–2.59)
4 or more	1.63** (1.14–2.33)

ACE, indicates adverse childhood experience; ADHD, attention deficit–hyperactivity disorder; OR, odds ratio; and CI, confidence interval.

** $P < .01$.

[†]Adjusted for child sociodemographic characteristics (gender, age, race, insurance status).

identify ACEs and recognize an underlying ACE exposure as a potentially important behavioral contributor to ADHD might result in treatment that is focused on managing the presenting behavior(s), but does little to address the underlying trauma. In addition, narrowly focusing on presenting symptoms and missing a trauma history increases the potential for misattributing behavioral patterns as solely those of ADHD when they might also be reflective of underlying ACE exposures. Our findings describing a significantly higher prevalence of ACEs among a national sample of children with parent-reported ADHD compared with children without ADHD, and associations between specific ACE types, ACE score, and parent-reported ADHD adds to a small literature that suggests that routine evaluation for ACEs should be an important part of ADHD assessment.³¹ Associations between parent-reported ADHD and socioeconomic hardship, parent/guardian divorce, familial mental illness, neighborhood violence, and familial incarceration, also suggest that providers who care for children with or who are suspected of having ADHD should consider wider familial and community-level adversities during ADHD assessments. Further research is needed to define mechanisms by which ACE exposure might cause, potentiate, or be misdiagnosed as ADHD, or by which ADHD might be associated with ACEs.

Our findings showing a significant association between parental mental illness and parent-rated moderate to severe ADHD are consistent with previous work in smaller clinical samples showing that parental psychopathology, particularly maternal depression, is significantly associated

with poorer psychosocial and academic functioning in children with ADHD.⁸ We also found a significant association between socioeconomic hardship and parent-rated moderate to severe ADHD, which further substantiates the influence of poverty on ADHD symptom progression. Socioeconomic hardship brings with it a concentration of risk factors that might influence ADHD severity, including fragmentation of ADHD care across primary care and subspecialty settings,³² increased risk of pre- and postnatal toxicant exposure,³³ and reduced intellectual and social stimulation.³⁴ ADHD diagnosis has also been shown to be a driver of socioeconomic hardship, with significant reported family financial burden because of missed work or job loss and higher out of pocket health-related expenditures.³⁵ The mechanisms by which socioeconomic hardship influences ADHD severity or by which ADHD severity affects socioeconomic hardship is an important area of further study. We also found a trend toward a graded relationship between ACE score and parent-rated moderate to severe ADHD, which adds to previous work in smaller, clinical samples that has shown that cumulative exposure to traumatic experiences is associated with worse overall ADHD symptom severity.^{36,37} These findings might be important to clinicians or caregivers who see a suboptimal response to stimulant medications or targeted behavioral therapies in a child who manifests symptoms of moderate to severe ADHD, but who also might have been exposed to multiple co-occurring traumatic stressors.

The primary strength of this study is its large sample size, which provides substantial power to examine associations between ACEs and ADHD, and extends findings of smaller studies of childhood and family stressors among children with ADHD to a nationally representative US sample. However, our study should be viewed in the context of several limitations. First, the cross-sectional nature of the study precludes inferring causality. We could not measure timing, duration, or severity of ACE exposures and cannot make any causal inferences about ACEs and ADHD diagnosis or severity. We also cannot infer the directionality of associations.

Second, the presence of ADHD and ADHD severity were entirely on the basis of parent report, with no diagnostic validation or confirmation. Studies have shown that parents with an underlying mental health condition, those who experience parenting stress, and those who have ADHD, might over-report their child's ADHD diagnosis and/or perceive their child's ADHD as severe.³⁸ Misclassification bias might have been introduced if parents failed to recognize that their child had ADHD.

Finally, there are unmeasured factors that might mediate or confound the association between ACE score and ADHD diagnosis and severity that our analysis did not include. We did not measure, for example, household composition, child physical health status, and severity of co-occurring mental health conditions, all of which have been found in studies to be related either to our primary outcomes or to ACE score, our primary exposure of interest.³⁹

CONCLUSIONS

In conclusion, our results suggest that ACEs are prevalent among a large, nationally representative sample of children with ADHD, and that the presence of 1 or more ACEs increases the likelihood of having a parent report an ADHD diagnosis and moderate to severe ADHD. Enhanced efforts to identify ACEs among children who have or who are suspected of having ADHD should be an important component of ongoing efforts to optimize ADHD evaluation methods, diagnosis, and management, and to enhance delivery of care that is sensitive and responsive to the needs of children and families who experience trauma.

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