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Medical Report

Defining the role of exposure to ACEs in ADHD: Examination in a national sample of US children

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ABSTRACT

Background: Clinical presentations of ADHD vary according to biological and environmental developmental influences. An emerging field of research has demonstrated relationships between exposure to adverse childhood experiences (ACEs) and ADHD prevalence, particularly in high-risk samples. However, research examining the combined role of traditional risk factors of ADHD and ACEs is limited, and reliance on high-risk samples introduces sampling bias.
Objective: To examine the influence of ACEs on ADHD diagnosis using a large, nationally representative sample of US children.
Participants and setting: Nationally representative samples (2017 and 2018) of 40,075 parents from the National Survey of Children's Health (NSCH).
Methods: We conducted logistic regression models to examine the association of ACEs and ADHD diagnosis, controlling for child and parent demographic variables and other risk factors.
Results: Exposure to ACEs was significantly associated with parent-reported ADHD diagnosis, controlling for known parental and child-risk factors of ADHD. The association followed a gradient pattern of increased ADHD prevalence with additional exposures. Compared to children with no ACEs, the odds of an ADHD diagnosis were 1.39, 1.92, and 2.72 times higher among children with one, two and three or more ACEs. The ACE most strongly associated with the odds of ADHD was having lived with someone with mental illness closely followed by parent/guardian incarceration.
Conclusions: Results further strengthen the evidence that ACEs exposure is associated with increased ADHD prevalence. Clinicians should assess ACEs in the diagnosis of ADHD. Furthermore, results of the study lend support to the efforts of agencies (both institutional and state-level) promoting routine screening of ACEs in children.

1. Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is a common neurodevelopmental disorder characterized by a persistent pattern of inattention, hyperactivity, and/or impulsivity that pervades across a variety of settings and results in functional impairment

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(American Academy of Pediatrics, 2019). ADHD is the most common neurodevelopmental disorder in childhood affecting approximately 6.1 million children aged 2–17 years in the U.S. (Danielson et al., 2018). Over the last decade, ADHD prevalence rates have markedly increased in the U.S. and internationally. One study demonstrated the prevalence rate increased two-fold from 2005 to 2014 from 6.8 % to 14.4 %; additionally, rates of ADHD medication usage for children and adolescents increased from 3.57 % to 8.51 %, respectively (Davidovitch, Koren, Fund, Shrem, & Porath, 2017).

However, ADHD prevalence rates differ across studies, prompting some scholars to question the accuracy of prevalence rates and diagnosis (Thomas, Sanders, Doust, Beller, & Glasziou, 2015). Accurate diagnosis of ADHD is essential to appropriate treatment selection, including medication. Many factors can contribute to the misdiagnosis of ADHD, including failure to use evidence-based assessment techniques and overlooking mimickers of ADHD symptoms.

The American Academy of Pediatrics (AAP) ADHD Clinical Practice Guidelines strongly recommends primary care physicians rule out any alternative cause of symptoms or impairment when determining a diagnosis of ADHD (Wolraich et al., 2019). Given the effects of traumatic stress on child behavior, children exhibiting symptoms of hyperactivity, inattention, and impulsivity may be experiencing a traumatic stress response rather than ADHD (Jimenez, Wade, Lin, Morrow, & Reichman, 2016). Screening tools commonly used by primary care physicians do not typically include screening questions about adverse experiences nor do they supplant extensive history taking.

ACEs refer to the exposure to traumatic events, such as community or domestic violence, loss of a family member, or incarceration of a parent/caregiver, before 18 years of age (Felitti et al., 1998). The original ACEs questionnaire (Felitti et al., 1998) consisted of 10-items that assessed the respondents exposure to the following events during their first 18-years of life: psychological, physical or sexual abuse; lived with an individual with substance abuse or mental illness; domestic violence towards mother; and criminal behavior in the household. Recent research has demonstrated changes in brain development in children who have experienced ACEs that may influence connectivity in the areas of the brain responsible for planning, attention, and inhibition (McLaughlin, Sheridan, & Lambert, 2014; McLaughlin et al., 2010; Weems, Russell, Neill, & McCurdy, 2019). The effects of ACEs on neurodevelopment can manifest as attention difficulties, poor academic performance, aggression, and social problems in children and adolescents (Jimenez et al., 2016). Thus, individuals who experience ACEs are at higher risk for developing ADHD and other forms of psychopathology. This finding has been replicated in both high-risk and population-based studies (Brown et al., 2017; Fuller-Thomson and Lewis, 2015; Semiz Ü. et al., 2017).

The National Survey of Children's Health (NSCH) was utilized by Brown and colleagues (2017) to examine the associations between ADHD and ACEs. Results indicated children with ADHD had higher prevalence rates of ACEs exposure compared to children without ADHD. For example, children who had experienced financial hardship and familial mental illness were more likely (OR = 1.39 and 1.55, respectively) to have an ADHD diagnosis. However, exposure to known ADHD risk factors, such as low birthweight (Mick, Biederman, Prince, Fischer, & Faraone, 2002), or parent factors, such as parental stress or education (Rowland, Lesesne, & Abramowitz, 2002) that correlate with ADHD and ACEs were not accounted for, and the investigation did not report whether the presence of increased ACEs exposure was associated with ADHD prevalence.

It is also important to consider that societal changes may influence this association. For instance, a recent review (Finkelhor, 2020) reported that trends in ACEs exposure have declined in many indicators (e.g., child poverty, physical abuse, community violence) and risen for parental alcohol and drug abuse since the 2000. Indeed, the NSCH data utilized previously (Brown et al., 2017) to examine the link between ADHD and ACEs was sampled in 2011 in the fairly immediate aftermath of the US economic recession before subsequent recovery. For these reasons, it is important to update, replicate, and validate such findings to determine if associations hold given societal and public health shifts.

The purpose of this study is to examine the influence of ACEs on current parent-reported ADHD diagnosis in their child while controlling for child and parent demographic variables and other risk factors using the most recent NSCH data available from 2017 to 2018. We answer the following research questions: To what extent do ACEs associate with parent-report ADHD diagnosis? Furthermore, how does this association change with additional ACEs exposure?

2. Methods

2.1. Data

This study examined two years of cross-sectional data (2017, 2018) from public-use National Survey of Children's Health (NSCH) downloaded from the Child and Adolescent Health Measurement Inititative (CAHMI) website (Child and Adolescent Health Measurement Inititative, 2019; 2018). The NSCH is sponsored by the Maternal and Child Health Bureau (MCHB) at the Health Resources and Services Administration (HRSA) and administered by staff at the U.S. Census Bureau. The NSCH is a nationally representative cross-sectional survey of non-institutionalized children ages 0–17 years old in the United States. Parents or other knowledgeable adult caregivers answered questions on behalf of one focal child ages 0–17 years old chosen at random by interviews within each sampled household. Most 2017–2018 NSCH respondents (91.9 %) and other adult caregivers (79.2 %) identified themselves as parents (includes biological, adoptive, step, and foster parents) of the focal children. Approximately 12.6 % of children were in single parent/guardian households. The NSCH collects detailed information on the physical and emotional health of age-eligible children within selected households, and socio-demographic and socio-economic information on the children, their families, and up to two co-resident adult caregivers. The survey also contains limited information about the physical and mental health of parent/guardian respondents and, when applicable, one other adult in the household who typically cares for the child. Additional information about 2017–2018 NSCH instrument development/content, sample design, and CAHMI variable recodes is available elsewhere (US Census Bureau, 2018).

2.2. Measures

Currently diagnosed ADHD was the dependent variable. Children were considered to have ADHD if a parent/caregiver reported that the child had an ADHD diagnosis from a health care provider currently. The variable is measured dichotomously. Children never diagnosed with ADHD were coded as zero and children with a current ADHD diagnosis were coded as one.

Adverse childhood experiences (ACEs) was the primary independent variable. ACE exposure was measured via nine yes/no questions asking whether the focal child had ever experienced family economic hardship (1), racial discrimination (2), parent/guardian death (3), parent/guardian divorce or separation (4), incarceration of parent (5), witnessed parent/guardian domestic violence (6), witnessed or was a victim of violence in their neighborhood (7), living with someone who was mentally ill, and/or living with someone who was severely depressed, suicidal (8) or a substance abuser (9). These nine items were dichotomized (0 = No, 1 = Yes) and affirmative responses were summed to create an index, or count, of adverse childhood experiences with higher values indicating the presence of more adverse experiences (Range: 0–9). Affirmative responses were summed and categorized as follows: No ACEs (54.6 %), one ACE (23.4 %), two ACEs (9.5 %), and three or more ACEs (10.7 %). Children missing one or more ACE were listwise deleted (Missing N = 3,039, 5.8 %).

Analytical models also adjusted for potential child- and parent/guardian-level confounders. Child-level controls included age in years, gender, birth weight, and race-ethnicity. Age in years was measured continuously (Range: 3–17). Gender was measured dichotomously (reference was male). Race-ethnicity had the following categories: Non-Hispanic white (only, reference), Non-Hispanic black (only), Hispanic (any race), and Non-Hispanic other race-ethnicity (included multi-racial groups). All children had complete information on age, gender, and race-ethnicity. Birth weight was measured with a variable indicating weight 2,500 g or less (low birth weight) vs. 2,500 or more (not low birth weight, reference).

Family/household and parent/guardian controls included maternal age at birth, parental aggravation, household education, and poverty status. Maternal age when the focal child was born was measured continuously (Range: ≤ 18 years to 45+ years). Parental aggravation combines information from three items to rate how often during the prior month the respondent felt the child was “much harder to care for than most children his or her age,” “[did] things that really bother[ed] you a lot,” or “angry with this child” on a five-point ordinal scale. Respondents who said they “usually” or “always” felt the child was difficult, felt bothered by the child, or angry with the child were considered “often aggravated” and those who said they “never,” “rarely,” or “sometimes” had these feelings were considered “seldom aggravated” (reference). This variable was included to account for the observation that aggravation/stress is observed to correlate with both ADHD and ACEs (Crouch, Probst, Radcliff, Bennett, & McKinney, 2019; Crouch, Radcliff, Brown, & Hung, 2019; Theule, Wiener, Tannock, & Jenkins, 2013) Household education was measured from two items indicating the highest level of educational attainment completed by the respondent and up to one other primary adult caregiver within the household (if applicable). Household education had four categories: less than high school, high school/G.E.D., some college or technical school, or bachelor’s degree or higher (reference). Poverty status was measured using the family poverty ratio. Due to a large amount of missing

Table 1
Descriptive Statistics for Variables Included in Analysis (N = 40,075).

Variable	%
Dependent Variable	
Current ADHD diagnosis	8.5
Independent Variable	
No ACEs	56.4
1	23.4
2	9.5
3 or more	10.7
Covariates	
Child age (mean, SD)	10.0 (4.3)
Female	51.3
Race	
Non-Hispanic White	52.5
Non-Hispanic Black	12.7
Non-Hispanic Other	10.3
Hispanic	24.5
Maternal age (mean, SD)[a]	29.3 (6.0)
Highest Adult Education	
<High school	8.4
High school diploma/GED	19.2
Some college	22.2
College degree	50.2
Low birthweight	9.2
Parent usually/always felt stress	5.0
Poverty[b]	20.2

[a] Maternal age top coded at 45.
[b] Based on multiply imputed data.

data (16 %), family poverty ratio was multiply imputed using regression-based imputation methods (US Census Bureau, 2018).

2.3. Analyses

Two multivariable binary logistic regression models were estimated to examine the extent to which adverse childhood experiences are associated with diagnosed ADHD among children ages 3–17 years old. Descriptive statistics for all variables included in the models are listed in Table 1, unadjusted estimated prevalence rates for each ACE included in the index are noted in Table 2, and unadjusted ADHD diagnosis rates by number and type of ACE reported are listed in Table 3. The first logit model (Table 4) regressed ADHD diagnosis on the categorical ACE index and potential confounders. This model allowed for the examination of the extent to which the odds of ADHD diagnosis among children ages 3–17 years old varies according to the number of ACEs reported net of potential child-level and family/parent-level confounders. The second logit model (Table 5) regressed ADHD diagnosis on a series of dichotomous variables representing each ACE included on the index and potential confounders. This model allowed examination of the extent to which specific adverse experiences were associated with the odds of ADHD diagnosis controlling for other ACEs and potential confounders. All analyses are weighted, account for the complex survey design, and incorporate multiply imputed poverty status data using Stata SE version 14.1 (StataCorp., 2015). The analyses were restricted to children ages 3–17 years old with complete information on ADHD diagnosis and all non-imputed covariates (N = 40,075, 76.9 %).

3. Results

Descriptive statistics for variables included in the analyses are depicted in Table 1. The estimated prevalence of children currently diagnosed with ADHD in the analytic sample was 8.5 %. Estimated prevalence rates for ACEs was 56.4 % for no ACEs, 23.4 % for one ACE, 9.5 % for two ACEs, and 10.7 % for three or more ACEs. Most children in the sample were non-Hispanic white (52.5 %), but children who were non-Hispanic black (12.7 %), Hispanic (any race, 24.5 %), and members of other racial-ethnic groups (10.3 %) were also well represented. The mean age of children in the sample was 10 years old (SD = 4.3). The sample was also diverse with respect to gender (51.3 % female). Most children in the sample lived in households with one adult who had some college education (22.2 %) or a bachelor's degree (50.2 %) and relatively few families had incomes below the federal poverty threshold (20.2 %). Finally, the prevalence of low birthweight (9.2 %) was low among children in the sample and few parents reported high levels of parental stress (5.0 %).

Table 2 shows estimated prevalence rates for all nine experiences included in the ACE index. The first column (overall prevalence) displays estimated prevalence rates for each ACE among all children in the analytic sample. The second column displays estimated prevalence rates for each ACE among children who had one or more adverse experiences. The first column notes that parental divorce (25.4 %) and economic hardship (18.6 %) had the highest overall prevalence within the sample and the other ACEs captured by the index were far less common. The results depicted in the second column are consistent with those shown in column one. Specifically, parental divorce (58.2 %) and economic hardship (42.7 %) were the most commonly reported ACE among children who had any ACE and the other ACEs on the index were far less prevalent in comparison among these children.

Table 3 displays ADHD prevalence by type and number of ACEs reported. As depicted in Table 3, ADHD prevalence was lowest among children with no ACEs (5.6 %; 95 % CI: 5.0−6.3) and highest among children with three or more ACEs (19.4 %; 95 % CI: 17.1−21.9). ADHD prevalence rates for children with one (8.8 %; 95 % CI: 7.8−10.0) or two (12.8 %; 95 % CI: 11.1−14.7) ACEs fell between these two extremes. Some evidence suggested that ADHD prevalence rates vary by the type of experience reported, but supplementary analyses indicated that these differences were not statistically significant. ADHD prevalence rates were highest among children who experienced domestic violence (21.9 %; 95 % CI: 15.5−21.9), community violence (19.9 %; 95 % CI: 16.7−23.6), parent/guardian incarceration (18.6 %; 95 % CI: 16.0−21.5.), and children who lived with someone who was either mentally ill (20.3 %; 95 %: CI 17.9−22.9) or had substance abuse problems (17.6 %; 95 % CI: 15.4−20.0). ADHD prevalence rates were slightly lower by comparison among children who experienced racial discrimination (15.4 % [95 % CI 12.1−19.4]), economic hardship (13.4 % [95 % CI 11.9−15.1]), parental divorce (13.3 % [95 % CI 12.1−14.6]), or a parent/guardian death (13.9 % [95 % CI 10.8−17.8]).

Lastly, Tables 4 and 5 display results from logistic regression models that predict ADHD diagnoses as a function of parent-reported ACEs adjusting for potential child-level (race-ethnicity, gender, birthweight) and parent/family-level (maternal age, caregiver

Table 2
Prevalence of Adverse Childhood Experiences in Analytic Sample.

	Overall Prevalence	Prevalence with One or More Experience
	% (95 % CI)	% (95 % CI)
Parental divorce	25.4 (24.5−26.3)	58.2 (56.5−59.8)
Parent or guardian death	3.6 (3.2−4.1)	8.3 (7.4−9.3)
Parent or guardian incarcerated	7.5 (7.0−8.1)	17.3 (16.1−18.5)
Domestic violence	5.7 (5.2−6.2)	13.1 (12.0−14.2)
Community violence	4.3 (3.9−4.7)	9.9 (9.0−10.8)
Lived with mental illness	7.9 (7.4−8.4)	18.0 (17.0−19.1)
Lived with substance abuse	8.4 (7.9−9.0)	19.4 (18.3−20.5)
Racial discrimination	4.3 (3.9−4.7)	9.8 (8.9−10.8)
Hard to get by on income	18.6 (17.8−19.5)	42.7 (41.1−44.4)

Table 3
Prevalence of ADHD by Type and Frequency of Adverse Childhood Experiences (N = 40,075).

	% ADHD Diagnosis (95 % CI)
Frequency	
No ACEs	5.6 (5.0–6.3)
1	8.8 (7.8–10.0)
2	12.8 (11.1–14.7)
3 or more	19.4 (17.1–21.9)
Type of Experience Reported	
Parental divorce	13.3 (12.1–14.6)
Parent or guardian death	13.9 (10.8–17.8)
Parent or guardian incarcerated	18.6 (16.0–21.5)
Domestic violence	18.5 (15.5–21.9)
Community violence	19.9 (16.7–23.6)
Lived with mental illness	20.3 (17.9–22.9)
Lived with substance abuse	17.6 (15.4–20.0)
Racial discrimination	15.4 (12.1–19.4)
Hard to get by on income	13.4 (11.9–15.1)

Table 4
Adjusted Odds Ratios of ADHD Diagnosis.

Variable	OR	95 % CI
Adverse Childhood Experiences (ACEs)		
No ACEs (reference)		
1	1.39***	[1.14, 1.69]
2	1.92***	[1.53, 2.39]
3 or more	2.72***	[2.19, 3.37]
Child age	1.09***	[1.07, 1.11]
Male	2.03***	[1.72, 2.40]
Race		
Non-Hispanic White (reference)		
Non-Hispanic Black	0.84	[0.64, 1.11]
Non-Hispanic Other	0.53***	[0.42, 0.66]
Hispanic (any race)	0.63***	[0.49, 0.81]
Mother age (mean)	0.98**	[0.97, 0.99]
Highest Adult Education		
<High school (reference)		
High school diploma/GED	1.19	[0.70, 2.05]
Some college	1.08	[0.64, 1.84]
College degree	1.08	[0.62, 1.87]
Low birthweight	1.35**	[1.10, 1.66]
Parent usually/always felt stress	6.40***	[5.14, 7.97]
Poverty	0.86	[0.68, 1.10]

OR = odds ratio; CI = confidence interval. *$p < .05$.
** $p < .01$.
*** $p < .001$.

education, caregiver stress, family poverty status) confounders. The models in Table 4 contain a categorical measure of ACEs. The adjusted odds of having a current ADHD diagnosis increased substantially with the number of ACEs reported. When compared to children with no ACEs, the estimated odds of having an ADHD diagnosis were 1.39 times higher among children with one ACE (OR = 1.39; 95 % CI: 1.14–1.69), 1.92 times higher among children with two ACEs (OR = 1.92; 95 % CI: 1.53, 2.39), and 2.72 times higher among children with three or more ACEs (OR = 2.72, 95 % CI: 2.19, 3.37) net of controls.

A logistic regression model including separate terms for each respective ACE included in the index revealed that the association varied depending on the ACE reported (Table 5). The ACE most strongly associated with the odds of ADHD was living with someone with a mental illness (OR = 1.72, 95 % CI, 1.39, 2.12) followed by parent or guardian incarceration (OR = 1.56, 95 % CI, 1.22, 2.01). Other statistically significant ACEs included difficulty getting by on income (OR = 1.31, 95 % CI, 1.09, 1.58) and parental divorce (OR = 1.22, 95 % CI, 1.02, 1.46). Taken together, the results displayed in Tables 4 and 5 imply that exposure to any of the more prevalent ACEs included on the index, regardless of type, is associated with increased odds of having an ADHD diagnosis. The results in Tables 4 and 5 also imply that and that the odds of having an ADHD diagnosis increases sharply as the number of ACEs reported increases (up to 3+ ACEs) in a gradient manner.

Table 5
Odds Ratios for Association of ACES with Current ADHD Diagnosis.

Variable	OR	95 % CI
Parental divorce	1.22*	[1.02, 1.46]
Parent or guardian death	1.20	[0.85, 1.68]
Parent or guardian incarcerated	1.56***	[1.22, 2.01]
Domestic violence	1.01	[0.74, 1.38]
Community violence	1.13	[0.84, 1.52]
Lived with mental illness	1.72***	[1.39, 2.12]
Lived with substance abuse	1.03	[0.80, 1.31]
Racial discrimination	1.22	[0.87, 1.70]
Hard to get by on income	1.31**	[1.09, 1.58]

OR = odds ratio; CI = confidence interval. Model controlling for race, gender, maternal age, parent education, low birthweight, parental stress, and poverty.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

4. Discussion

Existing research has demonstrated ACEs can influence brain development and can manifest symptoms of hyperactivity, inattention, and aggressive behavior in children (McLaughlin et al., 2010, 2014). Furthermore, studies have linked ACEs exposure with ADHD, suggesting that ACEs may influence ADHD (Ouyang, Fang, Mercy, Perou, & Grosse, 2008). In a previous examination in a nationally representative sample from 2011, Brown et al. (2017) demonstrated that children with ADHD experienced higher rates of adverse experiences than children without ADHD but did not account for some known ADHD risk factors. ACE prevalence among US youth has shifted since the turn of the century further necessitating updated analysis to ensure associations are replicable. The purpose of this study was to examine to influence of ACEs on parent-reported ADHD diagnosis prevalence using the NSCH from years 2017–2018 while controlling for both child and parent risk factors of ADHD. We aimed to answer the following research questions: To what extent do ACEs associate with parent-report ADHD diagnosis? How does this association change with additional ACEs exposure?

Approximately 8% of children in the analytic sample had a current diagnosis of ADHD, consistent with ADHD prevalence rates found in other population-based studies (Danielson et al., 2018). Results indicated half of the children had experienced 1 or more ACE which are consistent with findings of previous studies (Crouch, Probst et al., 2019; Crouch, Radcliff et al., 2019). Our results differed slightly from previous studies in that the most prevalent ACE experienced by children was parental or guardian divorce or separation followed closely by economic hardship (Brown et al., 2017; Crouch, Probst et al., 2019; Crouch, Radcliff et al., 2019). Importantly, we observed that the prevalence rate of parent reported ADHD in children increased sharply with the presence of each additional ACE exposure consistent with a 'dose-response' or gradient relationship. Indeed, the prevalence rate of ADHD among children with three or more ACEs was 3.4 times that of children without any ACEs exposure and validates previous findings that ADHD and ACEs co-occur frequently. This strongly suggests that ACEs exposure may influence ADHD, but the cross-sectional design prohibits interpretation of causal directionality. Research tracking ACEs exposure over time and designs that disaggregate confounding biological and environmental influences are needed.

ACEs exposure was significantly associated with parent-reported ADHD diagnosis controlling for known parental and child-risk factors of ADHD. Specifically, children who reportedly experienced 1 ACE had greater odds of having a current ADHD diagnosis compared to children with no ACE exposure. We discovered that some ACEs appear more important than others in this relationship. The ACE most strongly associated with the odds of ADHD was having lived with someone with mental illness closely followed by parent/guardian incarceration. Together, exposure to the most prevalent ACEs was associated with a greater risk of current ADHD diagnosis. Combined with the evidence that cumulative ACEs were related strongly to higher ADHD prevalence, this would suggest that compounded exposure to ACEs rather than any individual ACE is linked to ADHD diagnosis. This in turn would support 'toxic stress' conceptualizations as one developmental pathway to expression of the ADHD phenotype consistent with equifinality conceptualizations of ADHD and ACEs. Finally, it is important to consider in that exposure to ACEs tends to be higher for families with financial barriers to preventative services which could play a role in worsening child behavior problems. For instance, Crouch, Probst et al. (2019), Crouch, Radcliff et al. (2019) found access to fewer resources (e.g., health insurance, special healthcare needs, and single-parent households) significantly predicted economic hardship as an ACE.

Results of this study indicated the odds of having a current diagnosis of ADHD significantly increased with exposure to each additional ACE. This finding is consistent with the results of Brown et al. (2017) who found that children with 3 ACEs were 3.09 times the odds to have a parent-reported ADHD diagnosis. This study uniquely adds to the literature by replicating this finding while simultaneously controlling for known child and parent ADHD risk factors and correlates, including low birthweight, maternal age, parent/guardian education, and parental aggravation. The fact that these findings are highly consistent with Brown et al. (2017) who used the NCHS sample from 2011 is reassuring and further validates that ACEs exposure and ADHD are link given stability of the estimates for each ACE. This emphasizes the validity and stability of these influences given contemporary shifts in the overall prevalence rates of ACEs in US youth (Finkelhor, 2020).

The findings of this study suggest exposure to adverse events should be taken into consideration when determining a diagnosis of

ADHD in children. The most common and validated ADHD screening tools do not assess for symptoms of traumatic stress, thus primary care physicians are encouraged to incorporate ACEs screening questions into their routine practice. Primary pediatric care providers likely have more contact with families at-risk for ACEs compared to other healthcare sectors and are uniquely positioned to assess for ACEs within the child's medical home. However, some pediatric providers report concerns about parental perceptions, time, and burden of assessment as significant barriers to implementation (Wade, Becker, Bevans, Ford, & Forrest, 2017). Thus, ACE screening strategies to help increase the implementation of screening in the medical home may be helpful. Wade et al. (2017) developed a brief, two-step screening process to reduce duration and burden of assessment on primary care providers. Recent research has demonstrated that parents support ACEs screening within the medical home and may view their child's pediatrician as a change-agent to help break the intergenerational cycle of adversity (Conn et al., 2018). Finally, while clinicians will need to consider the potential impact of ACEs exposure when determining ADHD diagnosis, the strong co-occurrence of ADHD and ACEs observed however also provides strong justification for future studies that wish to investigate outcomes of trauma-informed care for youth with ADHD and elevated ACEs exposure.

Lastly, results of this study support the efforts of recent organizational and state-level policies regarding ACEs screening and intervention. In a recent joint clinical report by the AAP's Council of Children with Disabilities and Section of Developmental and Behavioral Pediatrics (Lipkin & Macias, 2020), it was noted that continuous monitoring of ACEs should also occur during well-child visits in addition to developmental surveillance and/or screening. Furthermore, legislative leaders and policy makers are beginning to understand the importance of ACEs and health and educational outcomes. For example, multiple states included ACEs in legislation initiatives in 2020 (National Conference of State Legislatures, 2020). Additionally, several states have developed state-wide initiatives that provide training to health care providers and early childhood professionals on how to identify/screen for and address the effects of ACEs (e.g., California's ACEs Aware program [State of California Department of Health Care Services, 2020]; Tennessee's Building Strong Brains Initiative [Tennessee Commission on Children & Youth, 2020]).

Strengths of this study include the use of national sampling of parents/caregivers of children as well as adjusting for covariates to assess the impact of ACEs exposure on current ADHD diagnosis. However, findings should be interpreted with caution. For example, this study used the NSCH ACEs index, which differs from the original Felitti et al. (1998) study in that the respondent is the parent/caregiver and does not include an item regarding exposure to sexual abuse due to the concern of invalidity and nature of the survey (i.e., national survey; Bethell et al., 2017). However, it should be noted the items used in the NSCH are well-established and validated in the literature (e.g., Brown et al., 2017; Bethell et al., 2017). Relatedly, this study relied on parent-reported variables, including ADHD diagnosis and ACEs exposure, which are subject to reporter bias. Furthermore, the use of a cross-sectional design limits any discussion of directionality. For example, possibly ACEs exposure is associated with parental history of mental health disorders, such as ADHD. Longitudinal research is needed in this area to further explore the relationship between childhood adversity and ADHD, as well as other forms of psychopathology.

5. Conclusion

Our study examined the associations between ACEs and parent-reported ADHD diagnosis in a nationally representative sample of children, while simultaneously controlling for known child and parent ADHD risk factors giving more power to the previous findings of Brown et al. (2019). There is growing evidence of the negative effects of toxic stress on the developing brain in children exposed to ACEs. Children are especially vulnerable to developmental or behavioral problems when affected by the social determinants of health and ACEs. Taken together, results from this study highlight the importance of screening for ACEs and social determinants of health when determining a diagnosis of ADHD for any child.

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