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ORIGINAL CONTRIBUTION

Trauma exposure in children with and without ADHD: prevalence and functional impairment in a community-based study of 6–8-year-old Australian children

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Abstract Both ADHD and trauma exposure are common childhood problems, but there are few empirical data regarding the association between the two conditions. The aims of this study were to compare lifetime prevalence of trauma exposure in children with and without ADHD, and to explore the association between trauma exposure and outcomes in children with ADHD. Children aged 6–8 years with ADHD (n = 179) and controls (n = 212) recruited from 43 schools were assessed for ADHD, trauma exposure and comorbid mental health disorders using the Diagnostic Interview Schedule for Children IV. Outcome data were collected by direct child assessment, parent report and teacher-report, and included ADHD symptom severity, internalizing and externalizing problems, quality of life, and academic functioning. Logistic and linear regression models were used to examine differences adjusted for child and family socio-demographics. Children with ADHD were more likely than controls to have ever experienced a traumatic event (27 vs 16%; OR: 1.99; 95% CI 1.21, 3.27). This difference remained significant in the adjusted model (OR: 1.76, 95% CI 1.03, 3.01) accounting for child factors (age and gender) and family socio-demographic factors (parent age, parent high school completion and single parent status). Among those with ADHD, trauma-exposed children had higher parent-reported ADHD severity and more externalizing problems than non-exposed children, however, this effect attenuated in adjusted model. Children with ADHD were more likely to have experienced a traumatic event than controls. The high prevalence of trauma exposure in our sample suggests that clinicians should evaluate for trauma histories in children presenting with ADHD.

Keywords Attention-deficit hyperactivity disorder · Posttraumatic stress disorder · Trauma exposure · Trauma · Stress

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Introduction

Attention-deficit/hyperactivity disorder (ADHD) and psychological trauma are both common in childhood and they are thought to be related [1–3]. While there is some evidence that children with ADHD may be more likely to experience trauma than children without ADHD, this research has largely focused on clinical samples, which over-represent boys and children with more severe ADHD [4], and exclude those who have the Inattentive subtype [5]. The extent to which elevated trauma exposure also occurs

among community samples is unclear. It is also unknown whether the co-occurrence of trauma with ADHD is associated with greater functional impairment in children than ADHD alone. We explore these issues using cross-sectional data from a large community sample of children with and without ADHD.

Many children and adolescents are exposed to traumatic events, and the associated psychological and developmental consequences can be significant [1, 6]. Trauma refers to "exposure to actual or threatened death, serious injury or sexual violence", either through direct experience, witnessing it occur to others, learning that it happened to a close family member or close friend, or experiencing repeated or extreme exposure to aversive details of the traumatic event [7]. The more commonly occurring traumatic events that affect children include motor vehicle and other accidents; natural and human-made disasters; sudden death of a parent, sibling, or peer; physical or sexual abuse; and witnessing or being the direct victim of domestic, community, or school violence [8]. One community study conducted in the USA found that two-thirds of children and adolescents had experienced a significant traumatic event by the age of 16 years [6].

There appears to be an association between ADHD and trauma or Posttraumatic Stress Disorder (PTSD) [3, 9–11]. Children with ADHD may be at higher risk for trauma exposure due to difficulties with self-regulation and impulsive behaviors [12], however, data on the prevalence of trauma exposure in the ADHD population are limited and highly inconsistent. For example, Wozniak et al. [11] reported 12% of a clinical sample of 128 boys with ADHD vs 7% of 109 non-ADHD comparison boys (age 6–17 years) had been exposed to a traumatic event over a 4-year follow-up period. In contrast, the World Mental Health Survey Initiative (community sample, $n = 629$) found 76% of respondents with childhood ADHD had been exposed to at least one traumatic event before age 16 [12]. Given trauma exposure and ADHD are common and appear to be interrelated in childhood, it is important to expand on this work, by describing the prevalence of these problems in other samples and exploring their impact on child functioning.

Many children are resilient to trauma exposure, with initial symptoms of distress reducing over time [13]. However, some children develop sustained psychological difficulties including anxiety, depression, behavioral symptoms [14, 15], and clinical or subclinical levels of posttraumatic stress [1]. Several studies have found an association between ADHD and PTSD in childhood [9, 10, 16, 17]. A recent meta-analysis by Spencer et al. [3] identified seven studies that examined rates of PTSD in children with and without ADHD. Six of these reported significantly higher rates of PTSD in children with ADHD than controls. Spencer et al. concluded there was a robust bidirectional relationship between ADHD and PTSD, in that risk for PTSD was higher in individuals with ADHD compared to those without ADHD and risk for ADHD was higher in individuals with PTSD than those without PTSD.

In the general population, trauma exposure in childhood is a risk factor for the development of mood and anxiety disorders, such as separation anxiety [15, 18] and Oppositional Defiant Disorder (ODD) [19]. In a study by Hoven et al. [18] 12.3% of children and adolescents (aged 9–21) exposed to the World Trade Center attack had probable Separation Anxiety Disorder. A study by Kilpatrick et al. [20] found adolescents with exposure to interpersonal violence (i.e., physical assault, sexual assault, or witnessed violence), had increased risk for a major depressive episodes and substance abuse/dependence. Traumatic stress symptoms have been linked to negative health status [21] and lower quality of life in children [22]. Prolonged exposure to trauma has been associated with poorer academic performance [23–25] and deficits in executive function [26, 27]. The effects of trauma exposure can also be long lasting. For example, in adolescent survivors of a cruise ship sinking, Yule et al. [28] found that 15% still met criteria for PTSD 5–7 years later. However, there has been no published research that examines outcomes for children with ADHD who are exposed to trauma.

The current study addresses these gaps in knowledge by examining a community-based sample of 6–8-year-old with and without ADHD. Specifically, we aimed to:

1. Compare the lifetime prevalence of trauma exposure between children aged 6–8 years with ADHD and children without ADHD.
2. Explore the association between trauma exposure and ADHD severity, internalizing and externalizing problems, quality of life, and academic functioning in children with ADHD.

We hypothesized that children with ADHD would have a higher prevalence of lifetime trauma exposure than the control group. We further hypothesized that children with ADHD who had been exposed to trauma would have greater impairment in all outcome domains than children with ADHD with no reported exposure to trauma.

Method

Study design

This cross-sectional study uses baseline data from the Children's Attention Project (CAP), a community-based study of children with ADHD and non-ADHD [29]. Consent to participate was provided by parents in each stage of the study. Ethics approval was granted by the Human Research Ethics

Committees of The Royal Children's Hospital (#31056) and the Victorian Department of Education and Early Childhood Development (#2011_001095).

Eligibility and screening

Participants were recruited from 43 government primary schools in Melbourne, Australia, selected for representation of diverse socioeconomic communities. Participants were recruited via a two-stage screening and case-confirmation procedure during their second year of formal education (Grade 1; aged 6–7 years). Screening involved parent and teacher completion of the ten-item Conners 3 ADHD Index (Conners 3AI) [30] for all Grade 1 children, over 2 consecutive years (2011, 2012).

Children were defined as 'positive screens' if their scores on both the parent and teacher ADHD indices were ≥ 75th percentile for age for boys, and ≥ 80th percentile for girls and/or they had a previous diagnosis of ADHD. Children were defined as 'negative screens' if their scores on both parent and teacher ADHD indices were < 75th percentile for boys and < 80th percentile for girls, and they had no previous ADHD diagnosis. Exclusion criteria for both groups were: intellectual disability, serious medical condition, genetic disorder, moderate-severe sensory impairment, neurological problem, and insufficient English to complete assessments. Children screening positive for ADHD, and a matched sample (gender, school) screening negative, were then invited to participate in baseline data collection for the longitudinal study.

Baseline data collection

Baseline data collection involved the confirmation of ADHD status via diagnostic interview, parent (primary caregiver) and teacher questionnaires and direct child assessments. Diagnostic interviews and child assessments were completed by trained research staff with at least a 4-year undergraduate degree in psychology, blinded to child screening status.

Measures

ADHD diagnostic status, *trauma exposure* and *comorbid mental health conditions* were assessed using the DISC-IV (National Institute of Mental Health Diagnostic Interview Schedule for Children IV) [31], a face-to-face structured diagnostic interview with the child's parent. The DISC-IV assesses Diagnostic and Statistical Manual for Mental Disorders IV (DSM-IV) childhood mental health conditions. DSM-IV symptoms and impairment thresholds (Version N, April 2007, algorithms) were used to confirm the presence of ADHD, PTSD, other internalizing disorders (social phobia, separation anxiety disorder, generalized anxiety disorder, obsessive compulsive disorder, major depression or dysthymic disorder) and externalizing disorders (oppositional defiant disorder or conduct disorder). Lifetime exposure to traumatic events was assessed using the DISC-IV PTSD module, which asks if children have ever experienced, witnessed, or been confronted with any of the eight potentially traumatic events: a natural disaster with threat of death or injury (e.g., flood, tornado, earthquake); a situation with threat of death/injury to someone close to the child; child attacked or badly beaten; child forced to do something sexual they did not want to do; child threatened with a weapon; child was in a bad accident; child witnessed someone killed, badly hurt or die; or child saw a dead body or pictures of the body of a someone close to them.

ADHD symptoms were measured using the 10-item Conners 3 ADHD Index (Conners 3AI) [30] from parents and teachers. Parents and teachers rated the child's symptoms in the last month, on a four-point scale from 'not true at all' to 'very much true'. The measure has strong psychometric properties [30].

Internalizing and externalizing problems were evaluated using the 5-item conduct (parent: $\alpha = 0.78$; teacher: $\alpha = 0.83$) and emotional subscales (parent: $\alpha = 0.71$; teacher: $\alpha = 0.77$) of the parent and teacher versions of the Strengths and Difficulties Questionnaire (SDQ) [32]. Parents and teachers rated the child's symptoms in the last 6 months on a three-point scale from 'not true' to 'certainly true'. Higher scores indicate more problems.

Quality of life was examined using the Pediatric Quality of Life Inventory (PEDS-QL) 4.0 [33]. The PEDS-QL is a 23-item parent report measure of children's quality of life across the following domains: social ($\alpha = 0.81$), school ($\alpha = 0.75$), physical ($\alpha = 0.87$) and emotional ($\alpha = 0.79$) functioning. Parents rated how much of a problem each item has been in the past month on a five-point scale from 'almost never a problem' to 'almost always a problem'. Higher scores indicate better quality of life [33].

Academic functioning was directly assessed using the Word Reading and Math Computation subtests from the Wide Range Achievement Test 4 (WRAT 4) [34], converted to standard scores for the child's age ($M = 100$, SD = 15). *Academic competence* was assessed using the teacher-rated Academic Competence scale ($\alpha = 0.96$) from the Social Skills Improvement System (SSIS) [35]. This comprises seven items rated on a 5-point scale from 1 'lowest 10%' to 5 'highest 10%' and converted to standard scores based on age.

A priori *confounders* included child age and sex, parent age, parent high school completion (yes/no), and single parent status (yes/no). Neighborhood socioeconomic disadvantage was measured by disadvantage index of the Socio-Economic Indexes for Areas (SEIFA) [36] for the child's postcode of residence [mean (SD) = 1000 (100)]. Higher scores reflect less disadvantage.

Analyses

Chi-square and *t* tests were used to examine demographic differences between the ADHD group and controls. Summary statistics were used to report the number of children who were exposed to traumatic events in the two groups (ADHD and non-ADHD controls). Logistic regression compared the likelihood of a child in the ADHD group having experienced a traumatic event, relative to non-ADHD controls. The logistic regression model was unadjusted initially, the analysis was then re-run to account for potentially confounding factors (child age and gender, parent age, parent high school completion and single parent status). A second adjusted model was re-run to account for these factors as well as the effect of other comorbidities (internalizing and externalizing disorders). Linear regression compared the mean difference on a range of outcomes (academic functioning, ADHD symptoms, internalizing/externalizing symptoms and quality of life) in children with ADHD and trauma exposure compared to those with ADHD alone. Logistic and linear regression models were unadjusted initially, then adjusted for child factors (age and gender) and family socio-demographic factors (parent age, parent high school completion and single parent status). All models controlled for school clustering. Effect sizes were calculated by standardizing outcome variables to have a mean of zero and a standard deviation of one. Analyses were conducted using Stata 13.1 (Stata Corp, College Station, TX, USA).

Results

Sample characteristics

All children who screened positive for ADHD ($n = 412$) were invited to participate in the longitudinal study, along with 412 matched (by school and gender) controls who screened negative. Of the children screening positive, 65% ($n = 267$) consented to participate, and 179 met DISC-IV criteria for ADHD. Of the children screening negative, 56% ($n = 231$) consented to participate, and 212 were confirmed as not meeting DISC-IV criteria for ADHD. There were no differences in child age and gender between those who consented to participate and those who declined. Amongst children who screened positive, consenting children were more likely to be from socially advantaged areas compared to those who declined participation. For children who screened negative, there was no difference in social advantage between those who consented or declined.

In the ADHD group, 52% ($n = 93$) met criteria for ADHD-Combined subtype; 36% ($n = 64$) for ADHD-Inattentive; and 12% ($n = 22$) for ADHD-Hyperactive subtype. Compared to non-ADHD controls, children with ADHD had greater ADHD symptoms severity, higher rates of internalizing and externalizing problems, and were more likely to be taking medication for behaviour, emotions or learning difficulties (see Table 1). Compared to controls, primary caregivers in the ADHD group were younger, more likely to be single parents, less likely to have completed high school and they reported higher levels of psychological distress.

Table 1 Sample characteristics for children with ADHD and non-ADHD controls

	ADHD *n = 179*	Control *n = 212*	*P* value
Child characteristics			
Child age in years, mean (SD)	7.3 (0.4)	7.3 (0.4)	0.41
Male, *n* (%)	124 (69.3)	135 (63.7)	0.24
ADHD symptom severity[a]—parent report, mean (SD)	13.7 (4.0)	1.3 (1.9)	< 0.001
ADHD symptom severity[a]—teacher report, mean (SD)	12.9 (5.4)	0.6 (1.6)	< 0.001
Internalizing disorder,[b, d] *n* (%)	46 (25.7)	10 (4.7)	< 0.001
Externalizing disorder,[b] *n* (%)	97 (54.2)	17 (8.0)	< 0.001
ADHD Medication use, *n* (%)	21 (12.6)	0 (0)	< 0.001
Primary caregiver characteristics			
Parent age in years, mean (SD)	37.2 (5.8)	38.9 (5.4)	0.005
Single parent family, *n* (%)	42 (25.2)	23 (11.4)	0.001
Did not complete high school, *n* (%)	63 (37.7)	39 (19.3)	< 0.001
Parent mental health problems[c], mean (SD)	5.3 (4.5)	2.6 (2.8)	< 0.001

[a]Conners 3 ADHD Index

[b]DISC-IV

[c]Kessler 6

[d]Excludes children diagnosed with PTSD

Prevalence of lifetime trauma exposure

Children with ADHD were more likely than controls to have ever experienced one or more of the eight traumatic events assessed in the DISC-IV (27 vs 16%; OR: 1.99; 95% CI 1.21, 3.27; see Table 2). This difference remained significant in the first adjusted model (OR: 1.76, 95% CI 1.03, 3.01). Single parent family was the only factor independently associated with trauma exposure (OR: 2.16, 95% CI 1.16, 3.96). However, the difference between children with ADHD and controls was no longer significant in the second adjusted model that additionally accounted for comorbid internalizing and externalizing disorders (OR: 1.46, 95% CI 0.78, 2.73).

The most common trauma exposures were similar for children with and without ADHD: 'Child was in a situation with threat of death/injury to someone close to them' (ADHD 17% vs Control 11%), followed by 'Child been in a bad accident' (ADHD 7% vs Control 4%) and 'Child witnessed someone killed, badly hurt, or die' (ADHD 6% vs Control 3%). There were no differences in lifetime trauma exposure between boys (22%) and girls (18%) overall, within the ADHD and control groups, or between ADHD-subtypes (Combined type 25%, Inattentive type 31%, Hyperactive 18%). Two children from the ADHD group met DSM-IV criteria for a diagnosis of PTSD, compared to no children in the control group.

Association between trauma exposure and child functioning in children with ADHD

In the unadjusted model, trauma-exposed children with ADHD had greater parent-reported ADHD severity than children with ADHD who were not exposed to trauma [mean difference (MD): 1.46, 95% CI 0.17, 2.75] and more severe parent-reported externalizing problems (MD: 0.76, 95% CI 0.004, 1.51). However, these differences were no longer significant in the adjusted model (MD: 0.53, 95% CI − 0.22, 1.28). We found no other group differences in impairment between exposed and non-exposed children for children with ADHD (Table 3). The control group exposed to trauma did not differ to the control group with no exposure to trauma on any of the functional outcomes assessed.

Discussion

In a community-based sample of 6–8-year-old children with and without ADHD, children with ADHD were more likely to have experienced a traumatic event in their lifetime than non-ADHD controls. The relationship between trauma exposure and ADHD remained significant when accounting for potential child and family confounding factors. However, this was no longer significant when accounting for comorbid internalizing and externalizing disorders. There were similar rates of trauma exposure between boys and girls and between ADHD-subtypes. Children from single parent households were more likely to have experienced a traumatic event in their lifetime. Situations with threat of death/injury

Table 2 Lifetime prevalence of trauma exposure in children with ADHD versus non-ADHD controls

Trauma	*N* (%)		OR[a] (95% CI)
	ADHD *n* = *179*	Control *n* = *212*	
Lifetime trauma exposure			
Ever experienced any trauma listed	48 (26.8)	33 (15.6)	1.99 (1.21, 3.27)
Experienced more than one of the traumas listed	19 (10.6)	13 (6.1)	1.82 (0.87, 3.79)
Type of trauma exposure			
Child was in a natural disaster with threat of death or injury (e.g., flood, tornado, earthquake, hurricane)	7 (3.9)	6 (2.8)	1.40 (0.46, 4.24)
Child was in a situation with threat of death/injury to someone close to them	30 (16.8)	23 (10.9)	1.66 (0.92, 2.98)
Child attacked or badly beaten	3 (1.7)	3 (1.4)	1.19 (0.24, 5.96)
Child forced to do something sexual that they didn't want to do	2 (1.1)	0 (0)	–
Child threatened with a weapon	5 (2.8)	0 (0)	–
Child been in a bad accident	12 (6.7)	8 (3.8)	1.83 (0.73, 4.59)
Child witnessed someone killed, badly hurt, or die	10 (5.6)	7 (3.3)	1.73 (0.65, 4.65)
Child saw a dead body or pictures of body of a someone close to them	3 (1.7)	1 (0.5)	4.75 (0.41, 54.48)
Posttraumatic stress			
PTSD diagnosis	2 (1.1)	0 (0)	–

[a]Model adjusted for school clustering

Table 3 Unadjusted and adjusted mean differences in child functioning for children with ADHD + trauma exposure versus those with ADHD alone

	Mean (SD)		Mean difference (95% CI)[f]					
	ADHD + trauma *n* = *48*	ADHD alone *n* = *131*	Unadjusted	ES	*P* value	Adjusted[g]	ES	*P* value
ADHD severity								
Parent-report[c]	14.8 (3.7)	13.3 (4.1)	1.46 (0.17, 2.75)	0.21	0.03	0.53 (− 0.22, 1.28)	0.23	0.17
Teacher-report[c]	13.2 (4.6)	12.8 (5.7)	0.46 (− 1.33, 2.24)	0.06	0.62	− 0.37 (− 1.30, 0.55)	− 0.15	0.43
Internalizing problems								
Parent report[d]	3.6 (2.7)	3.3 (2.3)	0.3 (− 0.51, 1.11)	0.14	0.47	0.13 (− 0.69, 0.95)	0.06	0.76
Teacher-report[d]	3.1 (2.7)	2.8 (2.5)	0.38 (− 0.48, 1.23)	0.16	0.39	0.38 (− 0.53, 1.28)	0.16	0.41
Externalizing problems								
Parent-report[d]	4.7 (2.0)	4.0 (2.4)	0.76 (0.004, 1.51)	0.32	0.05	0.53 (− 0.22, 1.28)	0.23	0.17
Teacher-report[d]	3.2 (3.0)	3.2 (2.6)	− 0.06 (− 0.97, 0.83)	− 0.03	0.86	− 0.37 (− 1.30, 0.55)	− 0.15	0.43
Quality of life								
Physical[e]	75.9 (18.1)	73.9 (21.8)	1.97 (− 5.11, 9.05)	0.10	0.59	4.26 (− 2.83, 11.35)	0.22	0.24
Emotional[e]	56.5 (17.8)	58.8 (18.8)	− 2.47 (− 8.72, 3.79)	− 0.13	0.44	− 0.41 (− 6.63, 5.82)	− 0.02	0.90
Social[e]	57.6 (20.3)	62.8 (20.3)	− 5.4 (− 12.2, 1.38)	− 0.25	0.12	− 2.7 (− 9.36, 3.97)	− 0.13	0.43
School[e]	53.6 (15.0)	53.9 (14.7)	− 0.74 (− 5.66, 4.17)	− 0.04	0.77	0.37 (− 4.61, 5.35)	0.02	0.89
Psychosocial[e]	58.4 (12.8)	60.1 (13.7)	− 1.99 (− 6.49, 2.5)	− 0.12	0.39	− 0.20 (− 4.64, 4.23)	− 0.01	0.93
Total QoL[e]	62.9 (12.1)	63.9 (14.4)	− 1.22 (− 5.88, 3.44)	− 0.08	0.61	0.83 (− 3.74, 5.40)	0.05	0.72
Academic functioning								
Reading[a]	95.4 (18.5)	97.7 (17.4)	− 2.83 (− 8.56, 2.90)	− 0.16	0.33	− 0.64 (− 6.0, 4.72)	− 0.04	0.81
Maths[a]	90.0 (15.4)	90.3 (14.5)	− 0.38 (− 5.20, 4.45)	− 0.02	0.88	1.84 (− 2.55, 6.23)	0.11	0.41
Competence[b]	86.5 (14.5)	86.4 (14.2)	0.1 (− 4.67, 4.87)	0.006	0.97	0.08 (− 4.72, 4.88)	0.005	0.97

[a]Wide Range Achievement Test 4

[b]Social Skills Improvement System

[c]Conners 3 ADHD Index

[d]Strengths and Difficulties Questionnaire

[e]Pediatric Quality of Life Inventory

[f]All unadjusted and adjusted analyses adjust for school clustering

[g]Adjusted for child (age, sex) and family socio-demographic factors (parent age, parent high school completion, single parent status)

to someone close to them was the most common traumatic event experienced by children in this sample, with children in the ADHD group more likely to have been exposed. Compared to children with ADHD who were not exposed to trauma, trauma-exposed children with ADHD had greater ADHD severity and externalizing problems by parent report but these differences attenuated when accounting for confounding child and family factors. There were also no differences for parent-reported internalizing problems or quality of life, any teacher reported outcomes or directly assessed academic functioning.

The lifetime prevalence of trauma exposure in our ADHD sample at age 6–8 years was 27%. Previous studies have found a rate of 12% 4-year exposure reported for a clinically referred sample of boys aged 6–17 years with ADHD [11] and a rate of 76% lifetime exposure by age 16 years reported for a community sample [12]. Comparison of prevalence rates with previous ADHD samples is difficult due to differences in numbers of trauma exposures assessed, differences in age range and study methodologies. Nevertheless, our findings show substantial exposure at this young age. Non-ADHD children reported a 16% lifetime exposure, similar to the 14% found in a general population study of trauma exposure in a sample of children aged 8–12 [37].

In our study, the association between ADHD and trauma exposure was somewhat attenuated when accounting for child (age and gender) and family sociodemographic factors. The relationship between ADHD and trauma may potentially be explained by family sociodemographic or environmental factors. A growing body of research has indicated that stressful family contexts, such as low-quality home environments or insensitive parenting, may impair the development of attentional control in early life [38, 39]. It has also been suggested that children with ADHD are at greater risk of trauma due to their symptoms (i.e., poor self-regulation, impulsive behaviors) [12]. Considerable previous research

has shown marked differences in parenting and child-rearing practices by family socio-economic status [40], and it is possible that child characteristics in combination with the child-rearing environment places children with ADHD at greater risk of experiencing traumatic events. To tease out these potential differences, a more nuanced approach to the measurement of traumatic events is required which separates out children's exposure to traumatic events that occur to the family as a whole, compared with those that occur to the child independently.

The relationship between trauma exposure and ADHD was no longer significant when accounting for comorbid internalizing and externalizing disorders in this study. It appears that the association between trauma and ADHD is not independent of other psychological comorbidities and it is not clear from the current design what causal processes may be happening. Longitudinal research that looks at the relative timing of the emergence of ADHD and other symptoms in relation to trauma exposure will help to elucidate these associations.

In this study we found that trauma exposure in children with ADHD was associated with parent reports of greater ADHD severity and more externalizing problems than in children with ADHD without trauma exposure. These associations were no longer significant after controlling for other family socio-demographic factors and were not found for teacher-reported outcomes. The lack of association between trauma exposure for children with ADHD and internalizing problems, quality of life or academic functioning indicates a lack of support for trauma having an additive adverse impact on functional outcomes in this sample who have previously been shown to have substantially impaired functioning across multiple outcome domains compared to non-ADHD control children [41]. It is possible the increase in parent-reported ADHD severity and externalizing problems was a reflection of parent-level rather than child-level factors. However, children in this study were only aged 6–8 years and relationships between trauma exposure and other functional outcomes may emerge later. As these children get older, they will be exposed to a greater number of traumatic events that will need to be negotiated in increasingly complex developmental and emotional stages.

This study has several limitations which should be considered when interpreting our findings. The cross-sectional nature of this study limited our ability to examine the effects of the nature and timing of trauma exposure. The timing between trauma exposure and onset of psychological symptoms was not measured in this study. Forthcoming prospective data from this study will help to clarify the links between trauma and outcomes by child age. Children in the study were aged 6–8 years old and it is possible that ADHD symptoms may not have emerged yet. The study relied on parent-report of trauma exposure. It is possible that some parents were unaware of or under-reported the child's trauma history [42]. Furthermore, some research has suggested that parents may be unreliable reporters of their child's internalizing symptoms, suggesting that parents' own mental health and responses to potentially traumatic events can influence their assessment of their child's symptoms [43]. Parents in the ADHD group had higher psychological distress (as measured by the K6) compared to the control group. Future research should include direct child measures of trauma exposure and posttraumatic stress symptoms.

This study design had a number of strengths. This was the first study to explore the associations between trauma exposure and a range of outcomes for children with ADHD. Our community-based sample was carefully phenotyped and included a large number of children in a narrow age band. The sample was inclusive of both genders and a range of sociodemographic backgrounds.

Our community study found that one in four children aged 6–8 years with ADHD had been exposed to a traumatic event. This highlights the need for clinicians to be evaluating potential trauma exposure in children presenting with ADHD. The diagnosis of ADHD is based on a persistent pattern of cross-situational symptoms and impairment, regardless of aetiology. Often multiple contributing factors appear to be operating, including both genetic and environmental influences. A trauma history can be difficult to elicit and may only emerge over time as trust is built with the child and/or parents. Although trauma exposure was not associated with functional outcomes for children in this sample, it is possible that as children grow older the effects of prior trauma exposure will become evident. Such findings would support specific trauma-oriented therapy alongside other interventions when significant traumatic stress symptoms are identified. Further research is needed to elucidate the mechanism of association between trauma exposure and ADHD, to support the substantial number of children impacted by these common childhood conditions.

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in this study. Some study data were collected and managed using REDCap electronic data capture tools hosted at MCRI. REDCap (Research Electronic Data Capture) is a secure, web-based application designed to support data capture for research studies.

Compliance with ethical standards

Conflict of interest Dr. Hazell or his employer has received payment from Shire for participation in advisory boards; Eli Lilly and Shire for speaker's bureau. Drs. Efron, Sciberras, Anderson, Alisic, Jongeling and Nicholson, and Ms Schilpzand report no biomedical financial interests or potential conflicts of interest.

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