

THE UNIVERSITY OF CHICAGO

The Relationship Between Community Violence
Exposure and Executive Functioning In Attention
Deficit/Hyperactivity Disorder (ADHD)
Diagnosed Youth

By

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Abstract

This study works to examine the impact of Community Violence Exposure on the executive functioning of youth previously diagnosed with Attention Deficit/Hyperactivity Disorder (ADHD). Utilizing medical chart data from the University of Chicago (UChicago) Medicine's Pediatric Neuropsychology program, this study includes 68 ADHD diagnosed participants aged 5 to 16 primarily from neighborhoods located in the south side of Chicago. As the measurement of executive functioning, both the Behavior Rating Inventory of Executive Function (BRIEF) first and second edition assessments were used both separately and combined. Results showed slight incompatibilities between the BRIEF-1 and BRIEF-2 GEC scores that were found to influence findings. Initial correlational analyses found a slight positive correlation between CVE and the BRIEF-1 GEC, and no significance for the BRIEF-2 GEC and BRIEF GEC combined profiles. Regression analyses conducted indicated a significant impact on executive functioning solely with the BRIEF-1 as the dependent variable. Findings indicate further need to study interactions between CVE and externalizing disorders to better inform treatment and diagnosis.

Introduction

Community Violence Exposure (CVE) refers to having been directly or indirectly experiencing an event that involves loss of property, threat of physical injury, actual injury, or death (Fowler et al., 2009; Stickley et al. 2021). Childhood exposure to violence a pervasive issue that can have short and long lasting impacts on psychological, physical, social, and academic functioning (Lewis et al., 2015). Researchers use several strategies to measure a child's history of exposure to violence including maltreatment histories and Adverse Childhood Experience (ACE) scores examine how traumatic childhood events impact the individual.

However community violence exposure is able to examine the impact of violence exposure on the individual level and for communities. Exposure to community violence can be both “direct victimization” or indirect when “witnessing violence” and is found at a higher rate in low-income urban communities (Foster & Brooks-Gunn, 2009; Sargent et al., 2020).

Community impoverishment and inadequate child care options are significant factors that differ between neighborhoods linked to increased violence exposure (Foster & Brooks-Gunn, 2009). In their study, Hanson et al. (2006) found African-Americans, Hispanics, and Native-American adolescents are at higher risk of being exposed to violence and witnessing domestic abuse than their white counterparts. Gender, personal temperament, and levels of CVE have been studied as factors in response variation to being exposed to violence (Lambert et al., 2021). Gender differences in conjunction with high CVE levels have been observed, with higher levels of parent rated aggression seen in boys and higher internalization seen in girls (Fowler et al., 2009; Lambert et al., 2021). The total amount and frequency/concentration of exposure to violence remains an important direction for CVE research, with studies exploring individual sensitization or desensitization in response (Lambert et al., 2021)

Traumatized children have been shown to have an increased risk of Attention Deficit/Hyperactivity Disorder (ADHD), Oppositional Defiant Disorder (ODD), and Post Traumatic Stress Disorder (PTSD) in comparison with their non-traumatized counterparts (Famularo et al., 1996). Multiple strategies of measuring violence exposure including; ACE scores (Brown et al., 2017), histories of maltreatment (Ford et al. 2000; González et al., 2019), PTSD symptoms (Daud & Rydelius, 2009; Schilpzand et al., 2018), and CVE (Stickley et al., 2021), have all been linked to increased rates of ADHD. A developing area of research examines the disruptive impact of prolonged childhood exposure of violence on cognitive and emotional

functions, and the symptoms overlap with those of ADHD (Pottinger, 2015). Exposure to Community violence has been associated with a harmful impact on internalizing and externalizing problems, academic outcomes, and increased PTSD rates (Foster & Brooks-Gunn, 2009).

Attention Deficit/ Hyperactivity Disorder

ADHD is a common childhood psychiatric disorder where those diagnosed “show a persistent pattern of inattention and/or hyperactivity–impulsivity” (American Psychiatric Association, 2013, p. 68). Those with ADHD have a higher risk for failure in school, antisocial behavior, other psychiatric problems, drug and alcohol abuse, accidental injuries, and premature death, suicide (Faraone et al., 2021). Outcomes of childhood diagnosis of ADHD is studied using; education, job instability, income, and risky sexual behavior (Hechtman et al., 2016), as outcomes. Results indicated that those whose symptoms persisted into adulthood fair the worst, in comparison with those without the disorder. Study participants whose symptoms of ADHD did not persist into adulthood fell in the middle, with some challenges continuing into adulthood.

In a study examining environmental risk factors for childhood ADHD Banerjee et al., (2007) identified Associations between increased parent-reported ADHD and socioeconomic hardship, parent/guardian divorce, familial mental illness, neighborhood violence, and familial incarceration. Brown et al., (2017) found parental mental illness and socioeconomic hardship associated with moderate to severe ADHD symptoms of children aged 4 to 17. When observing parent rated ADHD symptoms, Lewis et al., (2015) found symptoms were at the lowest when the child had a singular or no exposure to violence and symptoms were at the highest when the child has witnessed and experienced violence. Additionally the study found girls were at a elevated

risk for ADHD symptoms after witnessing or experiencing violence relative to the boys in the sample (Lewis et al., 2015)

In their study with 40 refugee children, Daud & Rydelius (2009) found 60% of boys and 25% of girls fulfilled diagnosis criteria for both PTSD and ADHD. However, the authors discussed that the co-occurrence of PTSD and ADHD can be compounded by similarities in diagnosis criteria related to inattention and hyperactivity/impulsivity; this presents a risk for misdiagnosis as well as wrong or incomplete treatment plans (Daud & Rydelius, 2009).

Understanding cumulative exposure to trauma and the patterns of symptoms that may emerge can inform clinicians who are observing poor treatment responses for moderate and severe cases with a history of trauma (Brown et al., 2017).

While research has worked to further the understanding of early life stressors, ADHD assessment does not routinely include a comprehensive trauma evaluation (Brown et al., 2017). Understanding patients' protective and risk factors both psychosocial and environmental can aid clinicians in treatment plan development (Brown et al., 2017). Practitioners focusing solely on presenting symptoms without considering trauma history can result in a misinterpretation of patient behavioral patterns hindering diagnostic accuracy (Brown et al., 2017). Related to this, Pottinger (2015) explored the possibility of implementing trauma counseling for children with ADHD living in violent communities, built around six core components including; safety concerns, self-regulation, information processing, traumatic experiences integration, relational engagement, and positive affect enhancement . Implemented in conjunction with other medication, the addition of trauma counseling optimizes treatment for inattentive and impulsive behaviors (Pottinger, 2015).

Executive Functioning

Executive functions include planning, impulse control, cognitive flexibility, self-monitoring attention control, working memory, and problem solving (Jarratt et al., 2005; Sandberg, 2002). In Daud & Rydelius (2009) study with refugee children the authors identify that in both ADHD and PTSD there is difficulty in sustaining attention, an incapacity to listen, difficulty completing duties, organizational issues, avoidance of mental tasks, memory difficulties, irritability, and restlessness can be observed. Relatedly, Hartl et al. (2005) conducted a study regarding the experiences of trauma that can be found in the histories of persons who hoard. They found that there was an increased presence of symptoms consistent with ADHD diagnosis in those individuals who had an increased trauma in their backgrounds. Together these studies suggest that the co-occurrence of ADHD symptoms is high for individuals with a history of trauma, specifically ones related to executive dysfunction.

Neuropsychological and neuroimaging studies have linked executive functioning to the pathophysiology of ADHD (Faraone & Larsson, 2019). Willcutt et al. (2005) test the hypothesis that the symptoms of ADHD are primarily caused by executive function deficits. They concluded that dysfunction in executive functions such as response inhibition, planning, vigilance, and working memory were strongly associated with ADHD but not the singular cause of the disorder. Similar work appears required when considering PTSD and comorbid ADHD and PTSD, given their shared profiles of dysfunction discussed earlier.

Emerging concerns regarding the comorbidity between ADHD and PTSD have prompted researchers to investigate more directly how ADHD may be assessed, specifically with regard to experiences that can lead to similar patterns of challenge. This has led in turn to paying greater attention to the profiles of executive and other challenges seen with ADHD and other disorders,

in order to more accurately diagnose and treat patients (Daud & Rydelius 2009; Weinstein et al., 2000) who present with either ADHD, PTSD, or comorbid ADHD and PTSD.

Current Study

Exposure to community violence increases victims' vulnerability to traumatic experiences that can interrupt executive functioning. This study aims to examine the relationship between Community Violence Exposure and the Executive Functioning of ADHD diagnosed adolescents. Community Violence Exposure is expected to negatively correlate with Executive functioning. Additionally the level of exposure to community violence exposure is expected to predict executive functioning abilities in ADHD-diagnosed adolescents, controlling for sex and IQ is expected to strengthen this prediction. Lastly Past history of trauma is expected to strongly amplify the hypothesized negative relationship between relationship CVE and EF, with past research supporting the negative impact trauma has on executive functioning (Daud & Rydelius, 2009; Hartl et al., 2005).

Methods

The current study examined retrospective medical chart data from 68 youths (ages 5-16) that had previously visited University of Chicago (UChicago) Medicine's Pediatric Neuropsychology program. The youths were primarily from neighborhoods located in the south side of Chicago. Participants were previously diagnosed with ADHD, with some presenting as well with co-occurring learning disabilities (e.g., Reading Disorder). Exclusion criteria for participants included comorbid neurodevelopmental disorders (e.g., Autism Spectrum Disorder), brain injuries, and cancer diagnoses, all challenges that also frequently present with ADHD symptoms. Participants's history of past trauma, family history of ADHD, and exposure to toxins in utero were obtained through review of their clinical evaluation reports. Because this study

utilized retrospective clinical data tied directly to research previously approved by the UChicago Medicine and Biological Sciences's Institutional Review Board, with Dr. Scott Hunter as principal investigator, further review was not required

Community Violence Exposure

Community Violence Exposure was coded as a continuous variable using Chicago Police Department (2018) and Federal Bureau of Investigation (2018) reports of violent crimes in participant zip codes for the year 2017. Reports of homicide, rape, aggravated assault/battery, and human trafficking were included in violent crime counts utilized for this review and were included in the coding of community violence.

Neighborhood Income

Participants's neighborhood income was coded as a continuous variable, again using zip codes and checking against data obtained regarding income levels from <http://unitedstateszipcodes.org> (Schulze & Kolb, 2012).

IQ

The Wechsler Intelligence Scale for Children (WISC) assessment battery is the most commonly used scale for measuring baseline cognitive abilities in children and adolescents. The WISC-4 (Fourth Edition) and WISC-5 (Fifth Edition) are the two most recent editions of the assessment (Jarratt et al., 2005; Sandberg, S. 2002; Wechsler, D. 2003a; Wechsler, D. 2014), and were utilized by the UChicago Medicine's Pediatric Neuropsychology Service as part of their evaluations for the youth included in this study .The WISC-5 is composed of 14 scales, three indexes, and a Full Scale IQ score. The WISC-4 is composed of 15 scales, 4 indexes, and a Full Scale IQ score. This study utilized the full scale IQ scores from these measures as an indication of current cognitive level.

Table 1*BRIEF Assessment Composite Standardized Scores*

	N	Min	Max	Mean	Std.Deviation
GEC (BRIEF-1)	25	39	90	66.52	12.758
GEC (BRIEF-2)	44	43	83	64.64	10.216
GEC BRIEF Combined	67	39	90	64.93	11.073
CRI (BRIEF-2)	44	45	85	63.30	9.054
ERI (BRIEF-2)	45	41	84	59.64	12.227
BRI (BRIEF-2)	44	38	82	60.61	11.008

Executive Functioning

The Parent completed form of the original version of the Behavior Rating Inventory of Executive Function (BRIEF) consists of eight clinical subscales scales, Inhibit, Shift, Emotional Control, Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor (Gioia et al. 2000), and two index scores (Behavioral Regulation and Metacognition). The subscales combine into a Global Executive Composite (GEC) score. The BRIEF-2 (Second Edition, Gioia, et al., 2015) includes the same eight subscales and GEC score as the BRIEF, but with the addition of three reconsidered index scores, the Behavioral Regulation Index (BRI), which includes the Inhibit and Self-Monitor subscales, the Emotional Regulation Index (ERI), which includes the Emotional Control and Initiate subscales, and the Cognitive Regulation Index (CRI), which includes the Working Memory, Plan/Organize, Organization of Materials, and Monitor subscales. Executive Functioning in the current study was measured using the parent report BRIEF and BRIEF-2 GEC scores. Due to the differences between the two measures, the BRIEF-1 and BRIEF-2 scores were coded separately, however due to the lack of new items

added and compatibility of BRIEF-1 and BRIEF-2 GEC scores (Gioia et al. 2015) an additional BRIEF combined variable was included, which combined the scores from both assessments

Table 1.

Analysis Strategy

All descriptive, correlation, and regression analyses were conducted using SPSS version 24 (IBM Corp. Released 2016). Initial correlation analyses using Pearson's test were conducted to examine the relationship between variables as well. Linear regression models controlling for IQ and Sex models used to test Community Violence as the independent variable and executive function as the dependent variable. Lastly moderator analyses were conducted to examine the effect of Personal Trauma history on the relationship between Executive Functioning and Community Violence Exposure. Due to the split of BRIEF-1 and BRIEF-2, three separated dependent variables BRIEF-1, BRIEF-2, and BRIEF Combined were tested in every analysis, except for the BRIEF-1 regression model adjusted for IQ due to low participant data for the WISC-4 IQ variable.

Results

Of the current study's 68 ADHD diagnosed participants 52 (76.5%) participants were male and 16 (23.5%) female. The average age of participants was 10.60 years ($SD=2.871$), the youngest participant was 5 and the oldest 16. In the sample there were 7 (10.3%) reports of participants with family History of ADHD, 9 (13.2%) reports of history of past trauma, and 7 (10.3%) reports of exposure to toxins in-utero (alcohol, tobacco, and illegal drugs). The average household income in participant neighborhoods of the sample was \$51,887.51, with the minimum recorded \$24,968 and maximum \$140,442 ($SD= 26007.89$). Table 2 shows the reported number of violent crimes in participant neighborhoods (CVE), by participant race.

Table 2*Community Violence Exposure by Race*

	N	Minimum	Maximum	Mean	Std. Deviation
Caucasian	26	13	1231	314.92	289.905
African American	23	13	1027	403.30	314.157
Hispanic	3	19	540	293.67	261.653
Asian	4	50	1231	493.50	530.854
Biracial	2	136	171	153.50	24.749
Other	4	7	171	70.00	71.657
Unknown	6	92	863	491.50	311.400
Total	68	7	1231	350.81	310.410

Initial Correlation analyses were conducted to examine the relationships between variables; executive functioning (Brief GEC scores), Community Violence Exposure, Neighborhood income, IQ, Race, and Sex (see Table 3 for results). Linear regressions results for unadjusted and adjusted models are shown in Table 4. The BRIEF-1 GEC was the only significant dependent variable in the unweighted models ($\beta = 0.02$, $p = .018$), while results using BRIEF-1 GEC ($\beta = -0.01$, $p = 0.81$) and BRIEF Combined GEC ($\beta = 0.02$, $p = 0.252$) as the dependent variable were not significant. Models adjusted for sex were only significant with regard to the BRIEF-1 GEC ($\beta = .025$, $p = .009$) as the dependent variable. A .051 change in R^2 the between these unadjusted and adjusted models indicates an increase in the CVE predictive power for executive functioning. Models adjusted for IQ were not statically significant for BRIEF-2 GEC or BRIEF Combined GEC as the dependent variable, and BRIEF-1 GEC as

dependent variable could not be run due to a low number of available WISC-4 data. The moderating effect of trauma history was examined using the interaction term CVE x Trauma History for each of the three BRIEF variables, examined one at a time. None of the three analyses produced statistically significant results, but did show a trend towards a negative moderating effect, reflecting the possible negative impact that direct history of trauma has on executive functioning.

Table 3

Correlations for Variables

Variable	CVE	Neighborhood Income	IQ	GEC BRIEF-1	GEC BRIEF-2	GEC BRIEF combined	Sex	Race
CVE	1							
Neighborhood Income	-.446**	1						
IQ	.78	-.086	1					
GEC BRIEF-1	.467*	-.246	-.037	1				
GEC BRIEF-2	-.037	.078	-.152	-1.000**	1			
BRIEF GEC Combined	.142	-.046	-.105	.955**	1.000**	1		
Sex	-.165	.203	-.030	-.005	.172	.124	1	
Race	-.175	.145	-.162	-.404*	.007	-.127	.004	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 4*Results for non-adjusted linear analysis regressions with CVE as the Independent Variable*

	Unadjusted model			Adjusted for Sex			Adjusted for IQ		
	R ²	β	P	R ²	β	P	R ²	β	P
BRIEF-1 GEC	.218	0.02	.018*	.269	.025	.009**	-	-	-
BRIEF-2 GEC	.001	-.001	.81	.031	-.001	.523	.023	.000	.656
BRIEF GEC Combined	.020	.005	.252	.041	.006	.250	.025	.004	.556

** Significant at the 0.01 level (2-tailed).

* Significant at the 0.05 level (2-tailed).

Discussion

The current study examined how community violence exposure influences executive functioning in an ADHD diagnosed population of urban dwelling youth. Initial correlational analyses found a slight positive correlation between CVE and the BRIEF-1 GEC measure for executive functioning, and no significance for the BRIEF-2 GEC and BRIEF GEC combined profiles. The observed association is contrary to the hypothesized expected negative correlation expected; this positive association may be due to increased parental attention to children diagnosed with ADHD in communities with higher violence, as one potential hypothesis. The strong negative association observed between CVE and neighborhood income reflects the impact increased violence in lower income neighborhoods has on children living within these environments (Foster & Brooks-Gunn, 2009; Sargent et al., 2020). This was anticipated and supported with the analyses conducted.

Of note, one challenge observed with these findings is the differences found between the different versions of the BRIEF in regard to its assessment of executive functioning across the cohort examined. There were modest, but clear incompatibilities between the BRIEF-1 and BRIEF-2 GEC scores that influenced findings. When discussed with Dr. Hunter, he highlighted that these concerns have been observed in other unpublished studies, and warrant continued consideration in future research (Hunter private communication, 2022).

Regression analyses conducted to examine CVE as a predictor for each of the BRIEF dependent variables indicated a significant impact on executive functioning with the BRIEF-1 as the dependent variable, but not with the BRIEF-2 or combined BRIEF GEC scores. This may indicate that CVE has a significant role in regard to variabilities seen in executive functioning in youth exposed to CVE, although accounting only for 22% ($R^2 = .218$) of the variance in executive functioning for ADHD diagnosed youth. Overall, the effect of this variance is rather small ($\beta = 0.02$). Further regression analysis controlling for sex and using BRIEF-1 as the dependent variable highlighted a .051 change in R^2 and a $\beta = .025$, presenting an improved predictive power for CVE. CVE was found to be a significant predictor of executive functioning in both of these models showing that it can aid in executive functioning research. Again the caveat being that this was seen solely with the older version of the BRIEF GEC model.

Direct experiences of trauma have been shown to have profound effects on the cognitive and emotional functions (Pottinger, 2015) of youth who have been exposed to such challenges as community based violence. This was tested with this study through the analysis of CVE x Trauma History as a moderating term. Notably, this did not prove to be a positive finding, counter to what was expected. Again, limitations, as discussed below, in the cohort and measures may be the contributing factor to this lack of a significant finding.

Limitations

The largest limitation for this study was the number of participants; through the development of the sample, we ultimately only had available to us 68 total participants. This was one likely factor contributing to the variabilities found and the differences seen with regard to predictions and findings. Future research would benefit from a greater sample size.

Further research using the BRIEF would greatly benefit from better understanding the observed differences between the BRIEF versions and the ultimate impact on GEC scores. Considerations in regard to the underlying structure of the indices and how they can be best interpreted across versions will be important for further research using these assessments.

Additionally, a common limitation in clinical research is often that participants seek help for reasons that are not specific to the study that is designed to answer questions like those posed with this one. The use of retrospective data to address the questions posed with this study meant developing an appropriate sample from what was first and formally a clinical database. Hence, not all information available in the records fully met the underlying questions being asked with the study design. This may have served to limit available data for answering for the questions effectively.

Research that illustrates how growing up in environments with elevated levels of violence and limited resources can impact the functioning of a developing brain has been steadily growing (Foster & Brooks-Gunn, 2009; Sargent et al., 2020). With additional research linking ADHD to executive functioning deficits, it is crucial to study how trauma, exposure to violence, and growing up in violent environments may further impact functioning (Faraone & Larsson, 2019; Willcutt et al. 2005). Types of exposure, polyvictimization, and multiple exposures are strong topics in the current literature examining violence exposure; it is anticipated that

considering comorbidities and varying sources of underlying risk will further inform research in the future (Foster & Brooks-Gunn, 2009). While the findings of this study do not clearly support the hypothesized influence of CVE on executive functioning, there are indications from the data that there is impact on functioning for some youth exposed to violence in the community.

Research on the interactions that underlie the complex relationships that are found between CVE and externalizing disorders will prove valuable in guiding better approaches to diagnosis and treatment over time. Particularly for those most vulnerable given environmental risks.

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