Title

Does attention-deficit/hyperactivity disorder increase the risk of minor blunt head trauma in children?

Journal
Journal of Child and Adolescent Psychiatric Nursing, 35(4)

Authors
Pakyurek, Murat
Badawy, Mohamed
Ugalde, Irma
et al.

Publication Date
2022-11-01

DOI
10.1111/jcap.12390

Peer reviewed

HHS Public Access
Author manuscript
J Child Adolesc Psychiatr Nurs. Author manuscript; available in PMC 2023 November 01.

Published in final edited form as:
J Child Adolesc Psychiatr Nurs. 2022 November ; 35(4): 356–361. doi:10.1111/jcap.12390.

Does Attention-Deficit/Hyperactivity Disorder Increase Risk of Minor Blunt Head Trauma in Children?

Murat Pakyurek, MD,
Department of Psychiatry and Behavioral Sciences, UC Davis, School of Medicine, Sacramento, CA

Mohamed Badawy, MD,
Department of Pediatrics, UT Southwestern, Dallas, Texas

Irma T. Ugalde, MD,
Department of Emergency Medicine, McGovern Medical School, Houston, TX

Paul Ishimine, MD,
Departments of Emergency Medicine and Pediatrics, University of California, San Diego, School of Medicine, La Jolla, CA

Pradip P. Chaudhari, MD,
Division of Emergency and Transport Medicine, Children's Hospital Los Angeles, Keck School of Medicine of USC, Los Angeles, CA

Kevan McCarten-Gibbs,
UCSF Benioff Children's Hospital Oakland

Ozra Nobari, MD,
Department of Psychiatry and Behavioral Sciences, UC Davis, School of Medicine, Sacramento, CA

Nathan Kuppermann, MD, MPH,
Departments of Emergency Medicine and Pediatrics UC Davis, School of Medicine, Sacramento, CA

James F. Holmes, MD, MPH
Department of Emergency Medicine, UC Davis, School of Medicine, Sacramento, CA

Abstract

Problem: It is unclear if attention-deficit hyperactivity disorder (ADHD) increases risk of head trauma in children.

Methods: We conducted a multicenter prospective observational study of children with minor blunt head trauma. Guardians were queried, and medical records reviewed as to whether the

Corresponding Author: Murat Pakyurek, MD, Department of Psychiatry and Behavioral Sciences, University of California, Davis Medical Center, 2230 Stockton Blvd. Sacramento CA 95817, Tel: 916 734-3574 Fax: 916 734-0849.

This study was approved by the UC Davis Institutional Review Board. All participating sites relied on the UC Davis Institutional Review Board for approval.

patient had previously been diagnosed with ADHD. Enrolled patients were categorized based on their mechanism of injury, with a comparison of those with motor vehicle collision (MVC) versus non-MVC mechanisms.

Results: 3,410 (84%) enrolled children had ADHD status available, and 274 (8.0%; 95% CI 7.1, 9.0%) had been diagnosed with ADHD. Mean age was 9.2 ± 3.5 years and 64% were male. Rates of ADHD for specific mechanisms of injury were: assaults: 23/131 (17.6%; 95% CI 11.5, 25.2%), automobile versus pedestrian 23/173 (13.3%; 95% CI 8.6, 19.3%), bicycle crashes 26/148 (17.6%; 95% CI 11.8, 24.7%), falls 107/1,651 (6.5%; 95% 5.3, 7.8%), object struck head 31/421 (7.4%; 5.1, 10.3%), motorized vehicle crashes (e.g. motorcycle, motor scooter) 11/148 (7.4%; 3.8, 12.9%) and MVCs 46/704 (6.5%; 95% CI 4.8, 8.6%).

Conclusion: Children with ADHD appear to be at increased risk of head trauma from certain mechanisms of injury including assaults, auto versus pedestrian, and bicycle crashes, but are not at an increased risk for falls.

1 INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common psychiatric disorders in children and adolescents. Large surveys and comprehensive systematic reviews estimate the prevalence of ADHD to be between 7.2% and 9.4% in the population (Danielson et al., 2018; Thomas, Sanders, Doust, Beller, & Glasziou, 2015). ADHD is characterized by core symptoms of inattention, hyperactivity and impulsivity that interferes with a child's development and function (American, Psychiatric, & Association, 2015). ADHD consists of the following three different subtypes: Inattentive, Hyperactive or Combined. Children with hyperactivity can be impulsive, disruptive and overly active. These children have excess motor activity manifesting as extreme restlessness and constant movement often when not appropriate and may have increased risk of traumatic injury (Simonoff, Pickles, Wood, Gringras, & Chadwick, 2007). Similarly, inattention may also increase risk of injury, especially traffic related injuries (Amiri et al., 2020) due to failure to carefully make road decisions. When combined, inattention, hyperactivity and impulsivity appear to significantly increase the risk of injury to children with ADHD(Amiri et al., 2020).

Injury is the leading cause of morbidity and mortality in childhood (Heron, 2019). Traumatic brain injuries (TBI) frequently occur after blunt head trauma and may result in temporary or permanent cognitive, behavioral or physical impairments that impact the function of the individuals and their families. An estimated 50,000 children are hospitalized for TBI in the United States each year (70-75 per 100,000 children) (Dewan, Mummareddy, Wellons, & Bonfield, 2016; Schneier, Shields, Hostetler, Xiang, & Smith, 2006). Increased risk of TBI is associated with male sex, previous TBI, low socioeconomic status, adverse life events, aggressive behaviors, and substance misuse (Guberman et al., 2020).

Several studies demonstrate an association of ADHD with specific types of injuries. Particular injuries associated with ADHD include burns,(Ghanizadeh, 2008) oral trauma, (Bimstein, Wilson, Guelmann, & Primosch, 2008) and fractures, especially to the upper extremities(Seens, Modarresi, MacDermid, Walton, & Grewal, 2021). ADHD is also associated with increased risk of driver-related motor vehicle collisions (MVC) in adolescents (Moffitt et al., 2015; Ramos Olazagasti et al., 2013; Tremblay, Boulerice, Arseneault, & Niscale, 1995). However, little is known if ADHD specifically increases the risk of blunt head trauma outside of adolescent driver-related MVCs and if there are particular mechanisms of injury that are more common in children with ADHD. Knowledge of increased risk of blunt head trauma due to ADHD, especially from certain mechanisms of injury, would help target additional injury prevention measures in this population.

Children with blunt head trauma at risk for traumatic brain injuries are routinely evaluated with cranial computed tomography (CT). Substantial variation in Emergency Department (ED) cranial CT use following blunt head trauma is known to occur(Stanley et al., 2014). Unfortunately, not all the factors that contribute to this variation are known. As variation in treatment of children with ADHD occurs(Sheldrick et al., 2015), determining if ADHD contributes to the variation in ED cranial CT use is warranted.

The objective of this study was to measure the rate of ADHD diagnosis in children who present to the ED with non-trivial, minor blunt head trauma. We hypothesized that children with non-MVC mechanisms of injury have higher rates of ADHD than children with passenger related MVC mechanisms of injury suggesting that ADHD increases the risk of blunt head trauma from mechanisms that involve activity on the part of the patient. Furthermore, we sought to determine if the ED evaluation of children with ADHD was different than those without ADHD by comparing CT rates in the two populations.

2 METHODS

2.1 Study design

We conducted a multicenter prospective observational cohort study of children with non-trivial blunt head trauma designed to validate the Pediatric Emergency Care Applied Research Network (PECARN) head trauma prediction rule. In this planned sub-study, we sought to evaluate the rate of ADHD in this population. The study was approved by the UC Davis institutional review board serving as the single institutional review board for all study sites.

2.2 Study setting and participants

Children presenting to one of the six participating EDs from May 2017 through January 2019 were eligible. Specific inclusion criteria followed the same criteria as in the PECARN head injury study (Kuppermann et al., 2009). Children younger than 18 years with non-trivial, minor (Glasgow Coma Scale [GCS] scores of 14 or 15) blunt head trauma or planned cranial computed tomography (CT) scanning following trauma were eligible. Trivial head trauma was defined as a mechanism of a ground level fall, or walking or running into stationary objects, as long as the patient lacked any signs or symptoms of head trauma or only had scalp lacerations or abrasions (Kuppermann et al., 2009). Patients were excluded for any of the following: penetrating trauma, pre-existing neurological disorders seriously complicating physical examination assessment, pre-existing ventriculoperitoneal shunts, injury occurring more than 24 hours from ED presentation, transfer of the patient with prior cranial CT/magnetic resonance imaging, pre-existing brain tumor or bleeding disorder, strong suspicion that the injury is the result of child abuse, or known pregnancy (Kuppermann et al., 2009). For this particular sub-study on ADHD, patients were further excluded if they were younger than four years, or they were 16 years or older. The younger age exclusion was chosen as children younger than four years would unlikely be diagnosed with ADHD. Children 16 years or older were excluded as they may have been the driver of the vehicle in the MVC.

2.3 Data collection

Patients were enrolled at the time of ED presentation by the ED faculty member or a pediatric emergency medicine fellow physician providing care. Patient demographic information was obtained from the guardians or medical health records as appropriate. Historical and physical examination findings including the six variables in the PECARN head injury prediction rule were collected by the physician providing care. The PECARN head injury variables for this age group included the following:1) altered mental status or GCS<15, 2) history of loss of consciousness, 3) any vomiting since the injury, 4) clinical signs of basilar skull fracture, 5) severe headache, or 6) a severe mechanism of injury (Kuppermann et al., 2009). Severe headache was defined as a headache present in the ED characterized by a score of at least eight on a ten-point scale. A severe mechanism of injury was defined by the following: MVC with patient ejection, death of another passenger, or rollover; pedestrian or bicyclist without helmet struck by a motorized vehicle; fall >5 feet; or head struck by a high-impact object (significantly heavily object struck head, baseball, horse kick, etc.) (Kuppermann et al., 2009). Guardians of enrolled patients were queried as to whether the patient had been previously diagnosed with ADHD. For those whose guardians were not available, the medical records were reviewed to identify any documented history of ADHD.

2.4 Outcome Measures

The primary outcome measure was the rate of ADHD. ADHD was considered present if the patient/patient's guardian disclosed a history of ADHD or ADHD was documented in the patient’s medical records.

2.5 Data Analysis

Data were described with descriptive statistics and 95% confidence intervals (CI). Bivariable comparisons were described with rate differences and 95% CIs. Patients involved as passengers in MVC mechanisms were considered to represent the prevalence of ADHD in the population and the reference group for the study (as this is a passive mechanism of injury). Patients with MVC mechanisms were chosen as the comparison group as a prior diagnosis of ADHD should have little influence on the patient presenting to the ED as a passenger following a MVC. Thus, the rate of ADHD in those with MVC mechanisms was a surrogate for the general rate in the population. This rate was then compared to the rate of ADHD in those patients with other mechanisms of injury to identify those mechanisms with a stronger association with ADHD. Differences in rates of ADHD were compared for those with MVC versus non-MVC mechanisms as well as MVC versus six different mechanisms of injury (assaults, automobile versus pedestrian, bicycle crashes, falls, objects striking the head and motorized vehicle crashes other than automobiles in which the patient was the driver or rider). Motorized vehicle mechanisms included any injury not related to automobiles, including all-terrain vehicles, motorcycles, motor scooters, etc. Relative risk ratios were calculated for each mechanism of injury and compared to the MVC group with the chi-squared test. Due to the multiple testing planned (n=7), we applied a Bonferroni correction to reach a cumulative alpha of 0.05. Therefore, an adjusted p-value of 0.007 was considered statistically significant. In addition, we performed a multivariable logistic regression analysis to determine if the presence of ADHD was associated with an increased rate of cranial CT scanning, controlling for age, sex, and the six PECARN head injury risk variables. A fixed effects model was used to adjust for specific site differences. We determined the sample size for the sub-study based on the MVC (comparison) cohort having a rate of ADHD of 7.2% and the non-MVC cohort having a rate of 12.2% (5% increase in the rate of ADHD in non-MVC mechanisms) (Thomas et al., 2015). Assuming 10% of enrolled patients had MVC mechanisms, with an alpha of 0.05 and power of 0.80, 3,808 patients were required.

3 RESULTS

A total of 4,070 injured children were enrolled into the main study and 3,410 (84%) had information regarding the diagnosis of ADHD and constitute the study population. The mean age was 9.2 ± 3.5 years and 2,167 (63%) were male. Of the 3,410 patients, 274 (8.0%, 95% CI 7.1, 9.0%) carried the diagnosis of ADHD of whom 162 (60%) reported taking ADHD medications. Demographic information including clinical findings is presented in Table 1. The mean age (9.1 ± 3.6 years) and rate of cranial CT use (292, 44.2%, 95% CT 40.4%, 48.1%) in the 660 patients with unknown ADHD status was similar to the remaining study population.

A total of 2,706 (79%) patients sustained non-MVC mechanisms of injury and 704 (21%) sustained MVC mechanisms. After removing the 17 patients with unknown mechanisms of injury, rates for each mechanism of injury are presented in Table 2. Assaults, automobile versus pedestrian and bicycle mechanisms all had statistically higher rates of ADHD than the rate associate with MVCs.

Among the 274 children with ADHD diagnoses, 118 (43.1%, 95% CI 37.1%, 49.2%) underwent cranial CT scanning, of whom five (4.2%, 95% CI 1.4, 9.6%) were confirmed to have TBIs. In the non-ADHD diagnosed group 989 (31.5%, 95% CI 30.0, 33.2%) underwent cranial CT scanning, and 54 (5.5%, 95% CI 4.1, 7.1%) were confirmed to have TBI. In the adjusted multivariable regression model, there was no association between a diagnosis of ADHD and cranial CT scanning (odds ratio = 1.17, 95% CI 0.85, 1.61), p-value=0.35.

4 DISCUSSION

This prospective study identified the rate of ADHD in a cohort of children with non-trivial minor blunt head trauma which was similar to the expected rate in the general population (Danielson et al., 2018; Thomas et al., 2015). Thus, no apparent association between ADHD and blunt head trauma in children was initially identified. On closer inspection of specific mechanisms of injury, however, certain mechanisms were associated with a higher rate of

ADHD than anticipated. This suggests that children with ADHD may be at higher risk for head trauma from specific mechanisms or activities.

This study assessed the rate of a prior diagnosis of ADHD in children sustaining non-trivial minor blunt head trauma by direct query of their guardian and review of the medical record. These methods likely ascertained a true rate of ADHD in the study population and probably only failed to identify those children with undiagnosed ADHD. The rate of ADHD documented in the current study is similar to that of the general United States population. The current study specifically sought to identify if children with ADHD are at increased risk of blunt head trauma as prior research regarding this association is limited. A survey from England suggested a two-fold increase in head trauma for children with ADHD (Rowe, Maughan, & Goodman, 2004). However, another study suggests no increase in the risk of trauma in children with ADHD, although that study was limited by its small sample size (Wozniak et al., 1999). Furthermore, a systematic review was inconclusive in assessing increased risk of head trauma in children with ADHD due to the limited evidence available to synthesize(Adeyemo et al., 2014).

The current study did not identify a statistically significant increase in the rate of ADHD in children when the rate in the MVC (comparison) group was tested against the rate in the non-MVC mechanisms of injury. This was likely due to the large number of patients with falls in the study, who had a similar rate of ADHD as the comparison group. However, when specific mechanisms of injury were compared to the MVC group, several mechanisms (assaults, automobile versus pedestrian incidents and bicycle incidents) had statistically higher rates of ADHD.

A prior study identified an increased risk of bicycle related injuries in children with ADHD (Grigorian et al., 2019). It further suggested that those with ADHD were less likely to wear helmets. In addition, one case-control study demonstrated that hyperactivity and deficits in vigilance/attention increased the risk of automobile versus bicycle/pedestrian incidents (Pless, Taylor, & Arsenault, 1995). The current study similarly demonstrates increased risk of bicycle incidents in children with ADHD although no data on helmet use were collected. Our results confirm the necessity of additional injury prevention work in children with ADHD regarding bicycle safety. Furthermore, additional interventions are needed for children with ADHD to prevent auto versus pedestrian incidents. Future studies should identify and evaluate the best interventions for children with ADHD to decrease head trauma from bicycle and auto versus pedestrian mechanisms.

This study evaluated all children with non-trivial blunt head trauma which includes those with and without actual brain injury. As many children with blunt head trauma undergo cranial CT scanning to identify brain injury, this study sought to identify any variation in the rate of cranial CT scanning in children with ADHD. After controlling for important patient history and physical examination findings, children with minor head trauma and ADHD do not appear to be at higher risk of undergoing cranial CT scanning. Furthermore, the rate of TBI on CT scan was similar in those children with (4.2%) and without (5.5%) ADHD, suggesting that although children with ADHD may be more likely to experience physical trauma, once injured no difference in the rate of TBI on CT exists.

The study has certain limitations. The study design required definition of a reference group to estimate the rates of ADHD in the population sampled. It is possible that the rate of ADHD in the comparison group does not represent the true rate of ADHD in the general population. A prospective, population-based study measuring incident rates would better answer this question. However, the rate of ADHD diagnosis in the MVC cohort (6.5%) is similar to estimates of the general population from a systematic review (7.2%)(Thomas et al., 2015). Patients with moderate-to-severe head injury (GCS scores less than 14) were excluded. Although these patients represent a small percent of children with blunt head trauma, this exclusion may have altered the results.

Patients were considered to have ADHD if this information was elicited during history gathering, which is subject to recall bias. Review of the medical records was undertaken to limit this potential bias. Patients were not formally tested for ADHD during ED evaluation and were not followed for the possibility of post discharge psychiatric evaluation and diagnosis. The ADHD diagnosis collected in this study did not differentiate inattentive type from hyperactive/impulsive type or combined type. This information could have assisted in comparing the possibility of proneness to non-trivial blunt trauma in these three ADHD subtypes. Finally, specific information on treated versus non-treated ADHD including taking ADHD medications was not collected. This could have helped distinguish the severity of the ADHD diagnosis and possibly limited our ability to determine how well the ADHD symptoms are managed.

CONCLUSION

In conclusion, children with ADHD who experience non-trivial minor blunt head trauma are at increased risk of certain mechanisms of injury including assaults, bicycle crashes, and auto versus pedestrian incidents. Future studies to evaluate interventions in children with ADHD to promote injury prevention are needed.

Acknowledgments:

The authors thank the participants, their families, and the staff of six participating sites.

Funding and support:

This work was supported by a grant from the National Institute of Child Health and Human Development R01 HD084674.

REFERENCES

Adeyemo BO, Biederman J, Zafonte R, Kagan E, Spencer TJ, Uchida M, … Faraone SV (2014). Mild traumatic brain injury and ADHD: a systematic review of the literature and meta-analysis. J Atten Disord, 18(7), 576–584. doi:10.1177/1087054714543371 [PubMed: 25047040]

American, Psychiatric, & Association. (2015). DSM-5: Diagnostic and Statistical Manual of Mental Disorders, 5th *Edition* Arlington, VA.

Amiri S, Esmaeili E, Salehpour F, Mirzaei F, Barzegar H, Mohammad Namdar A, & Sadeghi-Bazargani H (2020). Attention Deficit Hyperactivity Disorder (ADHD) in Patients with and without Head Trauma. Open Access Emerg Med, 12, 405–410. doi:10.2147/oaem.S265883 [PubMed: 33235528]

Bimstein E, Wilson J, Guelmann M, & Primosch R (2008). Oral characteristics of children with attention-deficit hyperactivity disorder. Spec Care Dentist, 28(3), 107–110. doi:10.1111/j.1754-4505.2008.00021.x [PubMed: 18489658]

Danielson ML, Bitsko RH, Ghandour RM, Holbrook JR, Kogan MD, & Blumberg SJ (2018). Prevalence of Parent-Reported ADHD Diagnosis and Associated Treatment Among U.S. Children and Adolescents, 2016. J Clin Child Adolesc Psychol, 47(2), 199–212. doi:10.1080/15374416.2017.1417860 [PubMed: 29363986]

Dewan MC, Mummareddy N, Wellons JC, & Bonfield CM (2016). Epidemiology of Global Pediatric Traumatic Brain Injury: Qualitative Review. World Neurosurgery, 91, 497–509.e491. doi:10.1016/j.wneu.2016.03.045 [PubMed: 27018009]

Ghanizadeh A (2008). Small burns among out-patient children and adolescents with attention deficit hyperactivity disorder. Burns, 34(4), 546–548. doi:10.1016/j.burns.2007.07.015 [PubMed: 17959315]

Grigorian A, Nahmias J, Dolich M, Barrios C Jr., Schubl SD, Sheehan B, & Lekawa M (2019). Increased risk of head injury in pediatric patients with attention deficit hyperactivity disorder. J Child Adolesc Psychiatr Nurs, 32(4), 171–176. doi:10.1111/jcap.12246 [PubMed: 31328370]

Guberman GI, Robitaille MP, Larm P, Ptito A, Vitaro F, Tremblay RE, & Hodgins S (2020). A Prospective Study of Childhood Predictors of Traumatic Brain Injuries Sustained in Adolescence and Adulthood. Can J Psychiatry, 65(1), 36–45. doi:10.1177/0706743719882171 [PubMed: 31623445]

Heron M (2019). Deaths: Leading Causes for 2017. Natl Vital Stat Rep, 68(6), 1–77.

Kuppermann N, Holmes JF, Dayan PS, Hoyle JD Jr., Atabaki SM, Holubkov R, … Wootton-Gorges SL (2009). Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. Lancet, 374(9696), 1160–1170. doi:10.1016/s0140-6736(09)61558-0 [PubMed: 19758692]

Moffitt TE, Houts R, Asherson P, Belsky DW, Corcoran DL, Hammerle M, … Caspi A (2015). Is Adult ADHD a Childhood-Onset Neurodevelopmental Disorder? Evidence From a Four-Decade Longitudinal Cohort Study. Am J Psychiatry, 172(10), 967–977. doi:10.1176/appi.ajp.2015.14101266 [PubMed: 25998281]

Pless IB, Taylor HG, & Arsenault L (1995). The relationship between vigilance deficits and traffic injuries involving children. Pediatrics, 95(2), 219–224. [PubMed: 7838639]

Ramos Olazagasti MA, Klein RG, Mannuzza S, Belsky ER, Hutchison JA, Lashua-Shriftman EC, & Castellanos FX (2013). Does childhood attention-deficit/hyperactivity disorder predict risk-taking and medical illnesses in adulthood? J Am Acad Child Adolesc Psychiatry, 52(2), 153–162.e154. doi:10.1016/j.jaac.2012.11.012 [PubMed: 23357442]

Rowe R, Maughan B, & Goodman R (2004). Childhood psychiatric disorder and unintentional injury: findings from a national cohort study. J Pediatr Psychol, 29(2), 119–130. doi:10.1093/jpepsy/jsh015 [PubMed: 15096533]

Schneier AJ, Shields BJ, Hostetler SG, Xiang H, & Smith GA (2006). Incidence of pediatric traumatic brain injury and associated hospital resource utilization in the United States. Pediatrics, 118(2), 483–492. doi:10.1542/peds.2005-2588 [PubMed: 16882799]

Seens H, Modarresi S, MacDermid JC, Walton DM, & Grewal R (2021). Prevalence of bone fractures among children and adolescents with attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. BMC Pediatr, 21(1), 354. doi:10.1186/s12887-021-02821-x [PubMed: 34412606]

Sheldrick RC, Leslie LK, Rodday AM, Parsons SK, Saunders TS, & Wong JB (2015). Variations in Physician Attitudes Regarding ADHD and Their Association With Prescribing Practices. J Atten Disord, 19(7), 569–577. doi:10.1177/1087054712461689 [PubMed: 23142852]

Simonoff E, Pickles A, Wood N, Gringras P, & Chadwick O (2007). ADHD symptoms in children with mild intellectual disability. J Am Acad Child Adolesc Psychiatry, 46(5), 591–600. doi:10.1097/chi.0b013e3180323330 [PubMed: 17450050]

Stanley RM, Hoyle JD Jr., Dayan PS, Atabaki S, Lee L, Lillis K, … Kuppermann N (2014). Emergency department practice variation in computed tomography use for children with minor blunt head trauma. J Pediatr, 165(6), 1201–1206.e1202. doi:10.1016/j.jpeds.2014.08.008 [PubMed: 25294604]

Thomas R, Sanders S, Doust J, Beller E, & Glasziou P (2015). Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. Pediatrics, 135(4), e994–1001. doi:10.1542/peds.2014-3482 [PubMed: 25733754]

Tremblay RE, Boulerice B, Arseneault L, & Niscale MT (1995). Does low self-control during childhood explain the association between delinquency and accidents in early adolescence? Criminal Behaviour and Mental Health, 5, 439–451.

Wozniak J, Crawford MH, Biederman J, Faraone SV, Spencer TJ, Taylor A, & Blier HK (1999). Antecedents and complications of trauma in boys with ADHD: findings from a longitudinal study. J Am Acad Child Adolesc Psychiatry, 38(1), 48–55. doi:10.1097/00004583-199901000-00019 [PubMed: 9893416]

Table 1:

Characteristics of patients with and without ADHD

	With ADHD (n=274)	**Without ADHD (n=3,136)**
Age (years ± SD)	10.8 ± 3.0	9.0 ± 3.5
Sex (male)	207 (76%)	1,960 (63%)
PECARN TBI Rule Findings		
Altered mental status	39 (14%)	353 (11%)
Loss of consciousness	80 (29%)	564 (18%)
Vomiting since injury	31 (11%)	470 (15%)
Clinical signs of basilar skull fracture	4 (1%)	36 (1%)
Severe headache	32 (12%)	258 (8%)
Severe mechanism of injury	104 (38%)	883 (28%)

Note: ADHD (Attention Deficit Hyperactivity Disorder), SD (Standard deviation),

PECARN (Pediatric Emergency Care Applied Research Network), TBI (Traumatic Brain Injury)

Table 2:

Mechanisms of Injury Compared to MVC

	ADHD Present	Difference in Rates*	Relative Risk	P-value*
MVC	46/704, 6.5% (4.8, 8.6)	Reference		
Non-MVC	223/2,689, 8.3% (7.3, 9.4)	1.8% (−0.2, 4.0)	1.3 (0.9, 1.7)	0.10
Assault	**23/108, 21.3% (14.0, 30.2)**	**14.7% (6.8, 22.7)**	**3.3 (2.1, 5.2)**	**<0.0001**
Auto v Ped	**23/173, 13.3% (8.6, 19.3)**	**6.8% (1.4, 12.1)**	**2.0 (1.3, 3.3)**	**0.003**
Bicycle	**26/148, 17.6% (11.8, 24.7)**	**11.0% (4.6, 17.4)**	**2.7 (1.7, 4.2)**	**<0.0001**
Fall	107/1,651, 6.5% (5.3, 7.8)	0.0% (−0.2, 0.2)	1.0 (0.7, 1.4)	0.96
Object struck head	31/421, 7.4% (5.1, 10.3)	0.8% (−2.3, 3.9)	1.1 (0.7, 1.7)	0.59
Motorized vehicle	11/148, 7.4% (3.8, 12.9)	0.9% (−3.7, 5.5)	1.1 (0.6, 2.1)	0.69
Other	2/40, 5.0% (0.6, 16.9)			
Unknown	1/17,5.9% (1.5, 28.7)			

*Compared to MVC

Note.

ADHD (Attention Deficit Hyperactivity Disorder), MVC (Motor Vehicle Collision)

Motorized vehicle includes motorcycles, all-terrain vehicles, motorized scooters, etc