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Original Research Article

Pediatric patients with attention deficit and hyperactivity disorder and accidental injuries: a cohort study

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ABSTRACT

Background: Attention deficit and hyperactivity disorder (ADHD) is linked to a higher risk of injuries, especially in childhood and adolescence. This study compares emergency department (ED) visits between pediatric patients with ADHD and healthy controls, identifying potential risk factors and differences in injury severity.
Methods: Retrospective cohort study including patients diagnosed with ADHD at a Neurodevelopment Clinic, and a control group of patients born at the same hospital. Medical records were reviewed for clinical data (number of ED accidents since birth and severity outcomes such as splints, hospitalization, surgeries, inter-hospital transfers and sequelae). Parametric measurements were used due to the sample size and absence of skewness. Negative binomial regression accounted for overdispersion in incidence rates.
Results: We analyzed 316 ADHD cases and 316 controls. Mean age was 11.9 years (SD 2.4), similar to controls (p=0.998), with 66.5% males in both groups. ADHD patients had 537 unintentional injury ED visits (controls: 387), an incidence rate ratio (IRR) of 1.36 (95% CI: 1.11-1.67). The IRR was higher for episodes ≥6 years (IRR 1.48; 95% CI: 1.16-1.88). Severity outcomes were similar (p=0.257). Lower parental education was associated with more episodes (IRR 1.39; 95% CI: 0.989-1.96). Comorbidities did not affect injury incidence (p=0.425), but patients without comorbidities required more procedures and transfers (p=0.018 and p=0.013, respectively). 79.7% of cases had most/all ED visits before starting psychostimulants.
Conclusions: Our study supports the increased risk of injuries among pediatric ADHD patients. While injury severity was comparable to controls, ADHD patients without comorbidities had greater severity. Psychostimulants suggested a protective effect.

Keywords: Attention deficit disorder with hyperactivity, Accidents, Emergency department, Hospital, Risk factors

INTRODUCTION

Attention deficit and hyperactivity disorder (ADHD) is one of the most common neurodevelopmental disorders in childhood, characterized by inattention, hyperactivity, and impulsivity.[1] Research has consistently shown that children with ADHD are at an increased risk of accidents and injuries due to difficulties in impulse control and sustained attention.[2] Studies have found that ADHD is associated with higher rates of emergency department (ED) visits for both minor and severe injuries.[2-6] Brunkhorst-Kanaan et al demonstrated that ADHD is linked to poor safety outcomes and an increased likelihood of injury-related hospitalizations.[2] Children with ADHD have also been shown to have greater difficulty adhering to safety regulations, which could further contribute to the risk of unintentional injuries.[3,4]

While previous studies have established that ADHD increases the risk of accidents and injuries, little is known about how specific factors such as age at the time of injury, ADHD medication, or parental characteristics contribute to this risk.[3,6] There is also limited knowledge regarding the severity of these injuries and whether ADHD patients

face a higher likelihood of more severe outcomes, such as hospitalizations, surgeries, or long-term sequelae, namely at a national level. This study seeks to fill these gaps by analyzing both the frequency and severity of injuries in ADHD patients, providing a more comprehensive understanding of potential risk factors that can inform clinical care and accident prevention strategies.

We aimed to assess differences in ED visits due to unintentional injuries between pediatric patients with and without ADHD, focusing on identifying risk factors for injury incidence and severity, such as the impact of ADHD medication use, parental education level, and comorbid conditions.

METHODS

We conducted a retrospective cohort study comparing pediatric patients with ADHD to a matched control group without ADHD. The study aimed to assess the incidence of ED visits due to accidents and non-intentional injuries and identify potential risk factors influencing injury frequency and severity among ADHD patients.

Baseline accident rate was estimated as 0.1 (10 episodes per 100 person-years) based on relevant literature.[7] Expected increase for the ADHD group was set at an incidence rate ratio (IRR) of 2 to detect a meaningful difference between the groups. Using a significance level of 0.05 and a study power of 80%, the EpiTools cohort sample size calculator (https://epitools.ausvet.com.au/cohortss) determined a required sample size of 394 participants, with 197 in each group.

ADHD patients were eligible if they had attended at least one clinical appointment by December 2023. For each ADHD case, a control was randomly selected from patients born in the same hospital nursery, ensuring a match in sex and date of birth. This method was used to control for potential confounders such as age and sex. Controls were excluded if they had any relevant follow up considered as higher accident risk (neurodevelopment, neurology, psychiatry or adolescent medicine). Replacements were selected using the same age and sex criteria.

Information was obtained from medical records of patients in the neurodevelopment clinic and matched controls from the hospital's nursery records. Data collection covered the period from birth to December 2023. Records provided comprehensive details on emergency department visits and injury circumstances.

Variables collected in both groups included age, sex, potential risk factors as preterm birth, low birth weight, gestational disease and medication, family history of neurodevelopmental or psychiatric conditions, number of siblings and respective age, and parents' educational levels. Additional data included ADHD subtypes (combined, inattentive, or hyperactive-impulsive) and comorbidities as well as age of initiation of stimulant medication.

Dependent variables included total number of ED episodes classified as unintentional injuries or accidents and categorized based on national ED classification: personal accidents, falls, school accidents, sports accidents, and assaults. Data on the severity of these episodes were collected as a nominal variable, recording outcomes such as need for splints, hospitalization, surgical procedures (including sutures or tissue adhesives), surgeries, inter-hospital transfers, and the presence of long-term sequelae.

Normality of variables was assessed prior to choosing statistical models. Due to overdispersion, negative binomial regression compared the incidence rate of ED visits between ADHD patients and controls. The IRR determined the relative risk of accidents in ADHD patients compared to controls. ANCOVA assessed the effect of ADHD-types and medication use on accident proportions after age six. Age was a covariate in all comparisons to control for age-related effects. Spearman's rank-order correlation analyzed associations between demographic factors (e.g., parental education, family history) and total accidents, as well as injury severity. Log (age) replaced age in regression models to account for potential non-linear relationships, improving model fit and representing the relationship between age and unintentional injury risk. All analyses were conducted using statistical package for the social sciences (SPSS) 29, with $p<0.05$ as the significance level.

The study was conducted according to the ethical standards of the institutional review board and in line with the principles of the Declaration of Helsinki. No direct contact with participants was required. Patient confidentiality and anonymity were maintained by removing identifying information from the dataset, and access to the medical records was restricted to authorized personnel only.

RESULTS

From a total of 327 patients from the neurodevelopment outpatient department, 11 were excluded due to ADHD diagnosis not definite at that moment, resulting in 316 individuals, exceeding the required sample size. Prevalence of males was greater in both groups (210/316, 66.5%), and mean age was identical (11.9 years, SD=2.4 years). ADHD-group evidenced a higher prevalence of preterm birth (12.9% compared to 2.5%, $p<0.001$). Due to the use of paper-based clinical records in the nursery during earlier years, detailed information for controls was often incomplete. Further sample characteristics are presented in Table 1.

ADHD patients experienced a total of 537 ED visits due to unintentional injuries, compared to 387 episodes in the control group. Although there were no significant age differences between the two groups, the analysis was

adjusted for age by using log(age) to account for potential non-linear effects. This adjustment yielded an incidence rate of 14.36 episodes per 100 person-years in the ADHD group, compared to 10.33 episodes per 100 person-years in the control group, corresponding to an IRR of 1.36 (95% CI: 1.11–1.67; p=0.003). Before 6 years of age, no significant differences were observed in total accidents (p=0.077), personal accidents (p=0.346), school accidents (p=0.718), or sports accidents (p=0.658), with no assaults recorded in this age group. After 6 years of age, differences remained non-significant only for sports accidents (p=0.619) and assaults (p=0.489). Significant findings are presented in Figure 1.

Severity of episodes

Defined severity indicators were compared between groups and no significant differences were found. Detailed results are presented on Table 2.

Table 1: Characteristics of both ADHD cases and control groups.

Characteristics	Cases, n=316	Controls, n=316
Sex assigned at birth, N (%)		
Male	210 (66.5)	210 (66.5)
Female	106 (66.5)	106 (66.5)
Age in years, mean (SD)	11.9 (2.4)	11.9 (2.4)
Premature, n/total available, N (%)	40/309 (12.9)	8/306 (2.5)
Low birth weight, n/total available, N (%)	37/303 (12.2)	Not available
Maternal illness during pregnancy, n/total available, N (%)	47/302 (15.6)	
FH of neurodevelopment/psychiatry disorder, n/total available, N (%)	126/309 (41.4)	
No. of siblings, median (Q1-Q3)	1 (1-2)	
No. of siblings with age gap ≤5 years, median (Q1-Q3)	0 (0-1)	
Proportion of caregivers with ≥10th grade, n/total available (%)		
Both	77/297 (25.9)	
One	78/297 (26.3)	
None	142/297 (47.8)	
ADHD type, N (%)		Non applicable
Inattentive	120 (38.0)	
Hyperactive/impulsive	33 (10.4)	
Combined	160 (50.6)	
Not available	6 (0.9)	

Table 2: Comparison of defined severity indicators between ADHD group and controls.

Severity indicators	Cases, n=316	Controls, n=316	P (Chi-squared test)
Bone cast/splint, N (%)	40 (12.7)	31 (9.8)	0.257
Hospitalization, N (%)	7 (2.2)	7 (2.2)	1.0
Surgical procedure (including suture/biological glue), N (%)	48 (15.2)	50 (15.8)	0.826
Procedure in operating room, N (%)	2 (0.6)	2 (0.6)	1.0
Hospital transfer, N (%)	9 (2.8)	6 (1.9)	0.433
Sequelae, N (%)	0 (0)	1 (0.3)*	0.367

*Complete loss of one tooth.

Subgroup analysis

Additional comparisons within the ADHD group were conducted to examine differences in the total incidence of accidents across various categories of variables.

Children with different ADHD subtypes showed similar accident incidence rates, with no significant differences between groups (p=0.472). The incidence was 12.36 episodes/100 person-years in the inattentive type, 16.35 in the hyperactive type, and 15.40 in the combined type.

Caregiver educational level was significantly associated with increased incidence (IRR=1.38; 95% CI: 1.11–1.73; p=0.004). Children whose caregivers had both ≥10th-grade education had an incidence of 11.09 episodes/100 person-years, whereas those with at least one caregiver with ≤9th-grade schooling had a higher incidence of 15.27 episodes/100 person-years. The presence of neurodevelopmental comorbidities did not significantly influence accident incidence (IRR=1.08; 95% CI: 0.90–1.29; p=0.425). Children with comorbidities had an incidence of 14.98 episodes/100 person-years, similar to the 14.06 observed in those without comorbidities.

Variables	IRR	95% CI (p value)
Total accidents	1.36	1.11-1.67 (p=0.003)
Total accidents ≥6y	1.48	1.16-1.88 (p=0.001)
School accidents ≥6y	1.58	1.15-2.18 (p=0.005)
Personal accidents ≥6y	1.50	1.05-2.15 (p=0.027)
Falls <6y	1.41	1.04-1.92 (p=0.027)
Falls ≥6y	1.60	1.06-2.41 (p=0.024)

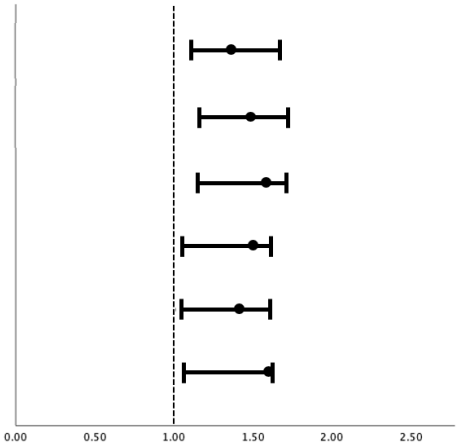

Figure 1: Comparison between ADHD group and controls trough incidence rate ratio for different types of injuries and accidents. Data presented only for types of injuries with statistically significant differences.

Hyperactive ADHD subtype required surgical procedures more often (27.3% versus inattentive 9.2% versus combined 16.9%; p=0.023). Although no differences were observed in the total number of accidents, patients without neurodevelopmental comorbidities were significantly less likely to require surgical procedures (22.6% versus 12.1%, p=0.018) or hospital transfers (6.5% versus 1.3%, p=0.013).

Stimulant use and ED visits

Proportion of accident episodes after beginning stimulant therapy was assessed in the ≥6 years age group. In 257/316 ADHD cases (81.3%), minority of episodes (<50%) occurred after first prescription, with 252/316 (79.7%) presenting no ED visits after first prescription. In a small percentage of patients (41/316, 13.0%), all ED visits occurred after starting pharmacological treatment.

DISCUSSION

In this retrospective cohort study, pediatric patients with ADHD had a higher incidence of unintentional injuries requiring emergency department visits compared with matched controls. This finding reinforces previous evidence linking ADHD with increased accident risk, likely related to impulsivity, inattention, and difficulties following safety rules.[8-10] Our age-stratified findings suggest that differences become more pronounced after six years of age, coinciding with more independence and higher-risk activities, as describe in the literature.[2,11]

Despite this higher incidence, differences in injury severity were not observed when comparing ADHD patients with controls, which aligns with more recent studies.[12,13] However, within the ADHD group, patients without neurodevelopmental comorbidities presented more surgical procedures and inter-hospital transfers. One possible explanation is that children with comorbidities may have more cautious parental supervision, reducing exposure to severe injuries despite similar accident frequency. Lower caregiver educational level was associated with a higher incidence of injuries, consistent with literature linking socioeconomic factors as independent factors with increased injury risk.[14-16] This finding highlights the need to consider family context when designing preventive interventions for ADHD patients, stressing the importance of focused reinforcement of strategies which prevent and mitigate accidents.

Regarding medication, stimulant treatment appeared indirectly protective: most ADHD patients experienced none or only a minority of injury-related ED visits after starting medication. This aligns with prior research showing improved impulse control and risk awareness with pharmacotherapy.[9,17] Nevertheless, the finding that a small subgroup had all injuries after starting medication may reflect other factors, such as poor adherence, more severe ADHD, or increased participation in activities as symptoms improve. Since medication status was assessed retrospectively, inferring causality should be made with caution.

Limitations

This study has limitations inherent to retrospective design, including missing data among controls and reliance on clinical documentation. Additionally, information on environmental factors, injury circumstances, and adherence to medication was unavailable. Nevertheless, the study benefits from a substantial sample, appropriate matching, and comprehensive injury assessment, contributing valuable national data on injury risk in ADHD.

CONCLUSION

In our study, children with ADHD evidenced a higher incidence of unintentional injuries compared with

controls, particularly after school age. ADHD patients without comorbidities show higher rates of procedures and hospital transfer. Lower caregiver education and stimulant therapy patterns seem to influence risk. These findings underscore the importance of targeted preventive guidance and family-centered education in ADHD management to reduce injuries in this vulnerable population.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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