ORIGINAL ARTICLE

Inattention and impulsivity in attention-deficit/hyperactivity disorder (ADHD) and pediatric extremity fractures: an association between neurobehavioral traits and trauma presentation

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ABSTRACT

BACKGROUND: This study aimed to investigate whether the severity of attention-deficit/hyperactivity disorder (ADHD) symptoms, particularly inattention and impulsivity, is associated with extremity fractures in children. Additionally, ADHD symptom scores were compared between surgically and conservatively treated fracture cases, and the relationship between trauma energy level and ADHD symptoms was evaluated.

METHODS: In this cross-sectional study, 160 children aged 7–17 years were evaluated. Participants were divided into three groups: children with surgically treated fractures (n=40), children with conservatively treated fractures (n=40), and fracture-free controls (n=80). ADHD symptoms were assessed using a parent-completed Screening and Assessment Scale based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). Sociodemographic data, trauma mechanisms, and fracture characteristics were also documented.

RESULTS: Children with fractures had significantly higher inattention scores (6.13±3.44 vs. 4.26±2.34; p<0.001), impulsivity scores (6.50±4.70 vs. 4.45±2.10; p=0.001), and total ADHD scores (12.60±6.41 vs. 8.74±3.62; p<0.001) compared with controls. No significant differences were observed between the surgical and conservative treatment groups or between low- and high-energy trauma subgroups. Sociodemographic variables and fracture history among siblings did not differ significantly between the groups.

CONCLUSION: Higher ADHD symptom scores were significantly associated with the occurrence of extremity fractures in children. These findings suggest that assessing ADHD-related symptoms may provide useful insights during pediatric trauma evaluations. However, due to the cross-sectional design, temporality and causality cannot be established. Longitudinal studies are needed to confirm these associations.

Keywords: ADHD; attention-deficit/hyperactivity disorder; behavioral risk factors; impulsivity; inattention; injury prevention; orthopedic injury; pediatric fractures; trauma.

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INTRODUCTION

Children may present with a variety of behavioral disorders, including conduct disorder, attention-deficit/hyperactivity disorder (ADHD), anxiety disorders, and somatic symptom disorders. Among these, ADHD—characterized by difficulties in sustaining attention, excessive activity, and impaired impulse control—has been identified as a potential risk factor for accidental injuries.[1-4] Previous studies have reported that children with fractures exhibit higher rates of behavioral problems and reduced social competence, suggesting that psychosocial factors may contribute to fracture risk and should be considered in injury prevention strategies.[5] According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), ADHD is a neurodevelopmental disorder characterized by persistent patterns of inattention and/or hyperactivity–impulsivity that interfere with academic, social, or occupational functioning. Inattention includes difficulties maintaining focus, following instructions, organizing tasks, resisting distractions, and remembering routine responsibilities.[6] Hyperactivity and impulsivity manifest as excessive movement, difficulty remaining seated, frequent talking, interrupting others, and difficulty waiting for one's turn.[6,7]

A substantial proportion of children and adolescents experience traumatic events, which may lead to significant psychological and developmental consequences.[8] Children with ADHD may be particularly vulnerable to traumatic experiences, likely due to impulsivity and difficulties with self-regulation.[9-12] Previous studies have demonstrated that trauma-exposed children with ADHD often exhibit more severe symptoms and greater externalizing behaviors compared with those without trauma exposure, although these associations may weaken after adjustment for confounding factors.[13] Although children with ADHD may recognize potentially dangerous situations, they often underestimate the severity of the potential consequences of their actions.[12,14] Given the high frequency of trauma exposure in this population, clinicians are encouraged to routinely assess trauma history in children presenting with ADHD. However, existing evidence regarding the prevalence of trauma exposure among individuals with ADHD remains limited and shows considerable variability across studies.[13]

Despite these associations, the direct relationship between ADHD symptom severity and fracture occurrence in children remains insufficiently explored. Therefore, this study aimed to investigate whether ADHD symptom scores—particularly inattention and impulsivity—are associated with the occurrence of extremity fractures in the pediatric population. Additionally, ADHD symptom scores were compared between surgically and conservatively treated pediatric fracture cases, and the potential relationship between trauma energy level and ADHD symptom severity was evaluated.

By examining demographic variables, familial fracture history, and trauma-related characteristics, this study further sought to determine whether ADHD symptomatology may represent an independent risk factor for fractures in children.

MATERIALS AND METHODS

This observational, cross-sectional study was conducted to investigate the association between childhood extremity fractures and attention-deficit/hyperactivity disorder-related symptomatology. This study was approved by the Başakşehir Çam ve Sakura City Hospital Ethics Committee (Date: 15.05.2025, Decision no: KAEK-11/09.04.2025.123), and all procedures were performed in accordance with the Declaration of Helsinki. Written informed consent was obtained from the legal guardians of all participants.

A total of 160 pediatric patients aged 7–17 years who presented to the orthopedics and traumatology outpatient clinic in 2025 were included. Participants were classified into three groups:

Group 1: Children with upper or lower extremity fractures requiring surgical treatment (n=40),

Group 2: Children with comparable fractures managed conservatively (n=40),

Group 3: Age- and sex-matched controls without a history of fractures, presenting with non-traumatic orthopedic complaints (n=80).

Children with chronic systemic or neurological diseases, previously diagnosed psychiatric disorders (including ADHD), those receiving psychotropic medications, or those with comorbid conditions or a history of open fractures were excluded. Therefore, ADHD-related measures in this study reflect parent-reported symptom scores rather than clinician-confirmed diagnoses.

Sociodemographic and clinical data were collected through structured interviews and review of medical records. The following variables were recorded: age, sex, parental age and age at childbirth, number of siblings, personal history of prior fractures, and fracture history among siblings. Trauma-related variables included mechanism of injury (categorized as fall, sports injury, traffic accident, or fall from height), trauma energy level (low-energy: fall or sports injury; high-energy: traffic accident or fall from height), and fracture laterality (right vs. left).

ADHD symptoms were assessed using the first 18 items of the DSM-IV-Based Screening and Assessment Scale for Attention Deficit and Disruptive Behavior Disorders, originally developed by Atilla Turgay[15] and subsequently validated in Turkish by Ercan et al.[16] This instrument evaluates two core dimensions: inattention and hyperactivity-impulsivity. The parent-completed questionnaire consists of two subscales: inattention (9 items) and impulsivity/hyperactivity (9 items). Each item is rated on a 4-point Likert scale. Subscale scores and a total score were calculated, with total scores ranging from 0 to 54.

Table 1. Normality was confirmed, as the skewness and kurtosis values of all variables fell within the acceptable range of −3 to +3

	Skewness	Kurtosis
Age	-0.124	-1.302
Maternal age	-0.046	-0.407
Paternal age	0.093	-0.887
Inattention score	1.055	1.475
Impulsivity score	1.546	2.814
Total ADHD score	1.030	0.933
Maternal age at childbirth	0.208	-0.711
Paternal age at childbirth	0.210	-0.814

Normality was assessed using skewness and kurtosis values. All variables fell within the acceptable range of −3 to +3.

Fracture cases were additionally categorized based on fracture history as either first-time fractures (coded as 1) or recurrent fractures in children with a prior fracture history (coded as 2).

Statistical analysis

An a priori power analysis was conducted using G*Power (version 3.1.9.7) to determine the minimum sample size required to detect a statistically significant difference in ADHD symptom scores between children with fractures and the control group. Assuming a medium effect size (Cohen's d=0.5), a significance level (α) of 0.05, and a statistical power ($1-\beta$) of 0.80 for a two-tailed independent samples t-test, the required minimum sample size was calculated as 64 participants (32 per group). To enhance statistical reliability and account for potential data loss, a total of 160 participants were included: 80 in the fracture group (40 surgical, 40 conservative) and 80 in the control group.

All statistical analyses were performed using IBM SPSS Statistics for Windows (version 26.0; IBM Corp., Armonk, New York, USA). The normality of continuous variables was assessed using skewness and kurtosis values, with values between −3 and +3 considered acceptable (Table 1).[17-19] As all variables fell within the acceptable range of −3 to +3, normal distribution was assumed, and parametric tests were applied. The primary comparison was prespecified as children with fractures (Groups 1 and 2 combined) versus fracture-free controls (Group 3), in accordance with the a priori power calculation. Secondary prespecified analyses included comparisons between surgically and conservatively treated fractures (Group 1 vs. Group 2) and between low- and high-energy trauma subgroups. Continuous variables were analyzed using independent-samples t-tests, while categorical variables were compared using chi-square tests. Subgroup analyses evaluated differences between fracture cases (Groups 1 and 2) and controls (Group 3), between surgical and conservative treatment groups (Group 1 vs. Group 2), and between low- and high-energy trauma within fracture subgroups. Additionally, associations between ADHD scores and both trauma energy level and surgical indication were examined. As these analyses were prespecified and addressed distinct clinical questions, hypothesis testing was limited to the defined contrasts; however, the potential for inflated type I error due to multiple comparisons is acknowledged as a limitation. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 160 pediatric participants were included and categorized into three groups: surgically treated fractures (Group 1, n=40), conservatively treated fractures (Group 2, n=40), and fracture-free controls (Group 3, n=80).

No significant association was observed between sex and group classification (p=1.000). The proportion of males and females were identical in the fracture group (Groups 1 and 2: 72.5% and 27.5%, respectively) and the control group (Group 3). This distribution was intentionally balanced to minimize potential confounding. Similarly, the total number of siblings did not differ significantly between groups (p=0.591). In Groups 1 and 2, the distribution of participants with 1, 2, 3, and ≥4 siblings was 6.3%, 41.3%, 32.5%, and 20.0%, respectively, compared with 5.0%, 45.0%, 37.5%, and 12.5% in Group 3. There was no significant association between group status and a history of fractures in siblings (p=0.738). In Groups 1 and 2, 35.0% of participants had siblings with a history of fracture, compared with 32.5% in Group 3. Likewise, the prevalence of prior fractures in the participants themselves did not differ significantly between groups (p=0.717). In Groups 1 and 2, 23.8% of participants reported a previous fracture, compared with 27.5% in Group 3 (Table 2).

No significant differences were observed in mean age between the fracture group (Groups 1 and 2: 11.7±3.01 years) and the control group (Group 3: 12.5±2.88 years; p=0.088). Similarly, no significant differences were observed between groups in terms of maternal age (Groups 1 and 2: 40.21±6.15 vs. Group 3: 41.03±6.48; p=0.417) or paternal age (Groups 1 and 2: 44.81±6.69 vs. Group 3: 45.35±6.83; p=0.616). No significant differences were observed in maternal age at childbirth between Groups 1 and 2 (28.46±5.18) and Group 3 (28.43±4.98; p=0.963), nor in paternal age at childbirth (Groups 1 and 2: 33.06±5.28 vs. Group 3: 32.75±5.27; p=0.708) (Table 2).

Inattention scores were significantly higher in the fracture group (Groups 1 and 2: 6.13±3.44) compared with the control group (Group 3: 4.26±2.34; p=0.000). Similarly, impulsivity scores were elevated in Groups 1 and 2 (6.50±4.70) compared to Group 3 (4.45±2.10; p=0.001). Total ADHD scores were also significantly higher in Groups 1 and 2 (12.6±6.41) relative to Group 3 (8.74±3.62; p=0.000), indicating a greater overall symptom burden in the fracture group (Table 2, Fig. 1).

No significant association was found between sex and treat-

Table 2. Comparison of categorical and continuous variables, including sociodemographic characteristics and attention-deficit/hyperactivity disorder (ADHD) subscale scores, between the fracture group (Groups 1–2) and the control group (Group 3)

Variable	Groups 1-2	Group 3	Total	
*Chi-square test	n (%)	n (%)	n (%)	p*
Sex				
Male	58 (72.5%)	58 (72.5%)	116 (72.5%)	1.000*
Female	22 (27.5%)	22 (27.5%)	44 (27.5%)	
Number of siblings				
1	5 (6.3%)	4 (5%)	9 (5.6%)	0.591*
2	33 (41.3%)	36 (45%)	69 (43.1%)	
3	26 (32.5%)	30 (37.5%)	56 (35%)	
≥4	16 (20%)	10 (12.5%)	26 (16.3%)	
History of fracture in a sibling				
Yes	28 (35%)	26 (32.5%)	54 (33.8%)	0.738*
No	52 (65%)	54 (67.5%)	106 (66.3%)	
Prior fracture history				
Yes	19 (23.8%)	22 (27.5%)	41 (25.6%)	0.717*
No	61 (76.3%)	58 (72.5%)	119 (74.4%)	
**Independent-samples t test	Mean±SD	Mean±SD	Mean±SD	p**
Age	11.7±3.01	12.5±2.88	12.1±2.96	0.088**
Maternal age	40.21±6.15	41.03±6.48	40.62±6.31	0.417**
Paternal age	44.81±6.69	45.35±6.83	45.08±6.74	0.616**
Maternal age at childbirth	28.46±5.18	28.43±4.98	28.44±5.06	0.963**
Paternal age at childbirth	33.06±5.28	32.75±5.27	32.91±5.26	0.708**
Inattention score	6.13±3.44	4.26±2.34	5.19±3.08	0.001**
Impulsivity score	6.5±4.7	4.45±2.1	5.48±3.77	0.001**
Total score	12.6±6.41	8.74±3.62	10.67±5.54	0.001**

SD: Standard deviation.

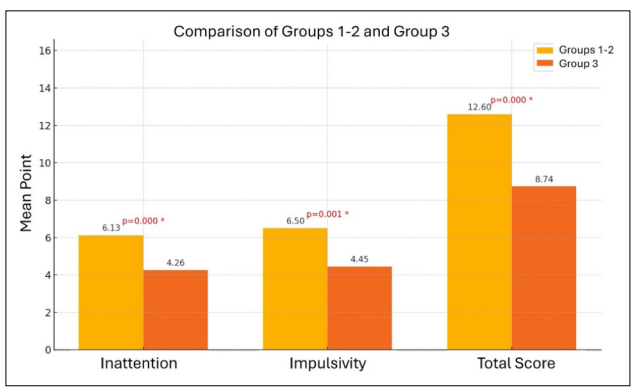

Figure 1. Comparison of inattention, impulsivity, and total attention-deficit/hyperactivity disorder (ADHD) scores between the fracture group (Groups 1 and 2) and the control group (Group 3). Children with fractures had significantly higher mean scores for inattention (p<0.001), impulsivity (p=0.001), and total score (p<0.001) compared with controls. Statistical significance was determined using independent-samples t tests.

ment group (p=0.802). In Group 1, 75% of participants were male and 25% female, compared with 70% male and 30% female in Group 2. The number of siblings did not differ significantly between groups (p=0.715). In Group 1, 7.5% of participants had one sibling, 35% had two, 35% had three, and 22.5% had four or more compared with 5%, 47.5%, 30%, and 17.5% in Group 2, respectively. There were no significant differences between groups in terms of sibling fracture history (p=0.101), reported in 25% of Group 1 and 45% of Group 2. Similarly, prior personal fracture history did not differ significantly (p=0.115). In Group 1, 15% of children had a previous fracture, while 85% did not. In Group 2, 32.5% had a previous fracture and 67.5% did not. The mechanism of trauma did not differ significantly between the groups (p=0.242). In Group 1, falls accounted for 50% of injuries, sports-related injuries for 25%, traffic accidents for 20%, and falls from height for 5%. The corresponding proportions in Group 2 were 57.5%, 30%, 5%, and 7.5%, respectively. Trauma energy levels were also

Table 3. Comparison of demographic, clinical, and trauma-related variables between surgically and conservatively treated pediatric fracture groups

Variable	Groups 1	Group 2	Total	
*Chi-square test	n (%)	n (%)	n (%)	p*
Sex				
Male	30 (75%)	28 (70%)	58 (72.5%)	0.802
Female	10 (25%)	12 (30%)	22 (27.5%)	
Number of siblings				
1	3 (7.5%)	2 (5%)	5 (6.3%)	0.715
2	14 (35%)	19 (47.5%)	33 (41.3%)	
3	14 (35%)	12 (30%)	26 (32.5%)	
≥4	9 (22.5%)	7 (17.5%)	16 (20%)	
History of fracture in a sibling				
Yes	10 (25%)	18 (45%)	28 (35%)	0.101
No	30 (75%)	22 (55%)	52 (65%)	
Prior fracture history				
Yes	6 (15%)	13 (32.5%)	19 (23.8%)	0.115
No	34 (85%)	27 (67.5%)	61 (76.3%)	
Mechanism of trauma				
Fall	20 (50%)	23 (57.5%)	43 (53.8%)	0.242
Sports injury	10 (25%)	12 (30%)	22 (27.5%)	
Traffic accident	8 (20%)	2 (5%)	10 (12.5%)	
Fall from height	2 (5%)	3 (7.5%)	5 (6.3%)	
Trauma energy level				
Low	30 (75%)	34 (85%)	64 (80%)	0.402
High	10 (25%)	6 (15%)	16 (20%)	
Injury side (laterality)				
Right	23 (57.5%)	18 (45%)	41 (51.3%)	0.371
Left	17 (42.5%)	22 (55%)	39 (48.8%)	
**Independent-samples t test	Mean±SD	Mean±SD	Mean±SD	p**
Age	12.08±3.12	11.33±2.88	11.7±3.01	0.268
Maternal age	40.03±5.78	40.4±6.57	40.21±6.15	0.787
Paternal age	44.58±6.71	45.05±6.75	44.81±6.69	0.753
Maternal age at childbirth	27.9±4.89	29.03±5.46	28.46±5.18	0.335
Paternal age at childbirth	32.45±5.57	33.68±4.98	33.06±5.28	0.303
Inattention score	5.9±3.51	6.35±3.39	6.13±3.44	0.562
Impulsivity score	6.73±5.42	6.28±3.91	6.5±4.7	0.672
Total score	12.58±6.99	12.63±5.87	12.6±6.41	0.972

SD: Standard deviation.

similar between the groups (p=0.402). In Group 1, 75% of injuries were low-energy and 25% were high-energy, whereas in Group 2, 85% were low-energy and 15% were high-energy. Laterality of injury showed no significant difference between the groups (p=0.371). In Group 1, 57.5% of fractures occurred on the right side and 42.5% on the left, while in Group 2, 45% were on the right and 55% on the left (Table 3).

There was no statistically significant difference between the groups in terms of age (p=0.268). The mean age in Group 1 was 12.08±3.12 years, compared to 11.33±2.88 years in

Table 4. Comparison of inattention, impulsivity, and total attention-deficit/hyperactivity disorder (ADHD) scores according to trauma energy level in surgically and conservatively treated fracture groups

	Trauma energy level		p*
	Low energy	High energy	
*Independent-samples t test	Mean±SD	Mean±SD	
Groups			
Group 1			
Inattention score	6.07±3.68	5.4±3.1	0.610
Impulsivity score	7.33±5.64	4.9±4.46	0.223
Total score	13.33±7.27	10.3±5.81	0.239
Group 2			
Inattention score	6.03±3.28	8.17±3.76	0.158
Impulsivity score	6.24±4.02	6.5±3.51	0.881
Total score	12.26±5.76	14.67±6.62	0.362
Total			
Inattention score	6.05±3.44	6.44±3.52	0.687
Impulsivity score	6.75±4.84	5.5±4.08	0.345
Total score	12.77±6.48	11.94±6.3	0.647

SD: Standard deviation.

Group 2. Similarly, maternal age did not differ significantly between groups (p=0.787), with a mean of 40.03±5.78 years in Group 1 and 40.40±6.57 years in Group 2. No significant difference was found in paternal age (p=0.753); the mean was 44.58±6.71 years in Group 1 and 45.05±6.75 years in Group 2. The groups also showed no statistically significant difference in maternal age at childbirth (p=0.335), with means of 27.9±4.89 years in Group 1 and 29.03±5.46 years in Group 2. Similarly, paternal age at childbirth was not significantly different between groups (p=0.303), averaging 32.45±5.57 years in Group 1 and 33.68±4.98 years in Group 2 (Table 3).

No statistically significant difference was found between Group 1 and Group 2 in terms of inattention scores (Group 1: 5.90±3.51; Group 2: 6.35±3.39; p=0.562). Similarly, impulsivity scores did not differ significantly between the groups (Group 1: 6.73±5.42; Group 2: 6.28±3.91; p=0.672). Total ADHD scores were also comparable between Group 1 (12.58±6.99) and Group 2 (12.63±5.87), with no significant difference (p=0.972) (Table 3).

There was no statistically significant difference in inattention scores between children with low-energy trauma (6.07±3.68) and those with high-energy trauma (5.40±3.10) in Group 1 (p=0.610). Similarly, impulsivity scores were not significantly different between the low-energy (7.33±5.64) and high-energy (4.90±4.46) subgroups (p=0.223). Total ADHD scores also showed no significant difference (low-energy: 13.33±7.27; high-energy: 10.30±5.81; p=0.239). In Group 2, the inattention score was 6.03±3.28 in the low-energy group and 8.17±3.76 in the high-energy group, with no statistically significant difference (p=0.158). Impulsivity scores were also similar between low- and high-energy subgroups (6.24±4.02 vs. 6.50±3.51; p=0.881). Likewise, total ADHD scores were not significantly different (low-energy: 12.26±5.76; high-energy: 14.67±6.62; p=0.362). When all fracture cases (Groups 1 and 2 combined) were analyzed together, no statistically significant differences were found in inattention scores between low-energy (6.05±3.44) and high-energy (6.44±3.52) trauma (p=0.687). Impulsivity scores were also comparable (6.75±4.84 vs. 5.50±4.08; p=0.345), as were total ADHD scores (12.77±6.48 vs. 11.94±6.30; p=0.647) (Table 4).

DISCUSSION

In this study, children with extremity fractures exhibited significantly higher inattention, impulsivity, and total ADHD scores compared to age- and sex-matched controls without fractures. These differences were statistically significant, suggesting a potential association between ADHD symptomatology and an increased risk of fractures in pediatric populations. However, no significant differences were observed between the surgical and conservative treatment groups in terms of ADHD scores. Similarly, subgroup analyses based on trauma energy levels revealed no statistically significant variations in ADHD symptom scores. Sociodemographic variables, including age, sex, parental age, number of siblings, and fracture history among siblings, did not differ significantly between groups. This suggests that ADHD-related behavioral charac-

teristics, rather than background factors, may play a more prominent role in fracture susceptibility.

These findings are consistent with the growing body of evidence linking ADHD symptomatology to an increased risk of injury. A meta-analysis by Seens et al.[20] reported that children with ADHD are approximately 2.5 times more likely to sustain bone fractures than their peers, with a pooled fracture prevalence of 4.83%. Most fractures occurred in the upper extremities, highlighting the need for targeted prevention strategies.[20] Similarly, Guo et al.,[21] in a nationwide cohort study of over 43,000 Taiwanese children, found a significantly higher fracture incidence in those with ADHD compared to controls (21.0 vs. 15.0 per 1,000 person-years). This increased risk persisted after adjusting for confounding variables such as age, sex, and geographic region, and was observed across all anatomical sites and age groups, with the highest risk seen in lower extremity fractures and in girls over the age of 10. These findings underscore the importance of age- and sex-specific prevention strategies in children with ADHD.[21] Similarly, Prasad et al.,[22] using national health records from England, reported that children with ADHD had a 25% higher risk of fractures compared to those without ADHD, with particularly elevated rates of long bone fractures. These results further emphasize the need for early injury prevention strategies and targeted counseling in this population.

Consistent with our findings, Loder et al.[5] identified increased behavioral difficulties, including impulsivity and hyperactivity, among children with fractures, along with reduced social competence, highlighting the contribution of psychosocial factors to pediatric injury risk. Uslu et al.[1] similarly demonstrated that children with extremity fractures had significantly higher impulsivity-hyperactivity scores compared to those with non-traumatic orthopedic conditions, suggesting that these behavioral traits may predispose children to fractures. Ziv-Baran et al.,[12] in a large-scale cohort study, reported a higher overall fracture incidence in children with ADHD compared to matched controls. The risk was further elevated in cases of recurrent fractures, while pharmacological treatment appeared to reduce this risk, suggesting a potential protective effect of early therapeutic intervention. However, this protective role should be interpreted with caution. Ortiz et al.[23] found that psychostimulant medications, including methylphenidate and mixed amphetamine salts, were associated with delayed bone healing and reduced bone density in children with distal radius fractures. This effect was most pronounced in patients treated for up to five years, although it appeared to diminish with longer treatment durations beyond five years. These findings suggest that, while stimulant medications may reduce injury incidence, they may concurrently impair fracture healing. This dual effect highlights the importance of considering medication history in orthopedic treatment planning and of providing appropriate counseling to families. Additionally, Kaya et al.[10] demonstrated that adult ADHD was more prevalent among patients presenting with trauma—particularly high-energy injuries—compared to those without a trauma history. This finding suggests a lifelong vulnerability to injury in individuals with ADHD, leading the authors to recommend that patients presenting with high-energy trauma be evaluated for ADHD. The association between ADHD symptoms and trauma has also been examined in specific contexts, such as dental injuries. Thikkurissy et al.[11] reported that children with recent dental trauma exhibited significantly higher hyperactivity/impulsivity scores, reinforcing the role of behavioral dysregulation in predisposing individuals to injury.

The impact of trauma exposure in children with ADHD has been further explored by Schilpzand et al.,[13] who identified a higher lifetime prevalence of traumatic experiences in children with ADHD compared to controls. Trauma-exposed children with ADHD also demonstrated greater symptom severity and more externalizing problems; however, these effects diminished after adjusting for confounding variables. Consistent with these findings, Alisic et al.[8] reported that 15.9% of trauma-exposed children developed posttraumatic stress disorder (PTSD), with girls exposed to interpersonal trauma being at the highest risk. This suggests that the relationship between trauma and psychiatric symptoms may be moderated by both gender and trauma type. From a developmental perspective, Lara et al.[9] found that ADHD often persists into adulthood, with symptom severity and the presence of both inattentive and impulsive features predicting long-term persistence. This supports the notion that early behavioral dysregulation not only increases injury risk during childhood but may also contribute to ongoing functional impairments across the lifespan. Martin et al.[24] highlighted that inattentive ADHD symptoms are associated with an increased risk of disordered eating in young adults, mediated by depressive symptoms and impulsivity, thereby illustrating the broader impact of ADHD beyond injury susceptibility.

Our results, showing elevated ADHD scores among injured children, are consistent with those of Brehaut et al.'s[3] population-based study, which reported a significantly higher risk of injuries—including fractures—among children prescribed methylphenidate for behavioral disorders, independent of socioeconomic and demographic variables. Rowe et al.[4] found that ADHD, but not conduct disorder, was significantly associated with unintentional injuries such as fractures, underscoring the unique behavioral risks linked to ADHD symptom profiles. Farmer et al.[14] provided further insight by demonstrating that although children with ADHD can recognize hazards, they often underestimate the severity of potential consequences and lack effective injury-prevention strategies—factors that may explain their increased injury risk despite intact hazard recognition. Byrne et al.[2] reported that while preschoolers with ADHD exhibited significantly more risk-related behaviors than controls, this did not correspond to a higher rate of severe injuries requiring emergency care,

suggesting a possible behavioral threshold at which impulsivity increases the risk of minor injuries without necessarily leading to major trauma. Ibáñez-Tejedor et al.[7] highlighted the influence of modifiable risk factors, such as smoking, in exacerbating ADHD symptoms in university students. Although focused on a different population, their findings reinforce the importance of considering environmental and behavioral contributors to ADHD symptom burden across developmental stages. Taken together, our findings align with a substantial body of literature identifying ADHD—particularly inattention and impulsivity—as significant contributors to pediatric fracture risk. While trauma energy level and treatment modality were not associated with ADHD symptom severity in our cohort, the elevated scores observed among injured children overall highlight the importance of screening for neurobehavioral vulnerabilities in pediatric trauma patients. Multidisciplinary collaboration among orthopedic surgeons, pediatricians, and mental health professionals is essential for early identification and targeted intervention, which may help mitigate future injury risk.

This study has several strengths and limitations. It is among the few to investigate the relationship between ADHD symptom severity and fracture risk in children. It includes a well-matched control group, analyzes both surgical and conservative fracture cases, and incorporates trauma energy levels into its assessment. The use of a validated ADHD symptom scale adds reliability to the findings. However, the cross-sectional design precludes causal inference. ADHD symptoms were assessed solely based on parent-reported questionnaires without clinical confirmation. Specifically, symptoms were measured using a parent-completed DSM-based screening scale rather than a structured clinical interview; therefore, reporting bias and misclassification are possible. Potential confounding factors, such as socioeconomic status and medication use, were not evaluated. Moreover, the control group consisted of children presenting with non-traumatic orthopedic complaints rather than a community-based sample, which may limit representativeness and introduce selection bias related to health-seeking behavior or activity patterns. Although basic sociodemographic characteristics were comparable between groups, multivariable analyses were not performed to adjust for potential confounders. Therefore, the findings should be interpreted as associative and potentially influenced by unmeasured or residual confounding. Although the primary and secondary comparisons were prespecified, the use of multiple planned pairwise tests may still increase the probability of type I error. Lastly, the single-center design and relatively limited sample size (despite power analysis) may restrict generalizability.

CONCLUSION

This study demonstrates a significant association between higher parent-reported ADHD symptom scores—particularly inattention and impulsivity—and the presence of extremity fractures in children. Although ADHD symptom scores did not differ significantly between surgically and conservatively treated fracture cases, children with fractures overall exhibited more behavioral symptoms than peers without fractures. These findings suggest that neurobehavioral factors may be relevant when interpreting pediatric fracture presentations and may help inform clinical history-taking and risk assessment. However, due to the cross-sectional design and reliance on a parent-reported symptom scale rather than a diagnostic evaluation, causal inferences cannot be made. Prospective, longitudinal, and multicenter studies are warranted to confirm these associations, evaluate potential confounders, and clarify underlying mechanisms.

Ethics Committee Approval: This study was approved by the Başakşehir Çam ve Sakura City Hospital Ethics Committee (Date: 15.05.2025, Decision No: KAEK-11/09.04.2025.123).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Dikkat eksikliği ve hiperaktivite bozukluğunda dikkatsizlik ve dürtüselliğin pediatrik ekstremite kırıkları ile ilişkisi: Nörodavranışsal özellikler ile travma arasındaki bağlantı

AMAÇ: Bu çalışmanın amacı, çocuklarda dikkat eksikliği/hiperaktivite bozukluğu (DEHB) semptom şiddetinin, özellikle dikkatsizlik ve dürtüsellik boyutlarının, ekstremite kırıkları ile ilişkili olup olmadığını araştırmaktır. Ayrıca, cerrahi ve konservatif olarak tedavi edilen kırık olguları arasında DEHB skorlarının karşılaştırılması ve travma enerji düzeyi ile DEHB semptomları arasındaki ilişkinin değerlendirilmesi amaçlanmıştır.

GEREÇ VE YÖNTEM: Bu kesitsel çalışmaya 7–17 yaş aralığında toplam 160 çocuk dahil edilmiştir. Katılımcılar üç gruba ayrılmıştır: cerrahi olarak tedavi edilen kırık olguları (n=40), konservatif olarak tedavi edilen kırık olguları (n=40) ve kırık öyküsü olmayan kontrol grubu (n=80). DEHB semptomları, ebeveynler tarafından doldurulan DSM-IV Temelli Tarama ve Değerlendirme Ölçeği kullanılarak değerlendirilmiştir. Sosyodemografik veriler, travma mekanizması ve kırık özellikleri kaydedilmiştir.

BULGULAR: Kırık saptanan çocuklarda, kontrol grubuna kıyasla dikkatsizlik (6.13±3.44'e karşı 4.26±2.34; p<0.001), dürtüsellik (6.50±4.70'e karşı 4.45±2.10; p=0.001) ve toplam DEHB puanlarının (12.60±6.41'e karşı 8.74±3.62; p<0.001) anlamlı derecede daha yüksek olduğu görülmüştür. Cerrahi ve konservatif tedavi grupları arasında ya da düşük ve yüksek enerjili travma alt grupları arasında DEHB skorları açısından anlamlı bir fark saptanmamıştır. Sosyodemografik değişkenler ve kardeşlerde kırık öyküsü açısından gruplar arasında anlamlı fark bulunmamıştır.

SONUÇ: Yüksek DEHB semptom puanlarının, çocuklarda ekstremite kırığı görülme sıklığı ile anlamlı şekilde ilişkili olduğu saptanmıştır. Bu bulgular, pediatrik travma değerlendirmelerinde DEHB ile ilişkili semptomların dikkate alınmasının yararlı olabileceğini düşündürmektedir. Ancak kesitsel tasarım nedeniyle nedensellik kurulamaz; bu ilişkinin yönünü ve olası klinik etkilerini değerlendirmek için ileriye dönük uzunlamasına çalışmalara ihtiyaç vardır.

Anahtar sözcükler: Davranışsal risk faktörleri; dikkat eksikliği ve hiperaktivite bozukluğu; dikkatsizlik; dürtüsellik; ortopedik yaralanmalar; pediatrik kırıklar; travma; yaralanma önleme.

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