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ORIGINAL ARTICLE

The role of psychiatric status on pediatric extremity fractures: a prospective analysis

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Abstract

Purpose The aim of the study was to investigate the relationship between attention deficit and hyperactivity disorder (ADHD), anxiety, and depression with pediatric extremity fractures.

Methods Between November 2014 and November 2016, consecutive 138 patients with pediatric extremity fractures were prospectively investigated in terms of the tendency to anxiety, depression, or ADHD in the study group. Consecutive 168 non-trauma patients who were admitted to general pediatrics outpatient clinic were included the control group. Patients were performed with Turgay DSM-IV-Based Child and Adolescent Behavior Disorders Screening and Rating Scale-Parents Form (T-DSM-IV S), The Screen for Child Anxiety-Related Emotional Disorders (SCARED), and The Children's Depression Inventory (CDI).

Results There were not any significant differences between study and control groups regarding the age, gender distribution, economical level, or previous psychiatric admission rates ($p > 0.05$). In the study group, the previous ADHD history and previous fracture history were significantly higher than the control group ($p < 0.05$). In the study group, the severity of depressive signs and anxiety were significantly higher than the control group ($p = 0.000$ and $p = 0.019$; respectively). Regarding the previous fracture history, conduct disorder and tendency to depression were significantly higher in the study group ($p = 0.001$ and $p = 0.011$; respectively).

Conclusions The signs of ADHD, anxiety, and depression were determined to be higher in children with extremity fractures compared with the non-traumatic population. In patients with especially behavioral problems and depressive signs, directing to the child and adolescent psychiatrists will be protective to prevent re-fractures and high-energy traumas.

Keywords Pediatric extremity fractures · Attention deficit and hyperactivity disorder · Anxiety · Depression

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Introduction

Extremity fractures are one of the most common causes of hospitalizations and surgeries in childhood [1]. Pediatric extremity fractures generally take place due to accidental traumas, non-accidental (child abuse), and sometimes by some other pathological conditions [2]. Fall from high, simple fall, physical fight, motor vehicle accidents or pedestrian injuries, accidents associated with bike riding, and sports and playground activities may be seen among those accidental causes [3]. The association of psychosocial features of children with extremity injuries was investigated in many studies. In children with behavioral disorders, the risk of accidental injuries was reported to be 1.5 times higher than the children without those disorders [4]. In the literature, the psychiatric disease that was the most commonly investigated to be associated with the pediatric extremity fractures is the attention deficit and hyperactivity disorder (ADHD) [5].

ADHD is one of the most common disorders generally seen in school ages, with the impulsiveness, attention deficit, hyperactivity, oppositional disorder, behavioral disorders, or a combination of these symptoms [6]. It may weaken cognitive abilities and/or psychosocial functions. ADHD is a neuro-developmental disorder determined in approximately 3–5% of school-age children or adolescents [7]. Moreover, some basic emotional disorders such as anxiety and depression were also reported in children and adolescents with ADHD [8]. Impulsiveness, attention deficit, and executive dysfunctions are the main factors that may direct the adolescents with ADHD to dangerous behaviors causing injuries. When compared with their peers, the children with ADHD were observed to have a tendency for dangerous behaviors [9]. The children and adolescents with ADHD are more exposed to traumas due to some behavioral features such as anxiety, depressive mood, clumsiness, un-attendance to the game and sports rules, neglecting to take security precautions during activities, and difficulties in their relationships with the peers [10, 11]. In this study, we aimed to investigate the relationship between ADHD, anxiety, and depression with pediatric extremity fractures. Our hypothesis is that extremity fractures and re-fractures take place more commonly in children with anxiety, depression, and attention deficiency/hyperactivity.

Methods

This prospective study was conducted between November 2014 and November 2016 after the approval of local ethical committee (Protocol code—number: 2014/215–2014/15/08). Informed written consent was obtained from the parents or legal representatives of all participants. The patients aged between 6 and 16 years who were admitted to the emergency orthopedics outpatient clinic with extremity fractures were included in the study. Patients with mental retardation, chronic organic diseases, neurological diseases, pervasive developmental disorder, psychotic disorders, and patients younger than 6 years or older than 16 years of age were excluded from the study. Regarding the results of predictive power analysis, with 95% confidence interval and 80% power, it was determined that minimum 109 patients were required in both study and control groups (Power and Precision, Version 2.0; Biostat, Englewood, NJ, USA). In the study group, there were consecutive 138 patients; and in control group, consecutive 168 non-trauma patients who were admitted to general pediatrics outpatient clinic were included. Socio-demographic features of patients and the data about the fractures were recorded in the patient follow-up forms. The screening of the study participants was performed with Turgay DSM-IV-Based Child and Adolescent Behavior Disorders Screening and Rating Scale-Parents Form (T-DSM-IV-S), The Screen for Child Anxiety-Related Emotional Disorders (SCARED), and The Children's Depression Inventory (CDI) [12–14]. To prevent the effects of acute emotional reactions of parents and patients associated with trauma on answers, SCARED, CDI, and T-DSM-IV-S Parents Form were full-filled 2 days after the extremity fractures. The inventories were evaluated by an indipendent child and adolescent psychiatrist. In the study group, the correlation of psychiatric parameters with the economical condition was also evaluated. The economical condition was grouped as low–moderate–high regarding the per capita income in families. The tendency to anxiety, depression, or ADHD was investigated in the study group.

T-DSM-IV-S includes 9 items for attention deficiency, 9 items for hyperactivity/impulsiveness, 8 items for defiant/opposition disorder, and 15 items for behavioral disorders. The severity of each sign in this inventory filled by parents is evaluated according to the four-point Likert-type scale scoring (0 = absent, 1 = a bit, 2 = much, 3 = very much). SCARED is a self-report scale with 41 items evaluating the signs of anxiety disorders in children with 8–18 years of age. The total score of 25 or higher is considered as an alarming condition for anxiety disorders; and the higher the score, the higher the level of general anxiety. CDI is a self-assessment scale performed to investigate the childhood depression in children with 7–17 years of age. It is a scale with 27 items and each item is scored between 0 and 2; the higher the score, the higher the severity of depressive signs. All T-DSM-IV-S, SCARED, and CDI scales have validity and reliability studies in our country [15–17].

Statistical analysis

In descriptive statistics of the data, mean, standard deviation, minimum and maximum, frequency and ratio values were used. The distribution of variables was evaluated with Kolmogorov–Smirnov test. In the analysis of quantitative independent data, Mann–Whitney *U* test was performed. In the analysis of qualitative independent data, Chi-square, and, when Chi-square test conditions were not met, Fischer test were performed. In correlation analysis, Spearman correlation test was used. The analyses were performed with SPSS 22.0 (IBM Corp., Armonk, NY, USA).

Results

There were 138 consecutive patients (28 females and 110 males) in the study group. In control group, there were 168 consecutive non-trauma patients (43 females and 115 males) who were admitted to the social pediatrics department. Demographic features, fracture localization, fractured bone, and the trauma level are summarized in Table 1. There were not any significant differences between study and control groups regarding the age, gender distribution, economical level, or previous psychiatric admission rates ($p > 0.05$). In the study group, the previous ADHD history and previous fracture history were significantly higher than the control group ($p < 0.05$). There was not any substance-alcohol abuse in both groups. In upper extremities, distal radius and ulna and, in lower extremities, tibia were the most commonly fractured bones. The signs of ADHD were more frequent in the trauma patients. In the study group, regarding the T-DSM-IV-S scale, attention deficiency, hyperactivity impulsiveness, oppositional defiant disorder domains, and total score were significantly higher than the control group ($p < 0.05$). In the study group, the scores of SCARED and CDI scales were significantly higher than the control group ($p = 0{,}019$ and $p = 0{,}000$; $p < 0.05$, respectively). The severity of depressive signs and anxiety were significantly higher in the study group. There were not any significant differences in T-DSM-IV-S, SCARED, and CDI scores regarding the localization of fractures ($p > 0.05$) (Table 2). Similarly, there were not any significant differences in T-DSM-IV-S, SCARED, and CDI scale scores regarding the level of trauma ($p > 0.05$). Concerning the previous fracture history, T-DSM-IV-S conduct disorder domain and CDI scores were significantly higher in the study group ($p = 0.001$ and $p = 0.011$; $p < 0.05$, respectively) (Table 3). Patients with re-fracture showed a predisposition for depression and conduct problems. There was not any significant correlation between socioeconomic level and T-DSM-IV-S, SCARED or CDI scale scores ($p > 0.05$) (Table 4).

Discussion

The psychiatric condition that was the most commonly investigated to be associated with pediatric extremity fractures is the ADHD [5, 6]. However, some other mental disorders commonly accompany ADHD. Moreover, it was reported that if other co-morbid mental problems accompany ADHD, injury risk increases [18]. The clinical relevance of the present study is the assessment of the risk of depression, anxiety, and ADHD together in pediatric extremity fractures. In a study of Larson et al., it was reported that the children and adolescents with ADHD carry 7.4 times more risk for anxiety disorders, 8.0 times more risk for depression, 8.7 times more risk for autistic spectrum disorders, and 10.7 times more risk for Tourette syndrome [19]. The children with ADHD also have an increased risk of fractures, burns, and severe trauma forms such as intracranial or visceral injuries compared with the normal population. It was reported that the children with extremity fractures show behavioral problems including conduct disorder, anxiety, psychosomatic complaints, depression, and impulsive–hyperactive behavior [2]. In this study, simple falls (on the run), pedestrian accidents, falls from high, and cycling-related fractures were found to be higher than playground injuries, sports injuries, and fight-related fractures. This condition may explain that the features such as clumsiness, carelessness, indifference, or misevaluation of the risk may cause accidental injuries in children with impulsiveness/hyperactivity behavior. On the other hand, playground injuries, sports injuries, and fight-related fractures may be suggested to be caused by rude and aggressive behaviors which are typical for conduct disorders rather than hyperactivity. This relationship between the trauma mechanism and behavioral pattern is concomitant with the literature. The higher number of males in groups than that of females also overlaps with the observation that ADHD and anxiety are proportionally male-dominated [7, 20].

In a study of Uslu et al., due to the severe traumas, lower extremity fractures were reported to be more common in children with impulsiveness/hyperactivity [2]. In the present study, upper extremity fractures were significantly higher. However, there were not any significant differences regarding ADHD, anxiety, or depression between groups with different trauma severity and fracture localization (upper or lower extremity). In the study group, the re-fracture rate was determined as 38.4%. In patients with the previous fracture history, conduct disorder and depressive symptoms were significantly higher than the patients without a fracture history. Re-fractures were more commonly observed on the wrist (distal radius fractures 18.9%) and forearm (radius and ulna shaft fractures 13.2%). We believe that the main causes of re-fractures were reckless and dangerous physical activity,

Table 1 Descriptive features of the patients

	Study		Control		*p*
	Mean ± SD/*n* (%)	Median	Mean ± SD/*n* (%)	Median	
Age	11.5 ± 2.5	12.0	11.0 ± 2.2	11.0	0.052[m]
Gender					
Female	28 (20.3%)		43 (27.2%)		0.164[χ^2]
Male	110 (79.7%)		115 (72.8%)		
Economic status (Turkish Liras) (Per capita income)	2246 ± 795	2000	2237 ± 1043	2000	0.128[m]
Low (< 1500)	58 (42.1%)		73 (43.3%)		
Medium (1500–3000)	48 (34.8%)		59 (35.2%)		
High (> 3000)	32 (23.1%)		36 (21.5%)		
Previous fracture history	53 (38.4%)		28 (17.7%)		0.000[χ^2]
Previous psychiatric admission	20 (14.5%)		12 (7.1%)		0.057[χ^2]
Previous ADHD history	6 (4.3%)		1 (0.6%)		0.036[χ^2]
Trauma mechanism					
Simple fall	43 (31.2%)				
Pedestrian injury	21 (15.2%)				
Playground injury	29 (21%)				
Sports injury	20 (14.5%)				
Fall from height	15 (10.9%)				
Bicycle injury	9 (6.5%)				
Physical fights	1 (0.7%)				
Fracture localization					
Upper extremity	98 (71%)				
Lower extremity	40 (29%)				
Trauma level					
Low energy	119 (86.2%)				
High energy	19 (13.8%)				
Fractured bone					
Wrist (radius/ulna)	36 (26.1%)				
Tibia/fibula	13 (9.4%)				
Femur	7 (5.1%)				
Forearm (radius/ulna)	19 (13.8%)				
Humerus	15 (10.9%)				
Patella	6 (4.3%)				
Malleolus	6 (4.3%)				
Metatars	4 (2.9%)				
Metacarp	11 (8%)				
Phalanges (hand)	11 (8%)				
Clavicula	6 (4.3%)				
Phalanges (foot)	4 (2.9%)				

[m]Mann–Whitney *U* test

[χ^2]Chi-square test

depressive mood, and uncontrolled behaviors. In addition, patients with the previous fracture history have tendency to depression and conduct problems. In literature, extremity fractures were generally reported to be associated with only impulsiveness/hyperactivity subscale [21]. The relationship between risk of extremity fractures and anxiety, depression, and all domains of ADHD was evaluated in the present study. To the best of our knowledge, there are no prospective studies that previously evaluated depression, anxiety, and ADHD together in pediatric extremity fractures. In our study, all domains of ADHD were significantly higher in the study group. Moreover, the scores of anxiety

Table 2 Evaluation of both groups and fracture localization in terms of psychiatric parameters

	Study		Control		*p*	Fracture localization				*p*
						Upper extremity		Lower extremity		
	Mean ± SD	Median	Mean ± SD	Median		Mean ± SD	Median	Mean ± SD	Median	
T-DSM-IV-S										
Inattention	5.7 ± 6.1	4.0	3.7 ± 3.9	3.0	0.005[m]	5.6 ± 6.0	4.0	6.2 ± 6.6	4.0	0.635[m]
Hyperactivity/impulsivity	6.4 ± 6.0	4.0	3.2 ± 3.4	2.0	0.000[m]	6.7 ± 6.4	4.0	5.1 ± 4.0	4.0	0.665[m]
Oppositional defiant disorder	4.6 ± 4.4	4.0	2.3 ± 2.4	2.0	0.000[m]	4.8 ± 4.7	3.0	4.0 ± 2.8	4.0	0.996[m]
Conduct disorder	1.0 ± 2.5	0.0	0.2 ± 0.6	0.0	0.000[m]	1.0 ± 2.7	0.0	0.8 ± 1.5	0.0	0.393[m]
Total	17.5 ± 15.7	13.0	9.3 ± 8.6	6.0	0.000[m]	17.8 ± 16.4	13.0	16.0 ± 12.1	14.5	0.919[m]
SCARED	23.6 ± 11.4	22.0	20.5 ± 14.3	18.5	0.019[m]	23.8 ± 11.5	22.0	22.1 ± 10.9	18.5	0.457[m]
CDI	8.7 ± 6.0	8.0	6.3 ± 5.4	5.0	0.000[m]	8.6 ± 6.2	8.0	8.8 ± 5.2	7.5	0.670[m]

T-DSM-IV-S Turgay DSM-IV-Based Child and Adolescent Behavior Disorders Screening and Rating Scale-Parents Form, *SCARED* The Screen for Child Anxiety-Related Emotional Disorders, *CDI* The Children's Depression Inventory

[m]Mann–Whitney *U* test

Table 3 Assessment of trauma level and previous fracture history in terms of psychiatric parameters

	Trauma level				p	Previous fracture history				*p*
	Low energy		High energy			Absent		Present		
	Mean ± SD	Median	Mean ± SD	Median		Mean ± SD	Median	Mean ± SD	Median	
T-DSM-IV-S										
Inattention	5.5 ± 6.0	4.0	7.1 ± 6.9	5.0	0.216[m]	5.0 ± 4.6	4.0	6.8 ± 7.9	3.0	0.882[m]
Hyperactivity/impulsivity	6.4 ± 6.2	4.0	6.6 ± 5.2	5.0	0.446[m]	6.1 ± 5.8	4.0	6.8 ± 6.4	4.0	0.602[m]
Oppositional defiant disorder	4.6 ± 4.5	3.0	4.7 ± 3.8	4.0	0.571[m]	4.3 ± 3.8	3.0	5.2 ± 5.3	4.0	0.619[m]
Conduct disorder	1.0 ± 2.6	0.0	0.9 ± 1.7	0.0	0.452[m]	0.6 ± 2.1	0.0	1.6 ± 2.9	0.0	0.001[m]
Total	17.2 ± 16.0	12.5	19.3 ± 13.9	16.0	0.241[m]	15.8 ± 12.5	13.0	20.2 ± 19.5	14.0	0.443[m]
SCARED	23.7 ± 11.4	22.0	23.0 ± 11.9	21.0	0.724[m]	23.3 ± 10.4	21.0	24.1 ± 12.9	23.5	0.998[m]
CDI	8.6 ± 6.1	8.0	9.4 ± 5.4	8.0	0.426[m]	7.7 ± 5.8	7.0	10.1 ± 6.0	9.0	0.011[m]

T-DSM-IV-S Turgay DSM-IV-Based Child and Adolescent Behavior Disorders Screening and Rating Scale-Parents Form, *SCARED* The Screen for Child Anxiety-Related Emotional Disorders, *CDI* The Children's Depression Inventory

[m]Mann–Whitney *U* test

and depression scales were significantly higher in the study group. Another noteworthy finding in the study group was the significantly higher rates of previous ADHD history. In a previous study, it was emphasized that socioeconomic status of the patients should not be ignored [4]. Brault et al. reported that there was a relationship between psychiatric problems with the low-income and low-educational level in children [22]. In another study, a significant correlation was determined between the prevalence of behavioral disorders and anxiety in children and low-social prestige, and low-income and low-educational level [23]. For that reason, we also investigated the relationship between the socioeconomic status of children with psychiatric parameters. However, we did not determine a significant correlation between socioeconomic status and ADHD, anxiety or depression. These findings also support that the tendency for not only ADHD but also for anxiety and depression was higher in children with extremity fractures compared with the control group. There are some limitations of this study. First, the evaluations of children behaviors were depending on the parents' reports. Second, the relationship between pediatric extremity fractures with the anxiety subgroups was not evaluated in anxiety scale. On the other hand, the strengths of the study include evaluation of anxiety and depression together with the ADHD unlike the previous studies, large case number, and prospective design.

In conclusion, the signs of ADHD, anxiety, and depression were higher in children with extremity fractures compared with the non-traumatic population in the present prospective study. Orthopedic surgeons should be aware of the behavioral problems in children and adolescents admitted with extremity fractures. The behavioral pattern of the children may be learned by asking the parents about the presence of some features such as clumsiness, recklessness,

Table 4 Relationship between socioeconomic status and psychiatric parameters of study group

	Socioeconomic status	
	r	*p*
T-DSM-IV-S		
Inattention	−0.041	0.638
Hyperactivity/impulsivity	−0.046	0.595
Oppositional defiant disorder	−0.066	0.445
Conduct disorder	0.044	0.609
Total	−0.082	0.339
SCARED	−0.214	0.052
CDI	−0.083	0.336

T-DSM-IV-S Turgay DSM-IV-Based Child and Adolescent Behavior Disorders Screening and Rating Scale-Parents Form, *SCARED* The Screen for Child Anxiety-Related Emotional Disorders, *CDI* The Children's Depression Inventory

r: Spearman's correlation test ($-1 \leq r \leq 1$; 00-0.19: very weak, 0.20–0.39: weak, 0.40–0.59: moderate, 0.60–0.79: strong, 0.80–1.0: very strong)

carelessness, intolerance, and uncontrollable motion without thought. In patients with especially previous extremity fracture history and behavioral problems and depressive signs, directing to the child and adolescent psychiatrists will be protective to prevent re-fractures and high-energy traumas.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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