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ORIGINAL ARTICLE
ORİJİNAL ARAŞTIRMA

Patterns and Trends of Traumatic Fractures in Children and Adolescents Due to Falls: A 10-Year Study in Turkey

Çocuk ve Ergenlerde Düşmeye Bağlı Travmatik Kırık Örüntüleri ve Eğilimleri: Türkiye'de 10 Yıllık Bir Çalışma

Emine Özdemir Kaçer[1], İlker Kaçer[2]

[1]Department of Pediatrics, Faculty of Medicine, Aksaray University, Aksaray, Turkey
[2]Department of Emergency Medicine, Aksaray Education and Training Hospital, Aksaray, Turkey

ABSTRACT

Aim: Falls are the leading cause of hospitalization and emergency department visits due to trauma in children aged 0 to 18 years. The aim of this study is to investigate the incidence and pattern of traumatic fractures (TFs) as a result of falls in a population of children and adolescents in Turkiye.

Material and Method: A retrospective review of medical records yielded data on 1417 patients with fractures due to falls.

Results: The male-female ratio was 2.9:1, with upper extremity fractures (57.6%) being most frequent, followed by lower extremity (27.3%) and craniofacial fractures (16.5%). High falls correlated with increased incidences of spinal, lower extremity, and craniofacial fractures, while low falls were associated with more upper extremity fractures. Notably, spine fractures prevailed in adolescents (15-18 years), and craniofacial fractures dominated in young children (≤3 years). Distinct gender differences emerged in fracture distribution. The study highlighted seasonal and temporal trends, with peak incidence in the fall and between 16:00 and 20:00. Nerve injuries were documented in 16.4% of cases, often linked to high-impact falls, spinal, and craniofacial fractures. Early complications/associated injuries (ASOIs) were found in 19.5%, while late complications/ASOIs occurred in 9.2% of cases.

Conclusion: Falls from high correlated with a higher frequency of early complications/ASOIs. To mitigate the impact of fall-related fractures, preventative measures, targeted interventions, and education are vital. Recognizing risk factors and designing strategies tailored to different age groups and genders can improve patient outcomes.

Keywords: Complications, falls, pediatric emergency, prevention strategies, traumatic fractures.

ÖZ

Amaç: Düşmeler, 0-18 yaş arası çocuklarda travma nedeniyle hastaneye yatış ve acil servis ziyaretlerinin önde gelen nedenidir. Bu çalışmanın amacı, Türkiye'deki çocuk ve ergen popülasyonunda düşme sonucu oluşan travmatik kırıkların (TF) insidansını ve paternini araştırmaktır.

Gereç ve Yöntem: Tıbbi kayıtların retrospektif olarak incelenmesi sonucunda düşmeye bağlı kırığı olan 1417 hastaya ait veriler elde edildi.

Bulgular: Erkek-kadın oranı 2,9:1 olup, en sık üst ekstremite kırıkları (%57,6) görülürken, bunu alt ekstremite (%27,3) ve kraniyofasiyal kırıklar (%16,5) izlemiştir. Yüksek oranda düşme omurga, alt ekstremite ve kraniyofasiyal kırık insidansında artışla ilişkiliyken, düşük oranda düşme daha fazla üst ekstremite kırığı ile ilişkilendirilmiştir. Özellikle, omurga kırıkları ergenlerde (15-18 yaş), kraniyofasiyal kırıklar ise küçük çocuklarda (≤3 yaş) baskındı. Kırık dağılımında belirgin cinsiyet farklılıkları ortaya çıkmıştır. Çalışma, sonbaharda ve saat 16:00 ile 20:00 arasında en yüksek insidans ile mevsimsel ve zamansal eğilimleri vurgulamıştır. Sinir yaralanmaları vakaların %16,4'ünde belgelenmiştir ve genellikle yüksek darbeli düşmeler, omurga ve kraniyofasiyal kırıklarla bağlantılıdır. Erken komplikasyonlar/ilişkili yaralanmalar (ASOI) vakaların %19,5'inde, geç komplikasyonlar/ASOI'ler ise %9,2'sinde görülmüştür.

Sonuç: Yüksekten düşmeler daha yüksek erken komplikasyon/ASOI sıklığı ile ilişkilidir. Düşmeye bağlı kırıkların etkisini azaltmak için önleyici tedbirler, hedefe yönelik müdahaleler ve eğitim hayati önem taşımaktadır. Risk faktörlerini tanımak ve farklı yaş gruplarına ve cinsiyetlere göre uyarlanmış stratejiler tasarlamak hasta sonuçlarını iyileştirebilir.

Anahtar Kelimeler: Komplikasyonlar, düşmeler, pediatrik acil, önleme stratejileri, travmatik kırıklar.

Corresponding Author: Emine Özdemir Kaçer
Address: Aksaray Eğitim ve Araştırma Hastanesi Aksaray/Turkey. 68200
E-mail: dremineozdemir@hotmail.com

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INTRODUCTION

Falls are the leading cause of hospitalization and emergency department visits due to trauma in children aged 0 to 18 years (1, 2). In less developed countries, falls account for 25% to 52% of all injuries resulting in hospitalization in children (3). The impact of falls on children is significant, including fractures, permanent neurological damage, death, and significant cognitive and physical disability that lasts a lifetime (4, 5). Among pediatric injuries, fractures are common, accounting for 10% to 25% of cases. 17,18) While some studies suggest an increasing incidence of pediatric fractures in specific anatomic locations (5, 6) comprehensive population-level data on the overall trends and patterns of traumatic fractures (TFs) from falls in youth are lacking.

Although fractures from falls represent a small proportion of childhood injuries, many of these events can be prevented by environmental modifications and increased educational efforts. We believe that changes in incidence may be partly due to children's activity habits. Further study of this issue may reveal preventive measures to reduce the incidence of fall-related traumatic brain injury (TBI). Thus, understanding the patterns and trends underlying fall-related TBIs and correlated nerve injuries is of immense importance for prevention and education. In the present study, we conducted an investigation of a multi-center database that included cases of falls in children and adolescents aged ≤18 years over a 10-year period from 2013 to 2023 in Turkey. Incidence and models were succinctly outlined, taking into account different age groups, years of admission, causative factors, gender, and neurological functionalities. This endeavor provides enlightening insights into the crucial public health dilemma facing the youth of Turkey.

MATERIAL AND METHOD

Study population

We conducted a retrospective review of 2602 children and adolescents (≤18 years) diagnosed with fractures between January 2013 and January 2023 and admitted to our university-affiliated medical center. Within this group, 1417 patients sustained TFs due to falls (shown in **Figure 1**). Our study included all adolescents and young adults admitted to the hospital for TFs; however, patients treated as outpatients in the emergency department were excluded due to the lack of electronic medical records for such cases. Our research cohort consisted of transfers from other medical facilities and included a diverse group of patients. This study was conducted in Aksaray, a city in the Central Anatolian region of Turkey.

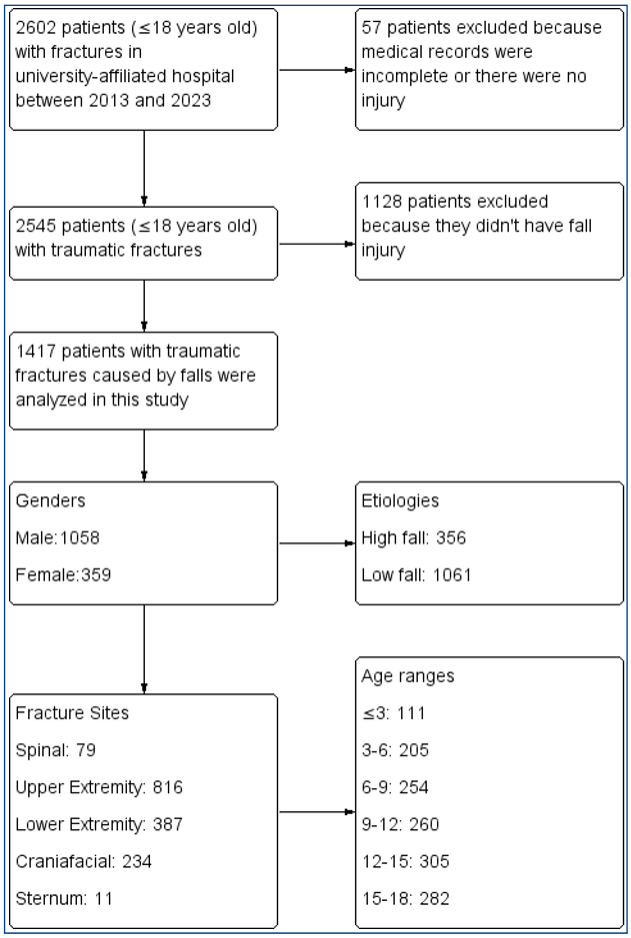

Figure 1. Study flow diagram

Data were obtained from the medical facility affiliated with the tertiary medical faculty hospital. We methodically searched the identification numbers of all patients (aged ≤18 years) with documented fractures in the medical record system. Subsequently, two independent physicians not involved in patient care meticulously reviewed the medical records. From these identification numbers, information was extracted that included cause, sex, age, American Spinal Cord Injury Association (ASIA) score, fracture location, and nerve injury. Definitive diagnoses of TFs were made by diagnostic means such as radiography, computed tomography (CT), and magnetic resonance imaging (MRI).

Fracture causes were categorized as high falls (falls from a height ≥ 2 meters) and low falls (falls from a height < 2 meters). The ASIA grading scale was used to assess spinal cord injury. TBIs were further subdivided into closed craniocerebral injuries (CCIs) and open craniocerebral injuries (OCIs), which include conditions such as concussion, cerebral contusion and laceration, and brainstem injury. The term "multiple fractures" refers to fractures that occur in more than one anatomic region, including the spine, upper and lower extremities, craniofacial region, and sternum/rib.

The study was approved by Aksaray University Clinical Research Ethics Committee and followed the guidelines of the Declaration of Helsinki (Institutional Review Board number: 2021/16-10).

Statistical analysis

All statistical analyses were performed with SPSS version 22.0 (SPSS, Inc., Chicago, IL). Pearson $\chi 2$ tests were performed to evaluate differences in age, sex distribution, and clinical characteristics between the 2 groups. The continuous variables, such as current age, were expressed as mean ± standard deviation (SD), and differences between the 2 groups were evaluated by independent samples t-test because the data were normally distributed. The type I error rate was set at 5% throughout the study, and $p<0.05$ was considered significant.

RESULTS

Demographic and general characteristics

A total of 1417 patients were included in the study, of which 1058 were male and 359 were female. The mean age of the participants was 10.9 ± 4.6 years, resulting in a male to female ratio of 2.9:1. Of the cases studied, the vast majority (1061 cases, 75.0%) were due to low falls, while the remaining 356 cases (25.0%) were due to high falls. The cumulative number of fractures was 2081, with 95 patients (6.7%) presenting with multiple fractures. Notably, upper extremity fractures were the most common, occurring in 816 patients (57.6%). This was followed by lower extremity fractures in 387 patients (27.3%) and craniofacial fractures in 234 patients (16.5%).

Among the upper extremity fractures, humeral fractures were observed in 417 cases (29.4%), followed by radial fractures in 277 cases (19.5%), ulnar fractures in 231 cases (16.3%), clavicle fractures in 70 cases (4.9%), metacarpal fractures in 16 cases (1.1%), and phalangeal fractures in 7 cases (0.4%). Lower extremity fractures included femoral fractures in 178 cases (12.5%), tibial fractures in 137 cases (9.6%), fibular fractures in 71 cases (5%), calcaneal fractures in 29 cases (2.0%), pelvic fractures in 21 cases (1.4%), patellar fractures in 20 cases (1.4%), and talar fractures in 11 cases (0.7%).

For patients with craniofacial fractures, the distribution was as follows: parietal fractures in 53 cases (3.7%), temporal fractures in 51 cases (3.6%), occipital fractures in 49 cases (3.4%), basilar skull fractures in 41 cases (2.8%), and frontal fractures in 33 cases (2.3%). Mandible fractures were observed in 47 cases (3.3%), nasal fractures in 16 cases (1.1%), maxillary fractures in 11 cases (0.7%), orbital fractures in 10 cases (0.7%), and zygomatic fractures in 7 cases (0.5%).

A total of 233 patients, or 16.4% of the cohort, experienced nerve injury. Of those with nerve injury, brain injury was documented in 139 cases (9.8%), spinal cord injury in 27 cases (1.9%), cranial nerve injury in 9 cases (0.6%), and spinal nerve injury in 68 cases (4.7%). In addition, a subset of 277 patients (19.5%) experienced early complications/associated injuries (ECOIs/ASOIs) and 131 patients (9.2%) experienced late complications/associated injuries (LCOIs/ASOIs). The category of early complications/associated injuries included nerve injury (n=233), hemorrhagic shock (n=9), lung injury (n=29), splenic injury (n=6), osteofascial compartment syndrome (n=5), renal injury (n=7), retroperitoneal hematoma (n=8), liver injury (n=7), and cardiac injury (n=1). Conversely, late complications/associated injuries included infections (n=37), pressure ulcers (n=2), fracture malunions (n=79), fracture nonunions (n=12), traumatic arthritis (n=1), myositis ossificans (n=5), and death (n=4).

The incidence of events showed subtle seasonal variations and a discernible temporal trend characterized by peaks during the autumn season (28.7%) and between 16:00 and 20:00 (33%). In terms of seasonal distribution, the fall period represented 28.7%, followed by summer with 27.6%, spring with 23.5% and winter with 20.2%. In terms of distribution throughout the day, the 16:00 to 20:00 period accounted for 33%, followed by 12:00 to 16:00 at 30.1%, 08:00 to 12:00 at 19.2%, 20:00 to 24:00 at 10.3%, while other time periods together accounted for 7.4% (see **Figures 2** and **3**).

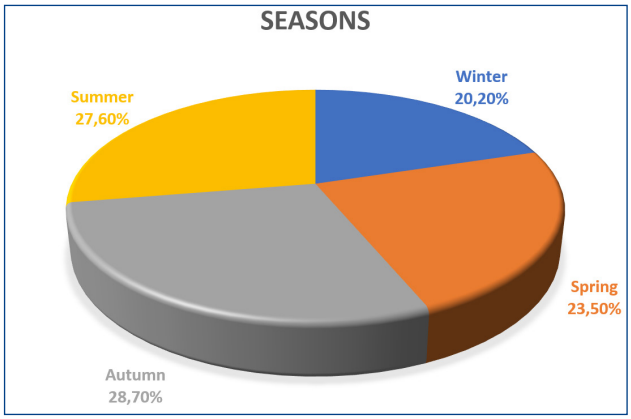

Figure 2. Season distribution.

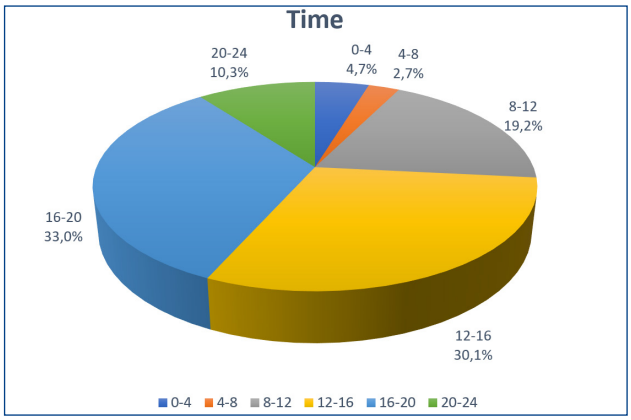

Figure 3. Time distribution.

Characteristics respect to different age groups

The age group 12 to 15 years was the most common with 305 cases (21.5% of the total patient population). Interestingly, this age group also had the highest sex ratio of 4.9. Conversely, the age group 4-6 years had the lowest sex ratio of 1.8. The highest frequency of emergency admissions was found in the age group ≤3 years (45%), while the lowest frequency was found in the age group 3-6 years (37.5%). In terms of health insurance coverage, the lowest prevalence (36%) was found in the age group ≤3 years, while the highest prevalence (52.8%) was found in the age group 13-15 years.

Notably, the prevalence of spine fractures showed a significant escalation within the 15-18 year age group (n=47, 16.6%) compared to the other age groups (all $p < 0.001$). Upper extremity fractures showed a significantly higher frequency in the 6-9 year age group (n=179, 70.4%) compared to the other groups (all $p < 0.05$), except for the 9-12 year age group. On the other hand, the frequency of lower extremity fractures showed a notable increase in the 15-18 year age group (n=122, 43.2%) compared to the other groups (all $p < 0.001$), except for the 12-15 year age group. Regarding craniofacial fractures, they were significantly more frequent in the age group ≤3 years (n=48, 43.2%) compared to the other groups (all $p < 0.01$) (see **Table 1**).

Characteristics respect to different year of admission, etiologies, and gender

The collective annual incidence of fractures in children and adolescents was (1315.7 ± 598.3) cases per 1,000,000 hospital admissions over a 2-year period. Remarkably, the annual incidence rates showed an exponential increase with the progression of admission years, rising from 322.2 to 1475.2 cases per 1,000,000 hospital admissions over a 2-year interval. Consistent with this trajectory, the proportion of emergency admissions rose steadily from 25.6% to 41.3% with each subsequent year of admission. Correspondingly, the prevalence of medical insurance among patients increased significantly from 25.6% to 66.9% ($p < 0.001$) over the duration of admission (see **Table 2**).

Table 1. Characteristics of patients' resulting from falls according to different age range groups.

Age range, y	≤3	3–6	6–9	9–12	12–15	15–18	Total
Total	111	205	254	260	305	282	1417
Male/Female (sex ratio)	74/37 (2.0)	132/73 (1.8)	187/67 (2.8)	191/69 (2.8)	253/52 (4.9)	221/61 (3.6)	1058/359 (2.9)
Emergency admission rate	50 (45)	77 (37.5)	98 (38.5)	110 (42.3)	116 (38)	111 (39.3)	562 (39.6)
Medical insurance rate	40 (36)	85 (41.4)	125 (49.2)	131 (50.3)	161 (52.8)	138 (48.9)	680 (47.9)
Etiologies							
High fall (≥2 m)	33 (29.8)	62 (30)	57 (22.4)	48 (18.5)	62 (20.3)	94 (33)	356 (25.0)
Low fall (<2 m)	78 (70.2)	143 (70)	197 (77.6)	212 (81.5)	243 (79.7)	188 (67)	1061 (75.0)
Nerve injury	17 (15.3)	34 (16.5)	49 (19.2)	37 (14.2)	42 (13.7)	54 (19.1)	233 (16.4)
Fracture sites							
Spinal fracture	0	4 (1.9)	3 (1.1)	6 (2.3)	18 (5.9)	47 (16.6)	78 (5.5)
Upper limbs fractures	47 (42.3)	122 (59.5)	179 (70.4)	175 (67.3)	154 (50.4)	139 (49.6)	816 (57.6)
Lower limbs fractures	18 (16.2)	37 (18.0)	39 (15.3)	49 (18.8)	122 (40.0)	122 (43.2)	387 (27.3)
Craniofacial fracture	48 (43.2)	57 (27.8)	42 (16.5)	39 (15.0)	31 (10.1)	17 (6.0)	234 (16.5)
Sternum and rib	0	0	1 (0.4)	2 (0.8)	4 (1.3)	3 (1.1)	10 (0.7)
Early complications/ASOIs	22 (19.8)	45 (21.9)	57 (22.4)	41 (15.7)	51 (16.7)	61 (21.6)	277 (19.5)
Late complications/ASOIs	6 (5.4)	19 (9.2)	28 (11.0)	19 (7.3)	33 (10.8)	26 (9.2)	131 (9.2)

ASOIs = associated injuries.

Table 2. Characteristics of patients' resulting from falls according to different year of admission.

Year of admission	2013-2014	2015-2016	2017-2018	2019-2020	2021-2022	Total
Total	39	184	313	419	461	1417
Male/Female (sex ratio)	24/15 (1.6)	143/41 (3.5)	233/80 (2.9)	305/114 (2.7)	351/110 (3.2)	1058/359 (2.9)
Emergency admission rate	10 (25.6)	69 (37.5)	129 (41.2)	164 (39.1)	190 (41.3)	562 (39.6)
Medical insurance rate	10 (25.6)	51 (27.7)	109 (34.8)	210 (50.1)	308 (66.8)	688 (48.5)
Etiologies						
High fall (≥2 m)	7 (17.9)	46 (25.0)	74 (23.6)	117 (27.9)	112 (24.2)	356 (25.0)
Low fall (<2 m)	32 (82.0)	138 (75.0)	239 (76.3)	302 (72.0)	350 (75.9)	1061 (75.0)
Nerve injury	1 (2.6)	31 (16.8)	43 (13.7)	85 (20.2)	73 (15.8)	233 (16.4)
Fracture sites						
Spinal fracture	0	13 (7.0)	17 (5.4)	26 (6.2)	22 (4.7)	78 (5.5)
Upper limbs fractures	26 (66.6)	111 (60.3)	175 (55.9)	234 (55.8)	270 (58.5)	816 (57.6)
Lower limbs fractures	14 (35.8)	46 (25.0)	79 (25.2)	107 (25.5)	141 (30.5)	387 (27.3)
Craniofacial fracture	0	23 (12.5)	59 (18.8)	79 (18.8)	73 (15.8)	234 (16.5)
Sternum and rib	0	0	1 (0.3)	3 (0.7)	6 (1.3)	10 (0.7)
Early complications/ASOIs	1 (2.5)	38 (20.6)	54 (17.2)	99 (23.6)	85 (18.4)	277 (19.5)
Late complications/ASOIs	5 (12.8)	20 (10.8)	34 (10.8)	31 (7.4)	41 (8.9)	131 (9.2)
Mean age	8.7 ± 3.1	10.7 ± 4.6	10.3 ± 4.7	10.8 ± 4.8	11.3 ± 4.6	10.7 ± 4.7

ASOIs = associated injuries.

Comparing high fall cases with low fall cases, the frequencies of emergency admissions, nerve injury, spinal fractures, lower extremity fractures, craniofacial fractures, sternum, and rib fractures, and early complications/ASOIs were all significantly increased in the high fall category (all $p < 0.001$). Conversely, the frequencies of medical insurance ($p=0.043$) and upper extremity fractures ($p < 0.001$) were significantly higher in low falls (see **Table 3**).

Regarding gender differences, female patients had significantly higher incidences of spinal fractures ($p=0.039$), lower extremity fractures ($p=0.047$), and craniofacial fractures ($p=0.042$) compared to their male counterparts. Conversely, male patients had a significantly higher incidence of upper extremity fractures ($p < 0.001$) and a higher mean age ($p < 0.001$) compared to female patients (see **Table 4**).

Table 4. Characteristics of patients' resulting from falls according to different genders.

Genders	Male	Female	p	t
Total (%)	1058 (74.6)	359 (25.4)	<.001	684.171
Emergency admission rate	415 (39.2)	147 (40.9)	.531	0.392
Medical insurance rate	503 (47.5)	185 (51.5)	.090	2.718
Etiologies				
High fall (≥2 m)	253 (23.9)	103 (28.6)	.090	2.456
Low fall (<2 m)	804 (75.9)	257 (71.5)		
Nerve injury	173 (16.5)	60 (16.5)	1.000	0.000
Fracture sites				
Spinal fracture	50 (4.7)	28 (7.7)	.039	4.278
Upper limbs fractures	645 (61.0)	171 (47.6)	<.001	19.734
Lower limbs fractures	273 (25.8)	114 (31.7)	.047	3.922
Craniofacial fracture	161 (15.2)	73 (20.3)	.042	4.193
Sternum and rib	6 (0.6)	4 (1.1)	.285	1.141
Early complications/ASOIs	198 (18.7)	79 (22.0)	.230	1.443
Late complications/ASOIs	99 (9.4)	32 (8.9)	.757	0.095
Mean age	11.1 ± 4.6	9.8 ± 4.8	<.001	4.592

ASOIs = associated injuries.

Patients with nerve injury had a significantly increased frequency of emergency admissions, high falls, spinal fractures, and craniofacial fractures compared to patients without nerve injury (all $p < 0.001$) (see **Table 5**).

Table 5. Characteristics of patients' resulting from falls according to nerve injury.

With or without nerve injury	With	Without	p	t
Total (%)	233 (16.4)	1184 (83.6)	<.001	1275.639
Male/Female (sex ratio)	173/60 (2.9)	883/301 (2.9)	1.000	0.000
Mean age	10.9 ± 4.9	10.7 ± 4.7	.602	0.522
Age range, year				
≤3	17 (7.3)	94 (7.9)	.447	4.753
3-6	34 (14.5)	171 (14.5)		
6–9	49 (21.0)	205 (17.3)		
9–12	37 (15.8)	223 (18.8)		
12–15	44 (18.8)	261 (22.0)		
15–18	53 (22.7)	229 (19.3)		
Emergency admission rate	117 (50.2)	445 (37.5)	<.001	13.028
Medical insurance rate	109 (46.7)	579 (48.9)	.660	0.193
Etiologies				
High fall (≥2 m)	132 (56.6)	224 (18.9)	<.001	142.107
Low fall (<2 m)	102 (43.7)	959 (80.9)		
Fracture sites				
Spinal fracture	37 (15.8)	41 (3.5)	<.001	51.280
Upper limbs fractures	91 (39.0)	725 (61.2)	<.001	38.595
Lower limbs fractures	43 (18.4)	344 (29.0)	.001	11.721
Craniofacial fracture	110 (47.2)	124 (10.5)	<.001	186.077
Sternum and rib	4 (1.7)	6 (0.5)	.110	2.557
Early complications/ASOIs	233 (100.0)	44 (3.7)	<.001	1135.760
Late complications/ASOIs	16 (6.9)	115 (9.7)	.235	1.407
Season				
Spring (2–4)	59 (25.3)	275 (23.2)	.888	0.637
Summer (5–7)	61 (26.2)	325 (27.5)		
Autumn (8–10)	68 (29.2)	335 (28.3)		
Winter (11–1)	45 (19.3)	249 (21.0)		

ASOIs = associated injuries.

Table 3. Characteristics of patients' resulting from falls according to different etiologies.

Etiologies	High fall	Low fall	p	t
Total (%)	356 (25.0)	1061 (75.0)	<.001	704.000
Male/Female (sex ratio)	256/103 (2.5)	803/255 (3.1)	.09	2.874
Emergency admission rate	177 (49.8)	385 (36.2)	<.001	20.799
Medical insurance rate	154 (43.5)	534 (50.2)	.043	4.116
Nerve injury	131 (36.5)	102 (9.5)	<.001	142.107
Fracture sites				
Spinal fracture	57 (16.2)	21 (2.0)	<.001	99.080
Upper limbs fractures	107 (30.0)	709 (66.8)	<.001	145.563
Lower limbs fractures	142 (39.6)	245 (22.9)	<.001	36.574
Craniofacial fracture	133 (37.6)	101 (9.5)	<.001	151.132
Sternum and rib	8 (2.2)	2 (0.2)	<.001	16.248
Early complications/ASOIs	153 (42.9)	124 (11.6)	<.001	164.921
Late complications/ASOIs	26 (7.3)	105 (9.8)	.202	1.627
Mean age	10.9 ± 5.4	10.7 ± 4.6	.735	0.339

ASOIs = associated injuries.

DISCUSSION

Turkey is rapidly becoming an emerging economy with significant growth. Located in the heart of Anatolia, Aksaray is home to a population of 436,904 in 2022, with a rural population of 26.7%. Benefiting from its strategic location, encompassing both the western region and adjacent rural communities in the east, and being the only tertiary hospital in our province, we note that our study population potentially reflects a representative urban-rural milieu within Turkey. The prevalence of fractures in children and adolescents is a widespread concern, with a significantly higher prevalence in males, as indicated by the sex ratio of 2.9 in our study, a trend consistent with previously published data (7). It's worth noting that male incidence rates show a later peak compared to their female counterparts, a pattern consistent with previous research findings (8).

Among our findings, the 15-18 year age group had the highest incidence of spine fractures and complications/associated injuries. The intricate interplay between extrinsic and intrinsic factors, which vary between age groups, contributes to the underlying reasons for fractures (6). Our observations also reveal slight seasonal variations and a clear temporal trend, with peak incidence occurring in the fall (28.7%) and between the ages of 16 and 20 (33%). This temporal pattern is partially consistent with previous studies (9). It's noteworthy that the pattern of traumatic fractures in children and adolescents is influenced to some extent by their activity habits and temporal events, such as rush hour and school dismissal times. In addition, the incidence of fall-related fractures increases with age, with an increased prevalence of injuries during the fall and summer months. Although fall fractures represent a minority of pediatric injuries, they can have serious consequences, including death. However, many such incidents can be prevented through environmental modifications and increased education, including public awareness campaigns and caregiver training. In addition, consideration of legislative strategies that have proven effective in other urban centers and regions is critical to reducing these risks (8, 10, 11).

The predominant fracture sites were upper extremity fractures (57.6%) and lower extremity fractures (27.3%), followed by craniofacial fractures (16.5%). This is consistent with a previous study in which the majority of fractures (73%) involved the upper and lower extremities (22%) (12). Forearm fractures, which were frequently observed, often emerged as the predominant diagnosis (13). However, it's important to note that these studies included fractures from a variety of causes, not just falls. In particular, high falls were significantly associated with increased frequencies of the spine, lower extremity, and craniofacial fractures compared with low falls. In contrast, upper extremity fractures were more common in low falls. This means that spine, lower extremity, and craniofacial fractures are more likely to occur in high falls, where the impact is substantial, while upper extremity fractures are more likely to occur in low falls, where individuals often use their hands to mitigate the impact of the fall.

In our study, the number of patients with traumatic fractures increased with age, ranging from 110 to 282 cases. The incidence of spine fractures in 15-18 year olds and craniofacial fractures in ≤3 year olds significantly exceeded other age groups. This underscores the importance of focusing on spine fractures in adolescents and craniofacial fractures in young children when seeking medical attention. In addition, female patients had an increased incidence of spine, lower extremity, and craniofacial fractures, while male patients had an increased incidence of upper extremity fractures and an older mean age. The distinct fracture patterns observed in relation to different etiologies, age groups, and sexes underscore the need for targeted intervention strategies aimed at reducing the incidence and consequences of falls. By tailoring interventions to these specific characteristics, it will be possible to better address the unique risks and vulnerabilities associated with fall-related fractures.

In our study cohort, nerve injury, early complications/associated injuries (ASOIs), and late complications/ASOIs were observed at rates of 16.4%, 19.5%, and 9.2%, respectively. The age groups 6 to 9 years and 15 to 18 years had the highest rates of nerve injury at 19.1% and 18.7%, respectively. Specifically, patients with nerve injuries were more likely to have higher rates of emergency department visits, a higher likelihood of experiencing high-impact falls, and an increased prevalence of spinal and craniofacial fractures compared to patients without nerve injuries. Because falls can lead to serious outcomes, including fractures, permanent neurological impairment, and even mortality, focusing on risk factors such as high-impact falls, spinal fractures and craniofacial fractures is paramount. Preventive measures and educational interventions are critical to mitigating the disabilities children may experience as a result of such injuries.

Among early complications/ASOIs, nerve injury was the most common (16.4%), followed by lung injury (2.0%). The most common late complications were fracture malunion (5.5%) and infection (2.6%). The incidence of early complications/ASOIs was significantly higher in high falls compared to low falls. Prompt recognition and management of uncontrolled hemorrhagic shock, timely treatment of pulmonary contusions, and careful prevention and management of infections are all critical facets of the care of children and adolescents with traumatic fractures. Together, these measures contribute to improved outcomes for these patients.

Limitations: This study has several limitations that require careful consideration. Primarily, its retrospective design and limited sample size are inherent drawbacks. In addition, only inpatient cases of children and adolescents were included, excluding those treated as outpatients in the emergency department due to the unavailability of electronic medical records for such cases. In addition, there may be a potential selection bias because the study includes patients referred to our teaching hospital. Despite these limitations, our study represents the most recent investigation of the incidence and configuration of traumatic fractures due to falls in children and adolescents in Turkey. It provides initial insights into this important public health problem in childhood. Injury incidence often results from a lack of awareness among the injured, their parents, and educators. This underscores the urgency of refining injury prevention interventions and intensifying research into the causes of injury among school-aged children. The results of our study underscore the potential effectiveness of deepening our understanding of the causes of injury and implementing appropriate interventions to reduce the incidence of injury. As a future step, future research efforts could include multi-city, multi-center investigations for a more comprehensive panorama. Such investigations hold promise for identifying preventive strategies to reduce the incidence of fall-related fractures in children and adolescents.

CONCLUSIONS

Upper extremity fractures predominated in low falls, representing the main etiology and most common site. Conversely, high falls, spinal fractures, and craniofacial fractures emerged as notable antecedents of nerve injury. Therefore, it is imperative to focus our attention on patients who have experienced high falls and have concomitant spinal or craniofacial fractures. This methodology facilitates early and timely detection of nerve injury in children, allowing for accurate diagnosis and prompt, targeted therapeutic intervention. Such an approach has the potential to increase the effectiveness of medical care and optimize outcomes for pediatric patients.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was approved by Aksaray University Clinical Research Ethics Committee and followed the guidelines of the Declaration of Helsinki (Institutional Review Board number: 2021/16-10).

Informed Consent: The mothers were first informed about the study and then signed written consent forms.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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