








Characteristics of School Injuries Presenting to the Emergency Department

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Abstract

Background School injuries account for approximately one-fifth of pediatric injuries. We aimed to investigate the frequency and severity of school injuries among school-aged children and determine clinical diagnoses and surgery requirement data.

Methods In this prospective study, children who were admitted to the emergency department due to school accidents over a 5-month period were included. Demographics, activity during trauma, mechanism of trauma, nature, severity, emergency department outcomes, and surgery requirement were evaluated.

Results The study included a total of 504 school-aged children, of whom 327 (64.9%) were male and 177 (35.1%) were female. Of the children, 426 (84.5%) had no evidence of injury or minor injury, while 78 (15.5%) had moderate or severe injury. There was a statistically significant difference between these two groups in terms of gender ($p = 0.031$). Of the 78 children with moderate or severe injuries, 45 had extremity fractures, 18 had lacerations, 5 had maxillofacial injuries, 4 had cerebral contusion, 1 had lung contusion, and 1 had cervical soft-tissue damage. Two patients with fractures and two with eyelid lacerations were treated surgically, and four patients with brain contusion were hospitalized for a close follow-up.

Conclusion This study revealed that the most common moderate or severe injuries in school accidents referred to emergency department were distal radius fractures and lacerations.

Keywords

- ▶ school health
- ▶ school
- ▶ child
- ▶ injury
- ▶ fracture
- ▶ lacerations

Introduction

Trauma is the major cause of mortality in children in both developed and developing countries worldwide.¹ The mortality rate in children hospitalized due to trauma has been reported to vary between 0.3 and 8.5% in various studies.¹

Traffic accidents, falls, and burns are the most common causes of mortality in this period of life.¹

School-aged children spend a large percentage of their active time in school. School injuries account for approximately one-fifth of pediatric injuries.^{2,3} There are many epidemiological studies on school accidents in the

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literature.⁴⁻¹⁵ Such studies are based on records obtained from school nursing units, national trauma registry, or emergency department (ED). Some researchers have evaluated injuries in subgroups, such as athletes and footballers, or specific injury sites, such as the head and lower extremity.¹⁶⁻¹⁹ The Injury Surveillance Guidelines prepared by the World Health Organization are frequently used in epidemiological studies in this area.²⁰ However, most of these studies, especially those with large samples, did not include clinical diagnoses and surgical requirement data.⁴⁻¹⁹

This study aimed to investigate the frequency and severity of school injuries referred to ED among school-aged children according to the Injury Surveillance Guidelines and determine clinical diagnoses and surgery requirement data.

Material and Method

Study Design

This study was designed as a prospective, observational, cohort study including patients with school-related injuries presenting to our ED over a 5-month period. The ED where this study was conducted receives an annual number of 438,000 emergency visits (both children and adults), located in a tertiary general hospital of a metropolis serving approx-

imately 3 million people. Our ED is also the biggest pediatric trauma center of the region.

Study Population

The study population of this study consisted of patients admitted to our ED with school-related injuries between October 10, 2019, and March 12, 2020. During the study period, there were a total of 51,986 admissions to ED, of which 8,416 were traumatic, and 2,609 of these traumatic admissions belonged to school-aged children. All school-aged children referred to our ED with a traumatic injury that occurred in the school building or yard were included in the study. Patients whose legal guardian did not give consent for their participation in the study and those with incomplete or unavailable forms or hospital records were excluded from the study. →Fig. 1 shows the inclusion and exclusion process of the patients.

Data Collection

Data were collected using two sources: a study form and the computer-based system of the hospital. The study form was completed for each study patient whose parents provided consent at the time of patient admission to the emergency trauma area. This form was prepared and completed

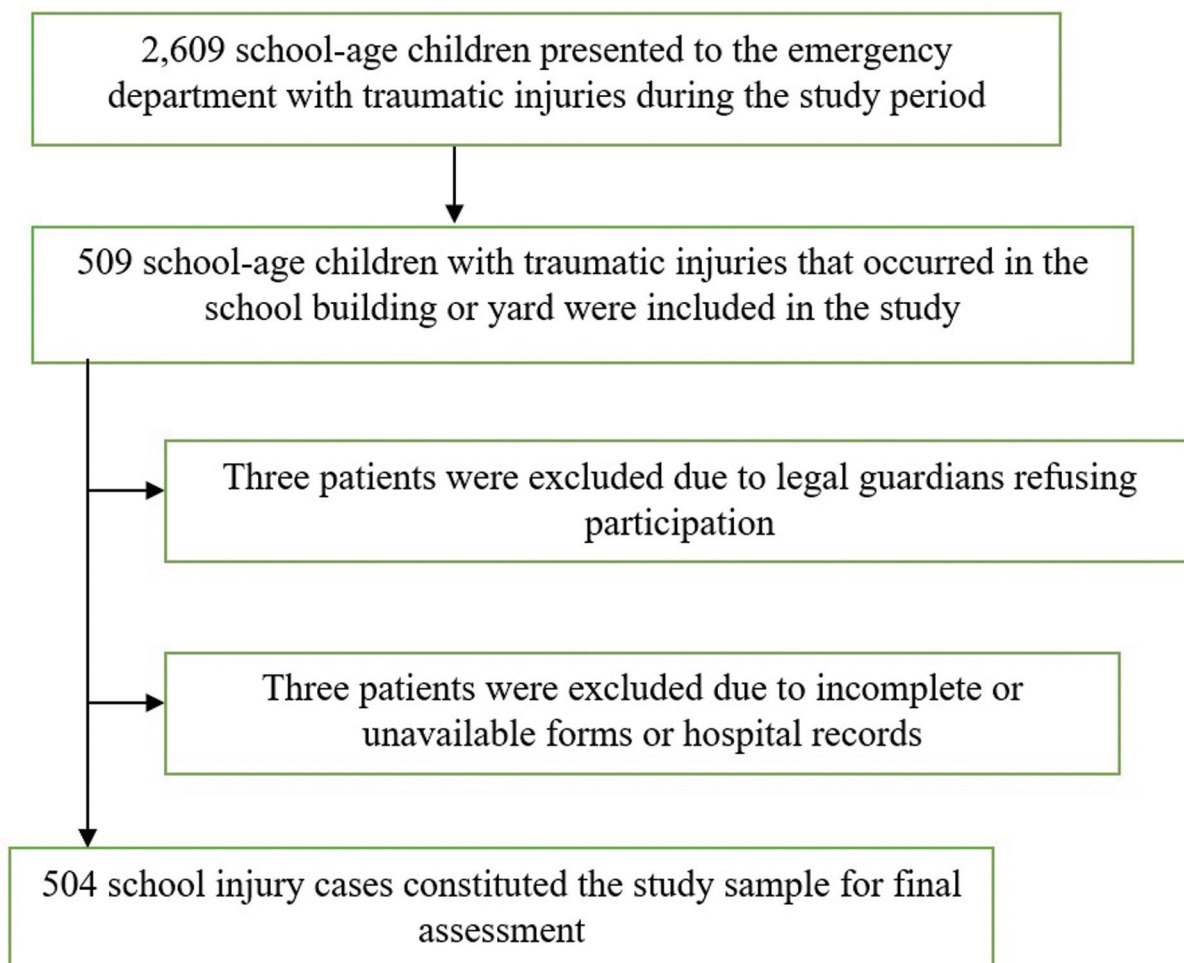


Fig. 1 Flowchart of the study.

according to the Injury Surveillance Guidelines of the World Health Organization. It included information on patient ID (allocated by the computer-based system of the hospital), demographic data, activity that was performed when the injury occurred, mechanism, nature, and severity of injury, and ED outcomes. Activity was noted as education, playing, or others; mechanism of injury was noted as falling, blunt trauma, sharp object trauma, moving vehicle, and others; nature of injury was noted as soft-tissue injury to the limbs, soft-tissue injury to the face and neck, open wound, bruise, fracture, head injury, and sprain; and ED outcome was noted as discharge and hospitalization. According to their age, the children were grouped as kindergarten (3–5 years), primary school (6–10 years), middle school (11–13 years), and high school (14–18 years). The clinical diagnoses and clinical follow-up of the patients who underwent surgery were recorded from the computer-based system of the hospital.

Statistical Analysis

IBM SPSS Statistics for Mac, Version 27.0 (Armonk, NY, IBM Corp) was used to perform statistical analyses. The Kolmogorov–Smirnov test was conducted for the evaluation of the conformance of variables to a normal distribution. The data that complied with a normal distribution were presented with mean and standard deviation values, and the remaining data were expressed as interquartile range and median values. Categorical data were presented with the number of cases and percentages. For the comparison of quantitative and qualitative data between two groups, the chi-square and Mann–Whitney *U* tests were used.

Ethics

Ethical approval was obtained from the local ethical committee of clinic research (approval number: B.10.1. TKH.4.34. H.GP.0.01/112). Before completing the study form, the legal guardians of the patients were asked to provide consent for their children's participation in the study, and the clinical data of only the patients for whom the guardians signed the informed consent form were included in the study.

Results

A total of 504 school-aged children who presented to our clinic with a traumatic injury that occurred in the school building or school yard were included in the study during the study period (►Fig. 1). Of the children, 327 (64.9%) were male and 177 (35.1%) were female. There was no evidence of injury or only minor injury was present in 426 (84.5%) children, while 78 (15.5%) children had moderate or severe injury. There was a statistically significant difference between these two groups in terms of gender ($p=0.031$) (►Table 1). The baseline characteristics of the enrolled patients and the comparison of characteristics between the no/minor injury and moderate/severe injury groups are summarized in ►Table 1.

Of the 78 children with moderate or severe injuries, 45 had extremity fractures, 18 had lacerations, 9 had maxillofacial injuries, 4 had cerebral contusion, 1 had lung contu-

sion, and 1 had cervical soft-tissue damage. The distribution of the extremity fractures is shown in ►Table 2. Of the 18 children with lacerations, 10 had laceration on the extremities, 4 under the chin area, 2 on the scalp, and 2 on the eyelid. There was canalicular damage in one of the eyelid lacerations. The lacerations other than the lacerations of the eyelid were sutured in the ED. The eyelid lacerations were sutured in the operating room. Four children with cerebral contusion were hospitalized for a close follow-up without the need for a neurosurgical intervention. Of the nine children with maxillofacial injuries, three had displaced nasal fractures without a septal hematoma. These patients were discharged after an outpatient clinic appointment was arranged. The demographics, mechanisms of injury, and final diagnoses of the patients who were treated surgically are presented in ►Table 3. No burn or mortality was observed in the study population.

Discussion

Many epidemiological studies have been performed in EDs related to accidents that occur in schools and nurseries around the world. The difference of our study from these studies is the definition of injury and ED outcomes including surgical requirement as well as epidemiological data. The most important finding of this study is that 15% of the injuries were moderate or severe, and the most common moderate or severe injury was a distal radius fracture. Two patients with fractures and two with eyelid lacerations were treated surgically, and four patients with brain contusion were hospitalized for a close follow-up.

This study revealed that the frequency of extremity fractures was higher than moderate or severe head injuries in school-aged children. This may be because in school accidents, the injury mechanism is often due to falling, blunt impact, or use of hands to protect oneself.²¹ Other plausible explanations for the higher number of extremity injuries include clumsiness and gait disturbances that can be caused by the elongation of the extremities and delays in motor development during adolescence.²² We were unable to assess this hypothesis using our dataset, but we consider that it should be investigated in further studies.

Previous studies have been conducted to identify groups at risk for school injuries. Studies have shown that different age groups are at higher risk.^{6,9,11} Linakis et al showed that children aged 10 to 14 years are at higher risk for school injuries.⁶ In another study, Al-Hajj et al reported that 3 to 5 years of age constituted the risk group.⁹ However, Ramirez et al showed that the 5 to 9 years group was at higher risk for school injuries.¹¹ In our study, there was no difference between those with no/minor injury and those with moderate/severe injury by age. All studies evaluating injury risk by gender have shown that male gender constitutes greater risk for school accidents. Our study showed similar results. There are several explanations for this finding, such as the more aggressive nature or stronger physical activity level of boys, or different expectations of parents and society from males, all of which may lead to more serious injuries.¹⁰

Table 1 Baseline characteristics of enrolled patients and comparison of characteristics between the injury severity groups

	Total	No evidence of injury or minor injury	Moderate or severe injury	p-Value
	504	426 (84.5%)	78 (15.5%)	
Age (y)	11 (3–17)	11 (3–17)	11 (4–16)	0.947
Age (y)				
3–5	9 (1.8%)	8 (1.9%)	1 (1.3%)	0.494
6–10	155 (30.9%)	134 (31.7%)	21 (26.9%)	
10–12	288 (57.5%)	239 (56.5%)	49 (62.8%)	
13–18	49 (9.8%)	42 (9.9%)	7 (9%)	
Gender				
Male	327 (64.9%)	268 (62.9%)	59 (75.6%)	0.031
Female	177 (35.1%)	158 (37.1%)	19 (24.4%)	
Activity				
Playing	107 (21.2%)	91 (21.3%)	16 (20.5%)	0.763
Educational activity	114 (22.6%)	94 (22.1%)	20 (25.6%)	
Other	283 (56.2%)	241 (56.6%)	42 (53.8%)	
Accompanying person				
Alone/friends	16 (3.2%)	13 (3.1%)	3 (3.8%)	0.514
Parents	458 (90.8%)	390 (91.5%)	68 (87.2%)	
Teacher	5 (1%)	2 (0.5%)	3 (3.8%)	
Other	25 (5%)	21 (4.9%)	4 (5.1%)	
Type				
Unintentional	458 (90.9%)	384 (90.1%)	74 (94.9%)	0.179
Violence	15 (3%)	14 (3.3%)	1 (1.3%)	
Self-harm	11 (2.2%)	9 (2.1%)	2 (2.6%)	
Other	20 (4%)	19 (4.5%)	1 (1.3%)	
Mechanism of injury				
Falling	252 (49.9%)	206 (48.4%)	46 (59%)	0.068
Blunt objects	207 (41.1%)	180 (42.3%)	27 (34.6%)	
Sharp objects	10 (2%)	6 (1.4%)	4 (5.1%)	
Moving vehicle	4 (0.8%)	4 (0.9%)	0	
Other	31 (6.1%)	30 (7%)	1 (1.3%)	
Injured area				
Head/neck	110 (22.6%)	85 (20.8%)	25 (32.1%)	0.008
Fingers	93 (19.1%)	81 (19.8%)	12 (15.4%)	
Hand/wrist	84 (17.2%)	64 (15.6%)	20(25.6%)	
Rest of the upper limb	61 (12.5%)	53 (13%)	8 (10.3%)	
Foot/ankle and toes	91 (18.7%)	81 (19.8%)	10 (12.8%)	
Rest of the lower limb	34 (7%)	32 (7.8%)	2 (2.6%)	
Thorax/abdomen	14 (2.9%)	13 (3.2%)	1 (1.3%)	
Nature				
Soft-tissue injuries (limbs)	225 (44.6%)	225 (52.8%)	0	0.006
Soft-tissue injuries (face and neck)	32 (6.3%)	22 (5.1%)	10 (12.8%)	
Open wound	19 (3.7%)	1 (0.2%)	18 (23%)	
Bruise/sprain	102 (20.1%)	102 (23.9%)	0	
Fracture (extremity)	45 (8.9%)	0	45 (57.6%)	
Head injury	80 (15.8%)	76 (17.8%)	4 (5.1%)	
Organ system injury	1 (0.2)	0	1 (1.2%)	

Note: Bolded p-Values are significant.

Table 2 Distribution of the fractures in the extremities

	n (45)	%
Fifth metacarpal neck	1	2.2
Fifth metacarpal shaft	1	2.2
Distal phalanx	3	6.6
Proximal phalanx	8	17.7
Distal radius (isolated)	18	40
Distal radius and ulna ^a	1	2.2
Proximal ulna	1	2.2
Humerus transcondylar ^a	1	2.2
Humerus supracondylar	1	2.2
Fifth metatarsal (neck)	1	2.2
Proximal phalanx (foot)	1	2.2
Lateral malleolus	7	15.5
Medial malleolus	1	2.2

^aSurgically treated.

Ninety-five percent of the children were referred to our ED by their parents or relatives who were their legally acceptable guardians. One percent of the children were brought to ED by their teachers. The reason for this is that when a child is injured at school, the school administration informs the parents, and if the parents are available, they are expected to take their child to ED. If the parents are not available, the teacher assumes this responsibility. Only 3.2% of the children presented to ED themselves or were taken there by their friends who were not their legal guardians. Although this demonstrates the independence and self-sufficiency of a child, it can cause legal problems for the medical team in cases requiring medical interventions.

Our study has several limitations. First, we had to terminate the study before the initially planned deadline due to the COVID-19 pandemic. In our country, due to the pandemic, face-to-face education was suspended in March 2020. Therefore, we were not able to include any more patients after this date in our sample. Second, we only included patients who presented to ED and did not evaluate those presenting to outpatient clinics with school injuries. We were also not able to evaluate minor injuries that were treated by school nurses and did not require referral to ED. Another limitation of our study is that the results have limited generalizability due to its single-center design. Multicenter studies should be performed with larger populations to identify groups at risk for different subgroups of injury.

In conclusion, our study revealed that the most common moderate or severe injuries in school accidents referred to ED were distal radius fractures and lacerations.

Availability of Data and Materials

The dataset generated and analyzed during this study is available from the corresponding author.

Table 3 Characteristics of surgically treated patients

	Age, y	Gender	Mechanism of injury	Diagnosis
Patient 1	10	Female	Falling	Humerus transcondylar fracture
Patient 2	13	Male	Blunt trauma	Distal radius and ulnar fracture
Patient 3	7	Male	Blunt trauma	Eyelid laceration
Patient 4	16	Male	Blunt trauma	Lower eyelid canalicular laceration

Informed Consent

Written informed consent was obtained from legal guardian of patient.

Ethical Approval

Ethical approval for this study was obtained from Ümraniye Training and Research Hospital Ethics Committee (approval number: B.10.1. TKH.4.34.H.GP.0.01/112). The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki.

Authors' Contributions

All authors are responsible for conception, design of the study, data collection, data analysis, and assembly. The manuscript was written and approved by all authors

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None.

Conflict of Interest

None declared.

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