BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-055639
Article Type:	Original research
Date Submitted by the Author:	23-Jul-2021
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Keywords:	EPIDEMIOLOGY, Paediatric orthopaedic & trauma surgery < PAEDIATRIC SURGERY, PUBLIC HEALTH

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Pediatric Injuries in Beirut: A Multi-Center study

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Short title: Pediatric injury in Beirut, Lebanon.

Abbreviations: Emergency Department (ED), Eastern Mediterranean Region (EMR), disability-adjusted life year (DALY), Pan-Asia Trauma Outcomes Study (PATOS),International Classification of Disease 9th clinical modification (ICD – 9 - CM) or 10th edition (ICD – 10 - CM*)*, Statistical Package for the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago, IL), Road Traffic Injury (RTIs), low- and middle- income countries (LMICs)

Abstract

Objective: This study aims to assess the epidemiology of pediatric injury in Lebanon, giving insights into their characteristics, contributing risk factors and outcomes.

Methodology: We conducted a retrospective review study of charts of children aged 0-15y at 5 hospital Emergency Departments (ED) located in Beirut for a one-year period (June 2017-May 2018). We performed descriptive analysis and a bivariate analysis comparing admitted and treated/discharged patients. This was followed by a logistic regression to identify the factors associated with hospital admission in pediatric.

Results: A total of 1,142 cases of pediatric injury ED cases were sampled, mean age was 7.7 ± 4.35 years. Children 0-5 years sustained more than one-third of the total cases, (206/516) 40.0% of the fall injuries and (220/366) 60.1% of home injuries. The leading cause of pediatric injury was fall (45.2%) Nearly 4.1% of the cases were admitted to hospitals with major contributing factors, including other insurance type (OR = 8.33 [CI 2.19 – 31.67]), head (OR =14.35 [CI 4.01–51.34]), abdomen (OR =8.25 [1.11 – 61.24]), upper extremity (OR = 5.79 [CI 2.04 – 16.49]), and lower extremity (OR =5.55 [95% CI 2.02 – 15.20]). The three types of injury with the highest hospital admission risk were fracture (OR =13.55 [CI 4.77 – 38.44]), concussion (OR = 13.60 [CI 2.83 – 65.41]), and organ system injury (OR =31.63 [CI 3.45 – 290.11]).

Conclusion: Pediatric injury a major health problem in Lebanon. Safety policies, parental awareness campaigns and child age-targeted injury interventions should be initiated to help reduce childhood injuries and improve child safety and well-being.

Article summary: Strengths and limitations of this study

- This study presents evidence on the characteristics, mechanisms and clinical outcomes of pediatric injuries at multiple centers in Beirut.
- Lebanon an upper- middle- income EMR country suffers from a large burden of injury, especially among the pediatric population. The number of studies investigating their injuries remains scarce with a limited impact of child injury prevention programs and safety policies.
- Evidence generated from this study will inform the design of parents' child safety awareness programs and injury prevention strategies.
- The study was a retrospective chart review study thus has its own inherited limitations of data variable availability in the original patients' records.
- Third, this study used emergency department and admission data with no follow up on information on the short- and long- term outcomes of multiple injuries including concussions and their impact on child's behavior and long-term impact

Introduction

Pediatric injury represents the 3rd leading cause of deaths for children less than 15 years of age, surpassing major common childhood diseases [1, 2]. It constitutes a major contributor to the Global Burden of Disease, accounting for nearly 10.6% of the global number of deaths in individuals less than 20 years of age[2]. An estimated 6 million children die every year as a result of injuries, with millions others requiring medical care through emergency visits and hospitalization[2, 3]. The pediatric population is particularly vulnerable to all types of injuries. Children's brain is under-developed, their physical and cognitive potentials are limited, which hinder their abilities to rationally judge their surrounding hazards and risky environment, ultimately increasing their vulnerability and exposure to many injuries.

Pediatric injury persists as one of the leading causes of child death in low- and middle- income countries [1, 4], most of which are unintentional [5, 6]. The high injury mortality and morbidity rate are mainly due to the multiple contributing factors associated with child's increased exposure to injuries including families' socioeconomic and educational status, income level, hazardous environment, and the degree of child supervision [7-9].

The Eastern Mediterranean Region (EMR) encompasses many low- and middle-income countries, hence reported the highest rate of child and adolescent injuries in the world with an estimated rate of 43.2 per 100,000 population in 2017. This high rate is equivalent to more than 130,000 children's deaths in 2017, mainly as a result of violence and transportation injuries [10, 11]. Lebanon an upper- middle- income EMR country suffers from a large burden of injury, especially among the pediatric population. The country's latest WHO 200-2012 estimates suggest that injury is the 3rd leading cause of death and the 5th leading cause of disability-adjusted life year (DALY)

in Lebanon [12]. Further to its substantial toll on children's physical and emotional well-being, pediatric injury places a substantial economic burden on injured children, their families and above all on the resource-limited Lebanese healthcare system [13]. Although children constitute approximately 31% of the Lebanese population [14], the number of studies investigating their injuries remains scarce with a limited impact of child injury prevention programs and safety policies [15-18]. Additionally, the lack of hospital surveillance systems and trauma registries in Lebanon render it challenging to accurately assess the magnitude of the child injury problem and its associated risk factors.

The main objective of this study is to illustrate pediatric injury epidemiology in Lebanon's capital city, Beirut. The study findings will offer an understanding of the magnitude, the mechanisms and the outcome of child injury. Evidence generated from this study will inform the design of parents' child safety awareness programs and injury prevention strategies and policies to protect children's lives and safeguard their health and well-being.

Methodology

Study Setting

We retrospectively reviewed and collected data from patients' charts at 5 hospitals Emergency Department in the greater Beirut district area, which houses almost 30% of the Lebanon population (2.2 million). We captured data from 5 local hospitals: The American University of Beirut Medical

Center (330 beds, 60,000 annual ED visits), Hariri Governmental Hospital (544 Beds, 17,000 annual ED visits), Geitawi hospital (250 beds, 11,000 annual ED visits), LAU medical center (120 beds, 6,000), and Sacre-Coeur hospital (155 beds, 4,000 annual ED visits). This study was approved by the American University of Beirut Internal Review Board (IRB) [BIO-2018-0061] and by each participating hospital ethical committee.

Patient Involvement

Patients or the member of the public were not involved in the study since it was a de-identified data and a retrospective chart review study.

Data Collection

Data was collected on children aged 0-15 who sustained any type of injury and presented to one of the participating hospitals within the 12-month period from June 2017-May 2018. We included both intentional and unintentional injuries in the database. We collected data on child socio-demographic information, injury mechanism, activity at the time of injury, injury location and body part injured, and injury anatomical and clinical outcomes. We adopted the Pan-Asia Trauma Outcomes Study (PATOS)[19] to design and develop the data collection form.

At each hospital, we retrieved ED data, reviewed patients' medical records, and filter injury cases by mechanisms coded according to the *International Classification of Disease 9th, clinical modification (ICD -9-CM)* or *10th edition (ICD -10-CM)* adopted at some hospitals or by keywords in case of a lack of proper coding. Data were captured into the Redcap software to do the data entry. To calculate the required sample size at each hospital, the prevalence for each month of the study period was calculated by dividing the number of ED injured patients by the total number of

ED patients for the corresponding month. A desired precision between 5% and 10 % was used and a 95% confidence interval was adopted while calculating the sample size.

Data Analysis

We performed descriptive and inferential statistical analysis using the Statistical Package for the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago, IL). The characteristics, trends and patterns of injury were described for the total sample and the four children's age groups (less than 1, 1-5, 6-10, and 11-15 years). Mean (standard deviation), median, and the interquartile range were calculated to summarize the age and the vital signs. Pearson's Chi-Square or Fisher's exact tests were used to assess the significance of the statistical association between all categorical variables and the outcome variable [ED disposition (admitted vs. treated and discharged)]. All clinically and statistically significant variables were included in a multivariate analysis using a stepwise logistic regression model to determine the factors associated with hospital admission. A p-value of ≤ 0.05 was used to indicate statistical significance. The final model was found to be a good fit to the data as the Hosmer-Lemeshow test indicated ($p=0.957$) and it discriminated perfectly the two categories of the outcome variable (area under the curve = 0.894 [95% CI: 0.848 – 0.940, $p<0.001$].

Results

A total of 1,142 cases of pediatric cases presented to participating hospitals with an injury during the one-year period (June 2017-May 2018), accounting for almost 23.5% of all traumatic ED cases. Children ages range from 0 to15 with mean age 7.7 ± 4.35 years, mostly Lebanese (80.3 %, n=917). Reported injuries were evenly distributed across age groups, with 399 (34.9%) among children aged 1-5 years, 370 (32.4%) among 6-10 years and 357 (31.3%) among 11-15 years of age, with an overwhelming number of males (n= 733, 64.2%) sustaining injuries compared to their female counterparts (n= 408, 35.7%). For all injury mechanisms, the male to female ratio was 1.8:1. Exceptionally to this pattern were children less than 1 year of age who were mostly females (n= 10, 62.5%) and reporting 1.4% (n=16) of the total injuries (Table 1).

Table 1: General Characteristics of the Studied Population.

	Frequency N (%)				
	<1	**1-5**	**6-10**	**11-15**	**Total**
Cases	16	399	370	357	1142
Gender					
Male	6 (37.5)	243 (60.9)	233 (63.0)	251 (70.3)	733 (64.2)
Female	10 (62.5)	156 (39.1)	137 (37.0)	105 (29.4)	408 (35.7)
Unknown	0 (0)	0 (0)	0 (0)	1 (0.3)	1 (0.1)
Nationality					
Lebanese	3 (18.8)	302 (75.7)	303 (81.9)	309 (86.6)	917 (80.3)

Non-Lebanese	13 (81.3)	96 (24.1)	66 (17.8)	46 (12.9)	221 (19.4)
Unknown	0 (0)	1 (0.3)	1 (0.3)	2 (0.6)	4 (0.4)
Hospital Type					
Private	3 (18.8)	309 (77.4)	308 (83.2)	298 (83.5)	918 (80.4)
Public	13 (81.3)	90 (22.6)	62 (16.8)	59 (16.5)	224 (19.6)
Insurance Type					
Private	13 (81.3)	330 (82.7)	322 (87.0)	312 (87.4)	977 (85.6)
Self	2 (12.5)	53 (13.3)	41 (11.1)	43 (12.0)	139 (12.2)
Others	1 (6.3)	16 (4.0)	7 (1.9)	2 (0.6)	26 (2.3)

The leading cause of pediatric injury was fall (n=516, 45.2%). Nearly (206/516) 40.0% of fall injuries sustained by children 0-5. Children pedestrians hit by vehicles or motorcycles represented the majority of the road injury cases (29.2%) and showed a substantially increased pattern with child age increase. Almost 35 children (3.1%) sustained a burn injury (Figure 1 and 2).

Most sustained injuries (85.1%) were mild injuries. Nonetheless, 9 children suffered from severe disability that affected their daily activities, these injuries were mainly reported among the older age group 6-15. (Table 2)

Figure 1: Distribution of the mechanism of injury by age groups.

Figure 2: Distribution of the mechanism of injury by gender.

Homes were the most common sites for injury occurrence (n=366, 32.0%), particularly for the young age groups 1-5 (n=207, 51.9%). As children get older, more frequent injuries were reported by 11-15 years old in sports/recreational outdoor areas (n=57, 16.0%) and on streets (N=20, 5.6%). Regardless of the location, playing was the most common activity carried out by children when injury occurred (n=947, 82.9%).

Table 2: Event characteristics per age group.

	Frequency N (%)				
	<1	**1-5**	**6-10**	**11-15**	**Total**
Cases	16	399	370	357	1142
Intent					
Unintentional	15 (93.8)	394 (98.7)	368 (99.5)	341 (95.5)	1118 (97.9)
Intentional/Assault	0 (0)	1 (0.3)	0 (0)	12 (3.4)	13 (1.1)
Unknown	1 (6.3)	4 (1.0)	2 (0.5)	4 (1.1)	11 (1.0)
Mechanism					
Road Traffic	0 (0)	10 (2.5)	10 (2.7)	8 (2.2)	28 (2.5)
Fall	7 (43.8)	199 (49.9)	172 (46.5)	138 (38.7)	516 (45.2)
Struck/hit by person or object	3 (18.8)	95 (23.8)	114 (30.8)	125 (35.0)	337 (29.5)

Others[1]	5 (31.3)	89 (22.3)	67 (18.1)	83 (23.2)	244 (21.4)
Unknown	1 (6.3)	6 (1.5)	7 (1.9)	3 (0.8)	17 (1.5)
Body Part					
Head	7 (43.8)	89 (22.3)	51 (13.8)	25 (7.0)	172 (15.1)
Face	3 (18.8)	127 (31.8)	81 (21.9)	41 (11.5)	252 (22.1)
Neck/Thorax	1 (6.3)	18 (4.5)	9 (2.4)	8 (2.2)	36 (3.2)
Abdomen	0 (0)	24 (6.0)	7 (1.9)	5 (1.4)	36 (3.2)
Spine	0 (0)	5 (1.3)	4 (1.1)	9 (2.5)	18 (1.6)
Upper Extremities	3 (18.8)	114 (28.6)	146 (39.5)	154 (43.1)	417 (36.5)
Lower Extremities	2 (12.5)	68 (17.0)	101 (27.3)	137 (38.4)	308 (27.0)
External (skin)	0 (0)	5 (1.3)	1 (0.3)	4 (1.1)	10 (0.9)
Other (non-anatomical injury)	0 (0)	4 (1.0)	1 (0.3)	0 (0)	5 (0.4)
Type					

[1] Others include: Stab or cut & Fire, flames or heat & Choking or hanging & Poisoning & Physical over-exertion & Others

Fracture	3 (18.8)	52 (13.0)	77 (20.8)	86 (24.1)	218 (19.1)
Sprain/Strain	1 (6.3)	38 (9.5)	79 (21.4)	117 (32.8)	235 (20.6)
Cuts, bites or open wound	6 (37.5)	154 (38.6)	116 (31.4)	70 (19.6)	346 (30.3)
Bruise or superficial injury	4 (25.0)	105 (26.3)	79 (21.4)	85 (23.8)	273 (23.9)
Burns	1 (6.3)	24 (6.0)	5 (1.4)	5 (1.4)	35 (3.1)
Concussion	2 (12.5)	13 (3.3)	12 (3.2)	8 (2.2)	35 (3.1)
Organ system injury	1 (6.3)	28 (7.0)	12 (3.2)	5 (1.4)	46 (4.0)
Other	0 (0)	1 (0.3)	1 (0.3)	0 (0)	2 (0.2)
Place					
Home	13 (81.3)	207 (51.9)	87 (23.5)	59 (16.5)	366 (32.0)
School	0 (0)	3 (0.8)	14 (3.8)	7 (2.0)	24 (2.1)
Street/highway	0 (0)	13 (3.3)	23 (6.2)	20 (5.6)	56 (4.9)
Residential institution	0 (0)	6 (1.5)	8 (2.2)	12 (3.4)	26 (2.3)
Sports/Athletics area	0 (0)	1 (0.3)	21 (5.7)	57 (16.0)	79 (6.9)

Recreational and cultural area and public building	0 (0)	13 (3.3)	18 (4.9)	9 (2.5)	40 (3.5)
Others[2]	0 (0)	5 (1.3)	5 (1.4)	7 (2.0)	17 (1.5)
Activity					
Education	0 (0)	0 (0)	2 (0.5)	2 (0.6)	4 (0.4)
Sports	0 (0)	0 (0)	24 (6.5)	56 (15.7)	80 (7.0)
Leisure/Play	13 (81.3)	366 (91.7)	310 (83.8)	258 (72.3)	947 (82.9)
Travelling not elsewhere classified	0 (0)	2 (0.5)	5 (1.4)	6 (1.7)	13 (1.1)
Arrival type					
Prehospital ambulance transport	0 (0)	3 (0.8)	3 (0.8)	7 (2.0)	13 (1.1)
Interhospital ambulance transport	0 (0)	0 (0)	1 (0.3)	1 (0.3)	2 (0.2)

[2] Others include: Industrial/construction; Farm, excluding home; Commercial; Countryside, water, sea; Medical service area

Prehospital transport using other vehicles (non-EMS)	15 (93.8)	383 (96.0)	353 (95.4)	343 (96.1)	1094 (95.8)
Interhospital transport using other vehicles (non-EMS)	0 (0)	7 (1.8)	6 (1.6)	3 (0.8)	16 (1.4)
Unknown	1 (6.3)	6 (1.5)	7 (1.9)	3 (0.8)	17 (1.5)

As for the anatomic injuries, the leading body parts injured were upper extremities (n= 417, 36.5%), lower extremities (n=308, 27.0%), face (n=252, 22.1%) and head (n=172, 15.1%). Children 1-5 sustained more than half of the reported head 89 (n= 89/172 51.7%) and face 127 (n= 127/252, 50.3%) injuries. Compared to the younger age group, children 6-10 and 11-15 suffered more injuries to extremities with 247 cases (66.8%) and 291 cases (81.5%) respectively (Table 2).

In terms of patients' disposition, nearly 1021 (89.4%) of the injured cases were treated and released at the ED while 47 children (4.1%) were admitted (Table 3).

Table 3: Pre-existing disability and outcome per Age group.

	Frequency N (%)

	<1	1-5	6-10	11-15	Total
Cases	16	399	370	357	1142
Pre-existing disability (GOS)					
Moderate disability[3]	0 (0)	1 (0.3)	3 (0.8)	1 (0.3)	5 (0.4)
Mild or no disability; no disability reported	16 (100)	393 (98.5)	362 (97.8)	354 (99.2)	1125 (98.5)
Unknown	0 (0)	5 (1.3)	5 (1.4)	2 (0.6)	12 (1.1)
ED Disposition					
Treated and discharged	9 (56.3)	350 (87.7)	333 (90.0)	329 (92.2)	1021 (89.4)
Transfer & AMA	4 (25.0)	15 (3.8)	10 (2.7)	8 (2.2)	37 (3.2)
Admitted	0 (0)	17 (4.3)	16 (4.3)	14 (3.9)	47 (4.1)
Unknown	3 (18.8)	17 (4.3)	11 (3.0)	6 (1.7)	37 (3.2)
Modified Rankin Score at Discharge					
No symptoms at all,	0 (0)	7 (1.8)	2 (0.5)	4 (1.1)	13 (1.1)

[3] Independent activities of daily living are possible, but cannot resume work/school life

No significant disability despite symptoms; able to carry out all usual duties and activities	9 (56.3)	237 (59.4)	165 (44.6)	125 (35.0)	536 (46.9)
Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance	1 (6.3)	110 (27.6)	173 (46.8)	208 (58.3)	492 (43.1)
Moderate disability; requiring some help, but able to walk without assistance	1 (6.3)	9 (2.3)	9 (2.4)	6 (1.7)	25 (2.2)
Moderately severe disability; unable to walk without assistance and	0 (0)	10 (2.5)	4 (1.1)	5 (1.4)	19 (1.7)

unable to attend to own bodily needs without assistance					
Severe disability; bedridden, incontinent and requiring constant nursing care and attention	0 (0)	1 (0.3)	4 (1.1)	0 (0)	5 (0.4)
Unknown	5 (31.3)	25 (6.3)	13 (3.5)	9 (2.5)	52 (4.6)
GOS at discharge					
Severe disability[4]	0 (0)	3 (0.8)	2 (0.5)	4 (1.1)	9 (0.8)
Moderate disability[5]	1 (6.3)	39 (9.8)	35 (9.5)	27 (7.6)	102 (8.9)
Recovering state: Mild or no disability; can resume work/school life	11 (68.8)	328 (82.2)	317 (85.7)	316 (88.5)	972 (85.1)
Unknown	4 (25.0)	29 (7.3)	16 (4.3)	10 (2.8)	59 (5.2)

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[4] Independent activities of daily living are not possible
[5] Independent activities of daily living are possible, but cannot resume work/school life

The leading type of injury for admitted pediatric cases was fracture (55.3%) (p<0.001) followed by concussion (21.3%) (p<0.001), organ system injury (21.3%) (p<0.001) and cuts/open wound (17.0%) (p=0.035). The most common body part among admitted pediatric cases were upper extremities (53.2%) (p=0.016), head (36.2%) (p<0.001) and abdomen (14.9%) (p<0.001). Unexpectedly, the type of insurance affected child's injury disposition status. Privately insured children were more likely to be admitted into the hospital (p= 0.004) as a result of their injuries (Table not shown).

Significant factors that were positively associated with hospital admission included: other insurance type (OR = 8.33 [95% CI 2.19 – 31.67]), body regions, namely head (OR =14.35 [95% CI 4.01– 51.34]), abdomen (OR =8.25 [1.11 – 61.24]), upper extremity (OR = 5.79 [95% CI 2.04 – 16.49]), Lower Extremity (OR =5.55 [95% CI 2.02 – 15.20]). The three types of injury with the highest hospital admission risk were fracture (OR =13.55 [95% CI 4.77 – 38.44]), concussion (OR = 13.60 [95% CI 2.83 – 65.41]), and organ system injury (OR =31.63 [95% CI 3.45 – 290.11]) (Table 4)

Table 4: Factors associated with hospital admission

Variable (Reference)	Odds Ratio*	95% CI	p-value
Insurance Type (Private)			
Self	0.96	0.31 – 2.99	0.942
Others	8.33	2.19 – 31.67	0.002

Body Part – Head (No) Yes	14.35	4.01 – 51.34	<0.001
Body Part – Abdomen (No) Yes	8.25	1.11 – 61.24	0.039
Body Part – Upper Extremity (No) Yes	5.79	2.04 – 16.49	0.001
Body Part – Lower Extremity (No) Yes	5.55	2.02 – 15.20	0.001
Type of injury – Fracture (No) Yes	13.55	4.77 – 38.44	<0.001
Type of injury – Concussion (No) Yes	13.60	2.83 – 65.41	0.001
Type of injury - Organ system injury (No) Yes	31.63	3.45 – 290.11	0.002

*Adjusted for: age, gender, hospital type, nationality, insurance type, mechanism of injury, location of injury (head; face; neck/thorax; abdomen and pelvic contents; upper extremity; lower extremity including bony pelvis), type of injury (fracture; cuts, bites or open wound; bruise or superficial injury; concussion; organ system injury), place of injury (home, including garden and out buildings; street/highway; sports and athletics area), activity (leisure/play).

Discussion

This study presents evidence on the characteristics, mechanisms and clinical outcomes of pediatric injuries at multiple centers in Beirut. Pediatric injury is a global public health problem, particularly in low- and middle- income countries and a substantial challenge to limited healthcare systems. Only in the last decade that pediatric trauma has gained recognition as a major health concern that needs to be understood and addressed [20]. The generated evidence from this study will help to understand the epidemiology of the pediatric injury in Lebanon, which in turn will guide the design and implementation of targeted interventions and effective child injury prevention strategies.

The study results underscore the substantial burden of pediatric injuries, accounting for nearly 23.8% of total traumatic cases presented to ED. These results are consistent with those generated in a similar local study and reported a comparable proportion of pediatric cases among ED presentations at 3 hospitals in Beirut [21]. The high prevalence of child injuries aligns with previous attempt to quantify the burden of childhood injuries in high-, middle- and low-income countries, regardless of countries' social and cultural disparities [2, 22-25]. A large number of these injuries were sustained by males, agreeing with existing literature that confirmed the predominance of injuries among males across all mechanisms of injuries along with the increased odds of sustaining repeated injuries [5, 26-29]. Moreover, this study highlighted the high frequency of injury occurrences among children aged 0 to 5. This age group sustained more than one-third of the total number of reported cases, almost 40.0% of the fall injuries and approximately 60.1% of home injuries. This study showed that unintentional injuries had a large toll on children, particularly those less than 5 years of age compared to their older counterparts. Young children are particularly vulnerable; their physical, mental and cognitive development depends on their

surrounding environment, which places them at an increased risk of undergoing injuries. Multiple factors increase the likelihood of their injury occurrence, namely child's curious attributes and discovery nature coupled with the lack of safe environment and parents direct supervision [30];[31]. This highlights parents' fundamental role in child active supervision to protect children as a vulnerable population as well as underscores the importance of ensuring a surrounding environment with built in child safety (e.g. locked cabins, gated stairs) that prevents and reduce childhood injuries (Sharma et al., 2018).

The present study has confirmed that the leading causes of injury across all age groups were falls followed by hit by objects and road traffic injury (mainly pedestrians). An abundance of literature observed similar findings in low-, middle- and high-income countries and confirmed that fall injury is responsible for the excess hospital ED visits and admissions among children [3, 26-28]. This is mainly due to the onset of independent mobility and poor balance among young children which increases their risk of sustaining fall injuries [32, 33]. Hit by person/objects and Road Traffic Injury (RTIs) were the other primary cause of injury among children, increasing with age and peaking at the age of 11-15. The lack of proper injury documentation at the hospital level hinders the comprehensive understanding of the external causes of these injuries, their circumstances and the safety measures adopted. Hence, there is an urgent need to institute a national injury surveillance system or trauma registry at hospitals in Lebanon, which are essential to provide high-quality epidemiological data on the incidence and circumstances of injuries requiring medical attention. Timely collection of injury data is critical for the development, adoption and evaluation of cost-effective injury prevention programs, strategies and policies. The generated evidence will serve to guide future policy priorities for childhood injury prevention and

to tailor the implementation of context-sensitive interventions to reduce injuries and mitigate their consequences on the pediatric population.

Similar to existing studies, our findings suggest that injuries in the 0-5 age group resulted mainly in the head or face trauma comparable to the 6-15 y who suffered mainly from upper extremity injuries [34]. These body parts are mostly caused by falls and are strongly associated with increased hospital admissions ($p<0.001$). A plausible explanation for this observed pattern of different body parts affected by fall injuries is related to the ability of older children to protect themselves from serious injuries using their peripheral extremities during the injury impact. This further reflects the preponderance of cuts and open wound in the younger age group 0-10 years old compared to sprain and strain sustained by the older age 10-15y.

Pediatric admission to hospitals considerably varies by injury types and mechanisms, body part injuries, and interestingly by insurance type. Head, abdomen and extremities ranked the highest among body parts injured that necessitate hospital admission. Patients with head, abdomen or upper extremity injuries are almost 14, 8 and 6 times more likely to be admitted to hospital as a result of their injuries. Fall is shown to be leading mechanism of hospital admission, which consistently agrees with regional studies [23, 26, 27]. Fracture, organ system injury and concussion topped the list of injury types resulting in hospital admissions. Patients with fracture or concussion are 13 times more likely to be admitted to hospital, and patients with organ injury are 31 times more risk of being admitted. Unexpectedly, these injury patterns are inconsistent with international studies where sprains and open wounds are the leading types of child injuries [29] while agreeing with regional studies confirming that fracture, concussion and organ system injury

are significant predictors of a child hospital admission [21, 35]. Although concussion cases constituted only 3.1% of the total pediatric cases, it comprises nearly 21% of the admitted cases ($p<0.001$). This present study showed that concussion and organ system injury are more common among the young age group while fractures are more prevalent among the older pediatric population [28, 34, 36, 37]. This is understandable as older children tend to be more actively involved in sports and leisure activities, and therefore relatively more prone to fractures of extremities than their counterparts. Regardless of child's age, knowledge of risk factors along with education, injury awareness programs and adequate intervention measures should be implemented to enhance environmental safety and prevent childhood injuries [6, 25, 38, 39]. Insurance influenced hospitalization

A widening gap persists between developed and developing countries in terms of injury prevention and severity outcomes. Previous literature noted that high income countries have actively and successfully devised numerous interventions to control for the burden of injury. Following the implementation of trauma registries, theses countries observed major reductions in childhood injury morbidity and mortality as a result of reduce injury frequency and severity, enhancement patients care and subsequently improved patients' outcome [34, 36]. Contrary to high income countries, injury remains the leading cause of child mortality in low- and middle- income countries (LMICs) [25]. Hence, a concerted endeavor is needed to transform child safety and wellbeing in LMICs, though a mixture of approaches ranging from improving emergency care, to building a national surveillance system, to designing and developing education and awareness programs, to implementing and enforcing proper safety regulations and legislations.

This study has some limitations. First, details on the injury mechanism, the circumstances and the adopted safety measures were missing from injured patients' files. This is mainly due to the retrospective nature of the study with its inherited limitations of data variable availability in the original patients' records. Second, standardized coding of injuries (i.e. International Codes of Disease ICD) is also lacking. This information is essential for accurate and reliable documentation and standardized reporting of injury cases to assess their associated risk factors and to design tailored and context-appropriate interventions. Third, this study used emergency department and admission data with no follow up on information on the short- and long- term outcomes of multiple injuries including concussions and their impact on child's behavior and long-term impact. Lastly, this study collected data from hospitals in Beirut. It is possible that data collected from rural areas reflect different findings.

Conclusion

Pediatric injury represents a persistent challenge to the pediatric population and the healthcare system in Lebanon. The lack of proper and standardized documentation of injury cases was common. The establishment of a high-quality surveillance system is crucial to help identify key injury priorities and guide the adaptation of evidence-based injury prevention strategies. Safety policies, awareness campaigns and age-targeted interventions should be initiated to control for childhood injuries and improve child safety. Future studies should examine several factors associated with pediatric injuries including the role of parental injury education and awareness

programs, caregiver's direct and active supervision and the presence of a safe and injury free environment.

Conflict of Interest Disclosures: All authors have declared that they have no financial conflict of interest.

Ethical approval: This study was approved by the American University of Beirut Internal Review Board (IRB) [BIO-2018-0061] and by each participating hospital ethical committee:

American University of Beirut Medical Center IRB

Geitawi University Hospital ethical committee

Sacre Coeur Hospital ethical committee

Lebanese American University Medical Center IRB

Rafic Hariri Hospital University Beirut IRB

Word Count: 3193

Funding/Support: CNRS, (BIO-0061)

Role of Funder/Sponsor (if any): Funded data collection and analysis

Data Sharing: No additional data available

Authors Contribution

Dr. Al Hajj and Dr. El Sayed conceptualized the study, provided insights into the discussion section and contributed to the write-up and editing of the manuscript.

Dr. Ariss carried out the literature reviews, provided insights into the discussion section and contributed the write up of the manuscript.

Ms. Rana Bachir was the lead statistician of this study, provided insight in data interpretation as well as contributing to the write up.

Dr. Mariana Helou, Dr. Elie Zaghrini, Dr. Fathallah Fatouh and Dr. Rachid Rahme all contributed for the data access, revision and final editing of the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Figure 1: Distribution of the mechanism of injury by age groups.

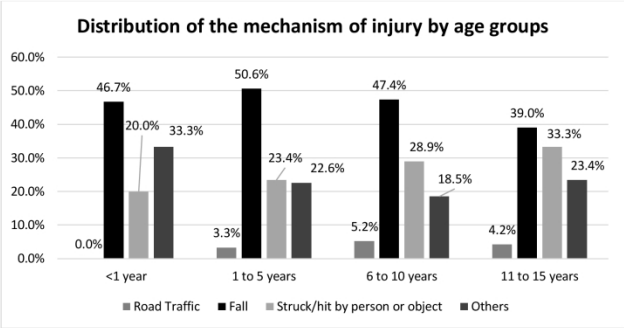

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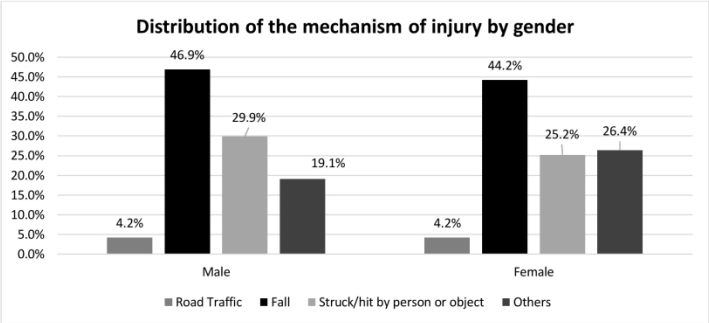
Figure 2: Distribution of the mechanism of injury by gender.



215x279mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract (Page 1-6)	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction (Page 7-8)		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods (Page 8-10)		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses
Results (page 11-22)		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data	15*	Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

Discussion (Page 22-27)		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information (Page 28)		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Pediatric Injury in Beirut: A Multi-Center Retrospective study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-055639.R1
Article Type:	Original research
Date Submitted by the Author:	09-Jan-2022
Complete List of Authors:	Al-Hajj, Samar; American University of Beirut Ariss, Abdel-Badih; American University of Beirut Medical Center, Bachir, Rana; American University of Beirut Helou, Mariana; Rizk Hospital, Department of Emergency Medicine Zaghrini, Elie; Lebanese Hospital Geitawi, Department of Emergency Medicine Fatouh, Fathalla; Harriri University Hospital, Department of Emergency Medicine Rahme, Rachid; Sacre-Coeur Hospital El Sayed, Mazen; American University of Beirut Medical Center, Department of Emergency Medicine; American University of Beirut Medical Center
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Epidemiology
Keywords:	EPIDEMIOLOGY, PUBLIC HEALTH, ACCIDENT & EMERGENCY MEDICINE, TRAUMA MANAGEMENT

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Pediatric Injury in Beirut: A Multi-Center Retrospective study

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Short title: Pediatric injury in Beirut, Lebanon.

Conflict of Interest Disclosures: All authors have declared that they have no financial conflict of interest.

Word Count:

Funding/Support: National Council for Scientific Research (CNRS)
Role of Funder/Sponsor (if any): Funded data collection and analysis

Data availability: Raw data were generated at the different hospitals (AUBMC, LAUMC, RHUH, Sacre Coeur hospital, Geitawi hospital). Derived data supporting the findings of this study are available from the corresponding author on request

Abbreviations: Emergency Department (ED), Eastern Mediterranean Region (EMR), disability-adjusted life year (DALY), Pan-Asia Trauma Outcomes Study (PATOS), International Classification of Disease 9th clinical modification (ICD – 9 - CM) or 10th edition (ICD – 10 - CM), Statistical Package for the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago, IL), Road Traffic Injury (RTIs), low- and middle- income countries (LMICs)

Table of Contents Summary: This study presents evidence on the characteristics, mechanisms and clinical outcomes of pediatric injuries at multiple centers in Beirut.

What's known on This Subject?

Lebanon an upper- middle- income EMR country suffers from a large burden of injury, particularly among its pediatric population. With the absence of injury surveillance systems and registries, the magnitude and extent of the pediatric injury burden remain ambiguous with a limited impact on child injury prevention programs and safety policies.

What This Study Adds?

The study findings offered an insight into understanding the mechanisms and outcomes of child injury. Evidence generated from this study will inform the design of parents' child injury prevention and safety programs and strategies.

Authors Contribution

Dr. Al Hajj and Dr. El Sayed conceptualized the study, provided insights into the discussion section and contributed to the write-up and editing of the manuscript.

Dr. Ariss carried out the literature reviews, provided insights into the discussion section and contributed the write-up of the manuscript.

Ms. Rana Bachir was the lead statistician of this study, provided insight into data interpretation and contributed to the write-up

Dr. Mariana Helou, Dr. Elie Zaghrini, Dr. Fathallah Fatouh and Dr. Rachid Rahme all contributed to the data access, revision and final editing of the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Abstract

Objective This study aims to assess the epidemiology of pediatric injury in Beirut, giving insights into their characteristics, contributing risk factors and outcomes.

Design and setting A retrospective study was conducted to review medical charts for children aged 0-15y presented to 5 hospital Emergency Departments (ED) located in Beirut over a one-year period (June 2017-May 2018).

Participants One thousand one hundred forty-two trauma-related visits for Children under 15 years of age were included. A descriptive analysis and a bivariate analysis were performed to investigate admitted and treated/discharged patients.

Primary outcome A logistic regression was conducted to identify factors associated with hospital admission among injured children.

Results A total of 1,142 cases of pediatric injury ED cases were sampled, mean age was 7.7 ± 4.35 years. Children 0-5 years accounted for more than one-third of the total cases, 40.0% (206/516) of the fall injuries and 60.1% (220/366) of home injuries. The leading cause of pediatric injury was fall (45.2%), nearly 4.1% of the cases were admitted to hospitals. Factors associated with

admission included injury to abdomen (OR =8.25 [1.11 – 61.24]), to upper extremity (OR = 5.79 [CI 2.04 – 16.49]), to lower extremity (OR =5.55 [95% CI 2.02 – 15.20] and other insurance type (OR = 8.33 [CI 2.19 – 31.67]). The three types of injuries mostly associated with hospital admission were fracture (OR =13.55 [CI 4.77 – 38.44]), concussion (OR = 13.60 [CI 2.83 – 65.41]), and organ system injury (OR =31.63 [CI 3.45 – 290.11]).

Conclusions Injury remains a major health problem among the pediatric population in Lebanon. Parental child safety educational programs and age-targeted injury prevention strategies should be initiated and implemented to mitigate the burden of child injuries and improve child safety and well-being.

Strength and limitations

- This study offers an insight into understanding the mechanisms and outcomes of child injury.
- Evidence generated from this study will inform the design of parents' child injury prevention and safety programs and strategies
- The data on details surrounding the injury event and on causes of deaths are also missing in ED documentation since there is a lack of proper documentation and universal coding among the hospitals at hand.

Introduction

Pediatric injury represents the 3rd leading cause of death among children aged less than 15, surpassing major common childhood diseases [1, 2]. An estimated 6 million children die every year as a result of injuries [1], with millions others requiring medical care through emergency visits and hospitalization [3]. Pediatric injury constitutes a major contributor to the Global Burden of Disease, accounting for nearly 10.6% of the global number of deaths for individuals less than 20 years of age [1, 4]. The pediatric population is particularly vulnerable to all types of injuries. Children have limited abilities to rationally judge hazards and risks in their surrounding environment, ultimately increasing their vulnerability and exposure to multiple types of injuries.

Pediatric injury persists as one of the leading causes of child deaths in low- and middle-income countries [2, 5-7]. The high injury mortality and morbidity rates are due to multiple contributing factors including but not limited to child's family socioeconomic and educational status and income level, hazardous environment, and the degree of child supervision [8-10]. The Eastern Mediterranean Region (EMR) which includes many low- and middle-income countries previously reported the highest rate of child and adolescent injury globally in 2017 with an estimated rate of 43.2 per 100,000 population. This high rate is equivalent to more than 130,000 child deaths in 2017, mainly caused by transport, violence, and regional conflicts and wars [11, 12]. Lebanon an upper- middle- income EMR country, suffers from a large burden of injury, especially among its pediatric population. The country's WHO 2000-2012 estimates suggest that injury is the 3rd leading cause of death and the 5th leading cause of disability-adjusted life year (DALY) in Lebanon [13]. Further to its substantial toll on children's physical and emotional well-being, injury results in a substantial economic burden on the injured child family and caregivers and above all on the resource-limited Lebanese healthcare system [14]. Although children represent approximately 31% of the Lebanese population [15], the number of studies investigating pediatric injuries remains scarce with a limited impact of injury prevention programs and safety policies [16-19]. Additionally, the lack of hospital surveillance systems and trauma registries in Lebanon render it challenging to accurately assess the magnitude and the extent of the child injury problem and its associated risk factors.

The main objective of this study is to examine the pediatric injury epidemiology in Lebanon's capital city, Beirut, providing insights into understanding its magnitude, injury mechanisms and outcomes. Evidence generated from this study will help to inform the design of future parents' child educational safety programs and injury prevention strategies and policies to reduce the child injury burden and mitigate its impacts on children's health and well-being.

Methodology

Study Setting

Data were retrospectively collected from reviewed patients' charts at Emergency Departments at 5 hospitals located in the greater Beirut district area, which encompasses almost 30% of the Lebanese population (2.2 million). Data were captured from 5 urban hospitals: The American University of Beirut Medical Center (330 beds, 60,000 annual ED visits), Hariri Governmental Hospital (544 Beds, 17,000 annual ED visits), Geitawi hospital (250 beds, 11,000 annual ED visits), LAU medical center (120 beds, 6,000), and Sacre-Coeur hospital (155 beds, 4,000 annual ED visits). This study was approved by Internal Review Board (IRB) [BIO-2018-0061] at the

American University of Beirut (leading site) and the ethical committee at each participating hospital.

Patient Involvement

Patients or members of the public were not involved in the study since it was a de-identified data and a retrospective chart review study.

Data Collection

Data were collected on children aged 0-15 who sustained any type of injury and presented to one of the participating hospitals within the 12 months period from June 2017-May 2018. Both intentional and unintentional injuries were included in the database. Additional information was collected related to child socio-demographic information, injury mechanism, activity at the time of injury, injury location and body part injured, and injury anatomical and clinical outcomes. The Pan-Asia Trauma Outcomes Study (PATOS)[20] was adopted to design and develop the data collection form.

At each hospital, patients' ED medical records were reviewed. Injury cases were filtered by mechanisms coded according to the *International Classification of Disease 9th, clinical modification (ICD -9-CM)* or *10th edition (ICD -10-CM)* adopted at some hospitals or by keywords at hospitals with the absence of a proper coding scheme. Data were manually captured by a trained MD into the Redcap software based on the concomitant ICD-10-CM. To calculate the required sample size at each hospital, the injury prevalence for each month of the study period was calculated by dividing the number of ED injured patients by the total number of ED patients for the corresponding month. The desired precision between 5% and 10 % was used and a 95% confidence interval was adopted while calculating the sample size.

Data Analysis

A descriptive and inferential statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago, IL). Characteristics, trends and patterns of injury were described for the total sample and the four children's age-stratified groups (less than 1, 1-5, 6-10, and 11-15 years). Mean (standard deviation), median, and the interquartile range were calculated to summarize age and vital signs. Pearson's Chi-Square or Fisher's exact tests were used to assess the significance of the statistical association between all categorical variables and the outcome variable [ED disposition (admitted vs. treated and discharged)]. All clinically and statistically significant variables were included in a multivariate analysis using a stepwise logistic regression model to determine the factors associated with hospital admission. A p-value of ≤ 0.05 was used to indicate statistical significance. The final model was found to be a good fit to the data as the Hosmer-Lemeshow test indicated ($p=0.957$) and it discriminated perfectly the two categories of the outcome variable (area under the curve = 0.894 [95% CI: 0.848 – 0.940, $p<0.001$].

Results

A total of 1,142 cases of pediatric cases were sampled from participating hospitals with a sustained injury during the one year (June 2017-May 2018), accounting for almost 23.5% of all traumatic ED cases. Children's ages ranged from 0 to15 with mean age 7.7 ± 4.35 years, mostly Lebanese (80.3 %, n=917), other nationalities were mainly Syrian and Palestinian. Reported injuries were evenly distributed across age groups, with 399 (34.9%) among children 1-5, 370 (32.4%) among

6-10 and 357 (31.3%) among 11-15 years of age, with more males (n= 733, 64.2%) sustaining injuries compared to their female counterparts (n= 408, 35.7%). The male to female ratio was 1.8:1. For all injury mechanisms with one exception for children aged < 1 who were mostly females (n= 10, 62.5%) and accounted for 1.4% (n=16) of the total injuries.

Table 1: General Characteristics of the Studied Population.

	Frequency N (%)				
	<1	**1-5**	**6-10**	**11-15**	**Total**
Cases	16	399	370	357	1142
Gender					
Male	6 (37.5)	243 (60.9)	233 (63.0)	251 (70.3)	733 (64.2)
Female	10 (62.5)	156 (39.1)	137 (37.0)	105 (29.4)	408 (35.7)
Unknown	0 (0)	0 (0)	0 (0)	1 (0.3)	1 (0.1)
Nationality					
Lebanese	3 (18.8)	302 (75.7)	303 (81.9)	309 (86.6)	917 (80.3)
Non-Lebanese (Syrian, Palestinian, etc…)	13 (81.3)	96 (24.1)	66 (17.8)	46 (12.9)	221 (19.4)
Unknown	0 (0)	1 (0.3)	1 (0.3)	2 (0.6)	4 (0.4)
Hospital Type					
Private	3 (18.8)	309 (77.4)	308 (83.2)	298 (83.5)	918 (80.4)
Public	13 (81.3)	90 (22.6)	62 (16.8)	59 (16.5)	224 (19.6)
Insurance Type					
Private	13 (81.3)	330 (82.7)	322 (87.0)	312 (87.4)	977 (85.6)
Self	2 (12.5)	53 (13.3)	41 (11.1)	43 (12.0)	139 (12.2)
Others	1 (6.3)	16 (4.0)	7 (1.9)	2 (0.6)	26 (2.3)

The leading cause of pediatric injury was fall (n=516, 45.2%). Nearly 40.0% (206/516) of fall injuries were sustained by children 0-5. Children pedestrians hit by vehicles or motorcycles represented the majority of the road injury cases (29.2%) and showed a substantially higher prevalence with increasing child age. Almost 35 children (3.1%) sustained a burn injury.
No mortality was identified in the collected sample and most reported pediatric injuries (85.1%) were mild. Nonetheless, nine children suffered from a severe disability that affected their daily activities. These injuries were mainly reported among the older age group 6-15. (Table 2)

Figure 1: Distribution of the mechanism of injury by age groups.

Figure 2: Distribution of the mechanism of injury by gender.

Home was the most common site for injury occurrence (n=366, 32.0%), particularly in young age groups 1-5 (n=207, 51.9%). More frequent injuries were reported in sports/recreational outdoor

areas by 11-15 years old (n=57, 16.0%) and on streets (N=20, 5.6%). Regardless of the location, playing was the most common mechanism of injury sustained by children (n=947, 82.9%).

Table 2: Event characteristics per age group.

	Frequency N (%)				
	<1	**1-5**	**6-10**	**11-15**	**Total**
Cases	16	399	370	357	1142
Intent					
Unintentional	15 (93.8)	394 (98.7)	368 (99.5)	341 (95.5)	1118 (97.9)
Intentional/Assault	0 (0)	1 (0.3)	0 (0)	12 (3.4)	13 (1.1)
Unknown	1 (6.3)	4 (1.0)	2 (0.5)	4 (1.1)	11 (1.0)
Mechanism					
Road Traffic	0 (0)	10 (2.5)	10 (2.7)	8 (2.2)	28 (2.5)
Fall	7 (43.8)	199 (49.9)	172 (46.5)	138 (38.7)	516 (45.2)
Struck/hit by person or object	3 (18.8)	95 (23.8)	114 (30.8)	125 (35.0)	337 (29.5)
Others[1]	5 (31.3)	89 (22.3)	67 (18.1)	83 (23.2)	244 (21.4)
Unknown	1 (6.3)	6 (1.5)	7 (1.9)	3 (0.8)	17 (1.5)
Body Part					
Head	7 (43.8)	89 (22.3)	51 (13.8)	25 (7.0)	172 (15.1)
Face	3 (18.8)	127 (31.8)	81 (21.9)	41 (11.5)	252 (22.1)
Neck/Thorax	1 (6.3)	18 (4.5)	9 (2.4)	8 (2.2)	36 (3.2)
Abdomen	0 (0)	24 (6.0)	7 (1.9)	5 (1.4)	36 (3.2)
Spine	0 (0)	5 (1.3)	4 (1.1)	9 (2.5)	18 (1.6)
Upper Extremities	3 (18.8)	114 (28.6)	146 (39.5)	154 (43.1)	417 (36.5)
Lower Extremities	2 (12.5)	68 (17.0)	101 (27.3)	137 (38.4)	308 (27.0)
External (skin)	0 (0)	5 (1.3)	1 (0.3)	4 (1.1)	10 (0.9)
Other (non-anatomical injury)	0 (0)	4 (1.0)	1 (0.3)	0 (0)	5 (0.4)
Type					

[1] Others include: Stab or cut & Fire, flames or heat & Choking or hanging & Poisoning & Physical over-exertion & Others

Fracture	3 (18.8)	52 (13.0)	77 (20.8)	86 (24.1)	218 (19.1)
Sprain/Strain	1 (6.3)	38 (9.5)	79 (21.4)	117 (32.8)	235 (20.6)
Cuts, bites or open wound	6 (37.5)	154 (38.6)	116 (31.4)	70 (19.6)	346 (30.3)
Bruise or superficial injury	4 (25.0)	105 (26.3)	79 (21.4)	85 (23.8)	273 (23.9)
Burns	1 (6.3)	24 (6.0)	5 (1.4)	5 (1.4)	35 (3.1)
Concussion	2 (12.5)	13 (3.3)	12 (3.2)	8 (2.2)	35 (3.1)
Organ system injury	1 (6.3)	28 (7.0)	12 (3.2)	5 (1.4)	46 (4.0)
Other	0 (0)	1 (0.3)	1 (0.3)	0 (0)	2 (0.2)
Place					
Home	13 (81.3)	207 (51.9)	87 (23.5)	59 (16.5)	366 (32.0)
School	0 (0)	3 (0.8)	14 (3.8)	7 (2.0)	24 (2.1)
Street/highway	0 (0)	13 (3.3)	23 (6.2)	20 (5.6)	56 (4.9)
Residential institution	0 (0)	6 (1.5)	8 (2.2)	12 (3.4)	26 (2.3)
Sports/Athletics area	0 (0)	1 (0.3)	21 (5.7)	57 (16.0)	79 (6.9)
Recreational and cultural area and public building	0 (0)	13 (3.3)	18 (4.9)	9 (2.5)	40 (3.5)
Others[2]	0 (0)	5 (1.3)	5 (1.4)	7 (2.0)	17 (1.5)
Activity					
Education	0 (0)	0 (0)	2 (0.5)	2 (0.6)	4 (0.4)
Sports	0 (0)	0 (0)	24 (6.5)	56 (15.7)	80 (7.0)
Leisure/Play	13 (81.3)	366 (91.7)	310 (83.8)	258 (72.3)	947 (82.9)
Travelling not elsewhere classified	0 (0)	2 (0.5)	5 (1.4)	6 (1.7)	13 (1.1)
Arrival type					
Prehospital ambulance transport	0 (0)	3 (0.8)	3 (0.8)	7 (2.0)	13 (1.1)

[2] Others include: Industrial/construction; Farm, excluding home; Commercial; Countryside, water, sea; Medical service area

Interhospital ambulance transport	0 (0)	0 (0)	1 (0.3)	1 (0.3)	2 (0.2)
Prehospital transport using other vehicles (non-EMS)	15 (93.8)	383 (96.0)	353 (95.4)	343 (96.1)	1094 (95.8)
Interhospital transport using other vehicles (non-EMS)	0 (0)	7 (1.8)	6 (1.6)	3 (0.8)	16 (1.4)
Unknown	1 (6.3)	6 (1.5)	7 (1.9)	3 (0.8)	17 (1.5)

As for the anatomic location of injury, the leading body parts injured were upper extremities (n= 417, 36.5%), lower extremities (n=308, 27.0%), face (n=252, 22.1%) and head (n=172, 15.1%). Children 1-5 sustained more than half of the reported head (n= 89/172, 51.7%) and face (n= 127/252, 50.3%) injuries. Compared to the younger age group, children 6-10 and 11-15 suffered more injuries to extremities with 247 cases (66.8%) and 291 cases (81.5%) respectively (Table 2). In terms of patients' disposition, nearly 1,021 (89.4%) of the injured cases were treated and released at the ED while 47 children (4.1%) were admitted to hospitals. Unknown outcomes accounted for approximately 3.2% of cases.

Table 3: Pre-existing disability and outcome per Age group.

	Frequency N (%)				
	<1	**1-5**	**6-10**	**11-15**	**Total**
Cases	16	399	370	357	1142
Pre-existing disability (GOS)					
Moderate disability[3]	0 (0)	1 (0.3)	3 (0.8)	1 (0.3)	5 (0.4)
Mild or no disability; no disability reported	16 (100)	393 (98.5)	362 (97.8)	354 (99.2)	1125 (98.5)
Unknown	0 (0)	5 (1.3)	5 (1.4)	2 (0.6)	12 (1.1)
ED Disposition					
Treated and discharged	9 (56.3)	350 (87.7)	333 (90.0)	329 (92.2)	1021 (89.4)
Transfer & AMA	4 (25.0)	15 (3.8)	10 (2.7)	8 (2.2)	37 (3.2)

[3] Independent activities of daily living are possible, but cannot resume work/school life

Admitted	0 (0)	17 (4.3)	16 (4.3)	14 (3.9)	47 (4.1)
Unknown	3 (18.8)	17 (4.3)	11 (3.0)	6 (1.7)	37 (3.2)
Modified Rankin Score at Discharge					
No symptoms at all	0 (0)	7 (1.8)	2 (0.5)	4 (1.1)	13 (1.1)
No significant disability despite symptoms; able to carry out all usual duties and activities	9 (56.3)	237 (59.4)	165 (44.6)	125 (35.0)	536 (46.9)
Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance	1 (6.3)	110 (27.6)	173 (46.8)	208 (58.3)	492 (43.1)
Moderate disability; requiring some help, but able to walk without assistance	1 (6.3)	9 (2.3)	9 (2.4)	6 (1.7)	25 (2.2)
Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance	0 (0)	10 (2.5)	4 (1.1)	5 (1.4)	19 (1.7)
Severe disability; bedridden, incontinent and requiring constant nursing care and attention	0 (0)	1 (0.3)	4 (1.1)	0 (0)	5 (0.4)
Unknown	5 (31.3)	25 (6.3)	13 (3.5)	9 (2.5)	52 (4.6)
GOS at discharge					
Severe disability[4]	0 (0)	3 (0.8)	2 (0.5)	4 (1.1)	9 (0.8)

[4] Independent activities of daily living are not possible

Moderate disability[5]	1 (6.3)	39 (9.8)	35 (9.5)	27 (7.6)	102 (8.9)
Recovering state: Mild or no disability; can resume work/school life	11 (68.8)	328 (82.2)	317 (85.7)	316 (88.5)	972 (85.1)
Unknown	4 (25.0)	29 (7.3)	16 (4.3)	10 (2.8)	59 (5.2)

In the bivariate analysis (table not shown), the leading type of injury for admitted pediatric cases was fracture (55.3%) (p<0.001) followed by concussion (21.3%) (p<0.001), organ system injury (21.3%) (p<0.001) and cuts/open wound (17.0%) (p=0.035). The most common injured body part among admitted pediatric cases were upper extremities (53.2%) (p=0.016), head (36.2%) (p<0.001) and abdomen (14.9%) (p<0.001). Privately insured children were more likely to be admitted to the hospital (p= 0.004) as a result of their injuries.

In the multivariate analysis, significant factors that were positively associated with hospital admission included: body regions, namely head (OR =14.35 [95% CI 4.01– 51.34]), abdomen (OR =8.25 [1.11 – 61.24]), upper extremity (OR = 5.79 [95% CI 2.04 – 16.49]), and Lower Extremity (OR =5.55 [95% CI 2.02 – 15.20]), in addition to 'other insurance type' (OR = 8.33 [95% CI 2.19 – 31.67]). The three types of injury with the highest hospital admissions were fracture (OR =13.55 [95% CI 4.77 – 38.44]), concussion (OR = 13.60 [95% CI 2.83 – 65.41]), and organ system injury (OR =31.63 [95% CI 3.45 – 290.11])

Table 4: Factors associated with hospital admission

Variable (Reference)	Odds Ratio*	95% CI	p-value
Insurance Type (Private)			
Self	0.96	0.31 – 2.99	0.942
Others	8.33	2.19 – 31.67	0.002
Body Part – Head (No)			
Yes	14.35	4.01 – 51.34	<0.001
Body Part – Abdomen (No)			
Yes	8.25	1.11 – 61.24	0.039
Body Part – Upper Extremity (No)			
Yes	5.79	2.04 – 16.49	0.001
Body Part – Lower Extremity (No)			
Yes	5.55	2.02 – 15.20	0.001
Type of injury – Fracture (No)			
Yes	13.55	4.77 – 38.44	<0.001
Type of injury – Concussion (No)			
Yes	13.60	2.83 – 65.41	0.001

[5] Independent activities of daily living are possible, but cannot resume work/school life

Type of injury - Organ system injury (No) Yes	31.63	3.45 – 290.11	0.002

*Adjusted for: age, gender, hospital type, nationality, insurance type, mechanism of injury, location of injury (head; face; neck/thorax; abdomen and pelvic contents; upper extremity; lower extremity including bony pelvis), type of injury (fracture; cuts, bites or open wound; bruise or superficial injury; concussion; organ system injury), place of injury (home, including garden and outbuildings; street/highway; sports and athletics area), activity (leisure/play).

Discussion

This study reports evidence on the characteristics, mechanisms, and clinical outcomes of pediatric injuries at multiple centers in Beirut. Pediatric injury is a global public health problem, particularly in low- and middle-income countries and a substantial challenge to limited healthcare systems. Pediatric trauma only recently was identified as a major health concern that warrants further investigation and response [21]. Evidence from this study would help to understand the epidemiology of pediatric injury in Lebanon, which in turn would guide the design and implementation of targeted interventions and effective child injury prevention strategies.

The study results underscore the substantial burden of pediatric injuries, accounting for nearly 23.8% of total traumatic cases presented to ED. These results are comparable to those generated in a local study and reported similar patterns of pediatric injuries among ED presentations at 3 hospitals in Beirut [22]. The high prevalence of child injuries is consistent with previous attempts to quantify the burden of childhood injuries in high-, middle- and low-income countries, regardless of countries' social and cultural disparities [1, 23-26]. A large number of these injuries were sustained by males, similar to existing literature that confirmed the predominance of injuries among males across all mechanisms of injuries along with the increased odds of sustaining repeated injuries [7, 27-30]. Moreover, this study highlighted the high frequency of injury occurrences among children aged 0 to 5. This age group sustained more than one-third of the total number of reported cases, almost 40.0% of the fall injuries and approximately 60.1% of home injuries. This highlights the vulnerability of young children as their physical, mental and cognitive development depends on their surrounding environment, which places them at an increased risk of getting injured. Moreover, the high prevalence of injury in non-Lebanese children less than 1 (mainly Palestinian and Syrian refugees) hints to their low socio-economic status, dire living conditions and limited access to emergency care and appropriate treatment. Contrary to existing literature, the study findings shows that children less than one year sustaining injuries were predominantly females. This can be possibly explained by the patriarchal society where males are more taken care of compared to females. Multiple factors increase the likelihood of injury occurrence, namely child's curious attributes and discovery nature coupled with the lack of safe environments and the absence of parents direct supervision [31];[32]. This underscores parents' fundamental role in child active supervision to protect children as a vulnerable population as well as underlines the importance of securing built-in child safety in the surrounding environment (e.g. locked cabins, gated stairs) that prevents and reduces childhood injuries (Sharma et al., 2018). This study demonstrates that unintentional injuries had a large toll on children, particularly those less than 5 years of age compared to their older counterparts. Nonetheless, it is worth noting that intentional injuries are under-reported in the Lebanese society, particularly with the lack of adequate policies or laws to

protect children from any forms of abuse. As a result, hospitals are constrained from reporting abuse even if observed during evaluation.

The present study confirms that the leading causes of injury across all age groups are falls followed by being hit by objects and road traffic injury (mainly pedestrians). An abundance of literature observed similar findings in low-, middle- and high-income countries and confirmed that fall injury is responsible for the excess hospital ED visits and admissions among children [3, 27-29]. This is mainly due to the onset of independent mobility and poor balance among young children which increases their risk of sustaining fall injuries [33, 34]. Hit by person/objects and Road Traffic Injury (RTIs) were other primary causes of injury among children, increasing with age and peaking at the age of 11-15. The lack of proper injury documentation at the hospital level hinders the comprehensive understanding of the external causes of these injuries, their circumstances and the safety measures adopted. Hence, there is an urgent need to institute a national injury surveillance system or trauma registry at hospitals in Lebanon, which is essential to provide high-quality epidemiological data on the incidence and circumstances of injuries requiring medical attention. Timely collection of injury data is critical for the development, adoption and evaluation of cost-effective injury prevention programs, strategies and policies. This will help to guide future policy priorities for childhood injury prevention and to tailor the implementation of context-sensitive interventions to reduce injuries and mitigate their consequences on the pediatric population.

Similar to existing studies, our findings suggest that injuries in the 0-5 age group resulted mainly in head or face trauma comparable to the 6-15 y who suffered mainly from upper extremity injuries [35]. These body parts are mostly caused by falls and are strongly associated with increased hospital admissions ($p<0.001$). A plausible explanation for this observed pattern of different body parts affected by fall injuries is related to the ability of older children to protect themselves from serious injuries using their peripheral extremities during the injury impact. This further reflects the preponderance of cuts and open wounds in the younger age group 0-10 years old compared to sprain and strain sustained by the older age 10-15y.
To note, neck and thoracoabdominal injuries were among the least injuries observed across all ages. Neck injuries are usually less common in children and thoracoabdominal injuries are usually associated with high impact mechanisms and high injury severity which were not frequent in this study.

Pediatric admission to hospitals considerably varies by injury types and mechanisms, body part injuries, and interestingly by insurance type. Head, abdomen and extremities ranked the highest among body parts injured that require hospital admission. Patients with head, abdomen or upper extremity injuries are almost 14, 8 and 6 times more likely to be admitted to hospital as a result of their injuries. Fall is shown to be the leading mechanism of hospital admission, which consistently agrees with regional studies [24, 27, 28]. Fracture, organ system injury and concussion topped the list of injury types resulting in hospital admissions. Patients with fractures or concussions are 13 times more likely to be admitted to the hospital, and patients with organ injury are 31 times more at risk of being admitted. Unexpectedly, these injury patterns are inconsistent with international studies where sprains and open wounds are the leading types of child injuries [30] while agreeing with regional studies confirming that fracture, concussion and organ system injury are significant predictors of a child hospital admission [22, 36]. Although concussion cases constituted only 3.1%

of the total pediatric cases, it comprises nearly 21% of the admitted cases (p<0.001). This present study showed that concussion and organ system injury is more common among the young age group while fractures are more prevalent among the older pediatric population [29, 35, 37, 38]. This is understandable as older children tend to be more actively involved in sports and leisure activities, and therefore relatively more prone to fractures of extremities than their counterparts. Regardless of child's age, knowledge of risk factors along with education, injury awareness programs and adequate intervention measures should be implemented to enhance environmental safety and prevent childhood injuries [6, 26, 39, 40].

A widening gap persists between developed and developing countries in terms of injury prevention and severity outcomes. Previous literature noted that high-income countries have actively and successfully devised numerous interventions to control for the burden of injury. Following the implementation of trauma registries, these countries observed major reductions in childhood injury morbidity and mortality as a result of reduced injury frequency and severity, enhanced patients care and subsequently improved patients outcomes [35, 37]. Contrary to high-income countries, injury remains the leading cause of child mortality in low- and middle-income countries (LMICs) [26]. Hence, a concerted endeavour is needed to transform child safety and wellbeing in LMICs, through a mixture of approaches ranging from improving emergency care to building a national surveillance system, to designing and developing education and awareness programs, to implementing and enforcing proper safety regulations and legislations.

This study has some limitations. First, injury studies usually report on mortality as an outcome. In our study population, no death cases were reported. This is potentially related to the fact that deaths would typically be coded differently at EDs in Lebanon, under 'cardiac arrest', without identifying a clear etiology such as traumatic death. Prehospital data on details surrounding the injury event and on causes of deaths are also missing in ED documentation since there is a lack of proper documentation in general in the prehospital field and these types of data are not usually shared with ED when the patient arrives at the hospital. Possibly, there were deaths among pediatric patients with 'Unknown outcomes' or among those who were transferred or who left AMA, however, this was not captured in our data. Second details on the injury mechanism, the circumstances and the adopted safety measures were missing from patients' medical records. This is mainly due to the lack of injury surveillance systems and the retrospective nature of the data capturing process with its inherited limitations of available data variables in patients' medical records. Third, standardized coding of injuries (i.e. International Codes of Disease ICD) is lacking, which might have affected the accurate and reliable documentation and standardized reporting of injury cases. This information is essential to assess injury-associated risk factors and to design tailored and context-appropriate interventions. Fourth, this study used emergency department and admission data with limited follow-up information on the short- and long-term outcomes of multiple injuries including concussions and their impacts on a child's behavior and long-term disability. Lastly, this study collected data from hospitals in Beirut. It is possible that data collected from rural areas reflect different trends and patterns in injury.

Conclusion

Pediatric injury represents a persistent challenge to the pediatric population and the healthcare system in Lebanon. With the lack of proper and standardized documentation of injury mechanisms, establishing a high-quality surveillance system is crucial to help identify priorities and guide the adaptation of evidence-based injury prevention strategies. Safety policies, awareness campaigns and age-targeted interventions should be initiated to control for child injuries and improve safety. Future studies should examine in further detail the several factors associated with pediatric injuries including the role of parental injury educational programs, caregiver's direct and active supervision and the presence of a safe and injury-free environment.

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36. Bradshaw, C.J., et al., *International study of the epidemiology of paediatric trauma: PAPSA research study.* World journal of surgery, 2018. **42**(6): p. 1885-1894.
37. Nesje, E., et al., *Epidemiology of paediatric trauma in Norway: a single-trauma centre observational study.* International journal of emergency medicine, 2019. **12**(1): p. 18.
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40. Nansel, T.R., et al., *Preventing unintentional pediatric injuries: a tailored intervention for parents and providers.* Health education research, 2008. **23**(4): p. 656-669.

Figure 1: Distribution of the mechanism of injury by age groups.

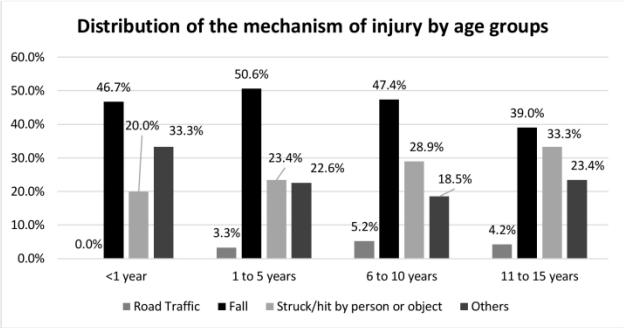

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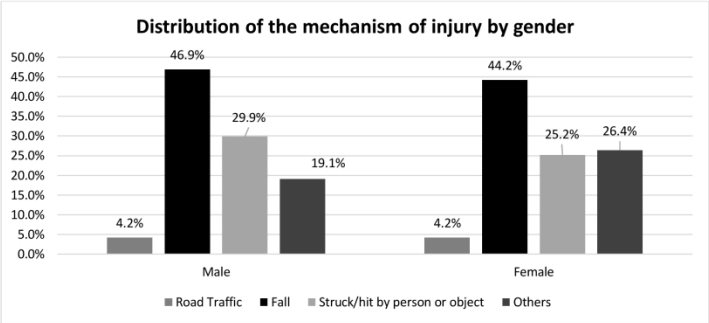
Figure 2: Distribution of the mechanism of injury by gender.



215x279mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract (Page 1-6)	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction (Page 7-8)		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods (Page 8-10)		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses
Results (page 11-22)		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data	15*	Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

Discussion (Page 22-27)		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information (Page 28)		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Pediatric Injury in Beirut: A Multi-Center Retrospective study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-055639.R2
Article Type:	Original research
Date Submitted by the Author:	01-Feb-2022
Complete List of Authors:	Al-Hajj, Samar; American University of Beirut Ariss, Abdel-Badih; American University of Beirut Medical Center, Bachir, Rana; American University of Beirut Helou, Mariana; Rizk Hospital, Department of Emergency Medicine Zaghrini, Elie; Lebanese Hospital Geitawi, Department of Emergency Medicine Fatouh, Fathalla; Harriri University Hospital, Department of Emergency Medicine Rahme, Rachid; Sacre-Coeur Hospital El Sayed, Mazen; American University of Beirut Medical Center, Department of Emergency Medicine; American University of Beirut Medical Center
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Epidemiology
Keywords:	EPIDEMIOLOGY, PUBLIC HEALTH, ACCIDENT & EMERGENCY MEDICINE, TRAUMA MANAGEMENT

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Pediatric Injury in Beirut: A Multi-Center Retrospective study

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Short title: Pediatric injury in Beirut, Lebanon.

Conflict of Interest Disclosures: All authors have declared that they have no financial conflict of interest.

Word Count:

Funding/Support: National Council for Scientific Research (CNRS)

Role of Funder/Sponsor (if any): Funded data collection and analysis

Data availability: Raw data were generated at the different hospitals (AUBMC, LAUMC, RHUH, Sacre Coeur hospital, Geitawi hospital). Derived data supporting the findings of this study are available from the corresponding author on request

Abbreviations: Emergency Department (ED), Eastern Mediterranean Region (EMR), disability-adjusted life year (DALY), Pan-Asia Trauma Outcomes Study (PATOS), International Classification of Disease 9th clinical modification (ICD – 9 - CM) or 10th edition (ICD – 10 - CM*)*, Statistical Package for the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago, IL), Road Traffic Injury (RTIs), low- and middle- income countries (LMICs)

Table of Contents Summary: This study presents evidence on the characteristics, mechanisms and clinical outcomes of pediatric injuries at multiple centers in Beirut.

What's known on This Subject?

Lebanon an upper- middle- income EMR country suffers from a large burden of injury, particularly among its pediatric population. With the absence of injury surveillance systems and registries, the magnitude and extent of the pediatric injury burden remain ambiguous with a limited impact on child injury prevention programs and safety policies.

What This Study Adds?

The study findings offered an insight into understanding the mechanisms and outcomes of child injury. Evidence generated from this study will inform the design of parents' child injury prevention and safety programs and strategies.

Authors Contribution

Dr. Al Hajj and Dr. El Sayed conceptualized the study, provided insights into the discussion section and contributed to the write-up and editing of the manuscript.

Dr. Ariss carried out the literature reviews, provided insights into the discussion section and contributed the write-up of the manuscript.

Ms. Rana Bachir was the lead statistician of this study, provided insight into data interpretation and contributed to the write-up

Dr. Mariana Helou, Dr. Elie Zaghrini, Dr. Fathallah Fatouh and Dr. Rachid Rahme all contributed to the data access, revision and final editing of the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Abstract

Objective This study aims to assess the epidemiology of pediatric injury in Beirut, giving insights into their characteristics, contributing risk factors and outcomes.

Design and setting A retrospective study was conducted to review medical charts for children aged 0-15y presented to 5 hospital Emergency Departments (ED) located in Beirut over a one-year period (June 2017-May 2018).

Participants One thousand one hundred forty-two trauma-related visits for Children under 15 years of age were included. A descriptive analysis and a bivariate analysis were performed to investigate admitted and treated/discharged patients.

Primary outcome A logistic regression was conducted to identify factors associated with hospital admission among injured children.

Results A total of 1,142 cases of pediatric injury ED cases were sampled, mean age was 7.7 ± 4.35 years. Children 0-5 years accounted for more than one-third of the total cases, 40.0% (206/516) of

the fall injuries and 60.1% (220/366) of home injuries. The leading cause of pediatric injury was fall (45.2%), nearly 4.1% of the cases were admitted to hospitals. Factors associated with admission included injury to abdomen (OR =8.25 [1.11 – 61.24]), to upper extremity (OR = 5.79 [CI 2.04 – 16.49]), to lower extremity (OR =5.55 [95% CI 2.02 – 15.20] and other insurance type (OR = 8.33 [CI 2.19 – 31.67]). The three types of injuries mostly associated with hospital admission were fracture (OR =13.55 [CI 4.77 – 38.44]), concussion (OR = 13.60 [CI 2.83 – 65.41]), and organ system injury (OR =31.63 [CI 3.45 – 290.11]).

Conclusions Injury remains a major health problem among the pediatric population in Lebanon. Parental child safety educational programs and age-targeted injury prevention strategies should be initiated and implemented to mitigate the burden of child injuries and improve child safety and well-being.

Strength and limitations

- This study offers an insight into understanding the mechanisms and outcomes of child injury.

- Evidence generated from this study will inform the design of parents' child injury prevention and safety programs and strategies

- The data on details surrounding the injury event and on causes of deaths are also missing in ED documentation since there is a lack of proper documentation and universal coding among the hospitals at hand.

Introduction

Pediatric injury represents the 3rd leading cause of death among children aged less than 15, surpassing major common childhood diseases [1, 2]. An estimated 6 million children die every year as a result of injuries [1], with millions others requiring medical care through emergency visits and hospitalization [3]. Pediatric injury constitutes a major contributor to the Global Burden of Disease, accounting for nearly 10.6% of the global number of deaths for individuals less than 20 years of age [1, 4]. The pediatric population is particularly vulnerable to all types of injuries. Children have limited abilities to rationally judge hazards and risks in their surrounding environment, ultimately increasing their vulnerability and exposure to multiple types of injuries. Pediatric injury persists as one of the leading causes of child deaths in low- and middle-income countries [2, 5-7]. The high injury mortality and morbidity rates are due to multiple contributing factors including but not limited to child's family socioeconomic and educational status and income level, hazardous environment, and the degree of child supervision [8-10]. The Eastern Mediterranean Region (EMR) which includes many low- and middle-income countries previously reported the highest rate of child and adolescent injury globally in 2017 with an estimated rate of 43.2 per 100,000 population. This high rate is equivalent to more than 130,000 child deaths in 2017, mainly caused by transport, violence, and regional conflicts and wars [11, 12]. Lebanon an upper- middle- income EMR country, suffers from a large burden of injury, especially among its pediatric population. The country's WHO 2000-2012 estimates suggest that injury is the 3rd leading cause of death and the 5th leading cause of disability-adjusted life year (DALY) in Lebanon [13]. Further to its substantial toll on children's physical and emotional well-being, injury results in a substantial economic burden on the injured child family and caregivers and above all

on the resource-limited Lebanese healthcare system [14]. Although children represent approximately 31% of the Lebanese population [15], the number of studies investigating pediatric injuries remains scarce with a limited impact of injury prevention programs and safety policies [16-19]. Additionally, the lack of hospital surveillance systems and trauma registries in Lebanon render it challenging to accurately assess the magnitude and the extent of the child injury problem and its associated risk factors.

The main objective of this study is to examine the pediatric injury epidemiology in Lebanon's capital city, Beirut, providing insights into understanding its magnitude, injury mechanisms and outcomes. Evidence generated from this study will help to inform the design of future parents' child educational safety programs and injury prevention strategies and policies to reduce the child injury burden and mitigate its impacts on children's health and well-being.

Methodology

Study Setting

Data were retrospectively collected from reviewed patients' charts at Emergency Departments at 5 hospitals located in the greater Beirut district area, which encompasses almost 30% of the Lebanese population (2.2 million). Data were captured from 5 urban hospitals: The American University of Beirut Medical Center (330 beds, 60,000 annual ED visits), Hariri Governmental Hospital (544 Beds, 17,000 annual ED visits), Geitawi hospital (250 beds, 11,000 annual ED visits), LAU medical center (120 beds, 6,000), and Sacre-Coeur hospital (155 beds, 4,000 annual ED visits). This study was approved by Internal Review Board (IRB) [BIO-2018-0061] at the

American University of Beirut (leading site) and the ethical committee at each participating hospital.

Patient Involvement

Patients or members of the public were not involved in the study since it was a de-identified data and a retrospective chart review study.

Data Collection

Data were collected on children aged 0-15 who sustained any type of injury and presented to one of the participating hospitals within the 12 months period from June 2017-May 2018. Both intentional and unintentional injuries were included in the database. Additional information was collected related to child socio-demographic information, injury mechanism, activity at the time of injury, injury location and body part injured, and injury anatomical and clinical outcomes. The Pan-Asia Trauma Outcomes Study (PATOS)[20] was adopted to design and develop the data collection form.

At each hospital, patients' ED medical records were reviewed. Injury cases were filtered by mechanisms coded according to the *International Classification of Disease 9th, clinical modification (ICD -9-CM)* or *10th edition (ICD -10-CM)* adopted at some hospitals or by keywords at hospitals with the absence of a proper coding scheme. Data were manually captured by a trained MD into the Redcap software based on the concomitant ICD-10-CM. To calculate the required sample size at each hospital, the injury prevalence for each month of the study period was calculated by dividing the number of ED injured patients by the total number of ED patients for

the corresponding month. The desired precision between 5% and 10 % was used and a 95% confidence interval was adopted while calculating the sample size.

Data Analysis

A descriptive and inferential statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago, IL). Characteristics, trends and patterns of injury were described for the total sample and the four children's age-stratified groups (less than 1, 1-5, 6-10, and 11-15 years). Mean (standard deviation), median, and the interquartile range were calculated to summarize age and vital signs. Pearson's Chi-Square or Fisher's exact tests were used to assess the significance of the statistical association between all categorical variables and the outcome variable [ED disposition (admitted vs. treated and discharged)]. All clinically and statistically significant variables were included in a multivariate analysis using a stepwise logistic regression model to determine the factors associated with hospital admission. A p-value of ≤0.05 was used to indicate statistical significance. The final model was found to be a good fit to the data as the Hosmer-Lemeshow test indicated (p=0.957) and it discriminated perfectly the two categories of the outcome variable (area under the curve = 0.894 [95% CI: 0.848 – 0.940, p<0.001].

Results

A total of 1,142 cases of pediatric cases were sampled from participating hospitals with a sustained injury during the one year (June 2017-May 2018), accounting for almost 23.5% of all traumatic ED cases. Children's ages ranged from 0 to15 with mean age 7.7 ± 4.35 years, mostly Lebanese (80.3 %, n=917), other nationalities were mainly Syrian and Palestinian. Reported injuries were

evenly distributed across age groups, with 399 (34.9%) among children 1-5, 370 (32.4%) among 6-10 and 357 (31.3%) among 11-15 years of age, with more males (n= 733, 64.2%) sustaining injuries compared to their female counterparts (n= 408, 35.7%). The male to female ratio was 1.8:1. For all injury mechanisms with one exception for children aged < 1 who were mostly females (n= 10, 62.5%) and accounted for 1.4% (n=16) of the total injuries. (Table 1)

Table 1: General Characteristics of the Studied Population.

	Frequency N (%)				
	<1	**1-5**	**6-10**	**11-15**	**Total**
Cases	16	399	370	357	1142
Gender					
Male	6 (37.5)	243 (60.9)	233 (63.0)	251 (70.3)	733 (64.2)
Female	10 (62.5)	156 (39.1)	137 (37.0)	105 (29.4)	408 (35.7)
Unknown	0 (0)	0 (0)	0 (0)	1 (0.3)	1 (0.1)
Nationality					
Lebanese	3 (18.8)	302 (75.7)	303 (81.9)	309 (86.6)	917 (80.3)
Non-Lebanese (Syrian, Palestinian, etc…)	13 (81.3)	96 (24.1)	66 (17.8)	46 (12.9)	221 (19.4)
Unknown	0 (0)	1 (0.3)	1 (0.3)	2 (0.6)	4 (0.4)
Hospital Type					
Private	3 (18.8)	309 (77.4)	308 (83.2)	298 (83.5)	918 (80.4)

Public	13 (81.3)	90 (22.6)	62 (16.8)	59 (16.5)	224 (19.6)
Insurance Type					
Private	13 (81.3)	330 (82.7)	322 (87.0)	312 (87.4)	977 (85.6)
Self	2 (12.5)	53 (13.3)	41 (11.1)	43 (12.0)	139 (12.2)
Others	1 (6.3)	16 (4.0)	7 (1.9)	2 (0.6)	26 (2.3)

The leading cause of pediatric injury was fall (n=516, 45.2%). Nearly 40.0% (206/516) of fall injuries were sustained by children 0-5. Children pedestrians hit by vehicles or motorcycles represented the majority of the road injury cases (29.2%) and showed a substantially higher prevalence with increasing child age. Almost 35 children (3.1%) sustained a burn injury.

No mortality was identified in the collected sample and most reported pediatric injuries (85.1%) were mild. Nonetheless, nine children suffered from a severe disability that affected their daily activities. These injuries were mainly reported among the older age group 6-15. (Table 2) (Figure 1 & 2)

Figure 1: Distribution of the mechanism of injury by age groups.

Figure 2: Distribution of the mechanism of injury by gender.

Home was the most common site for injury occurrence (n=366, 32.0%), particularly in young age groups 1-5 (n=207, 51.9%). More frequent injuries were reported in sports/recreational outdoor areas by 11-15 years old (n=57, 16.0%) and on streets (N=20, 5.6%). Regardless of the location, playing was the most common mechanism of injury sustained by children (n=947, 82.9%).

Table 2: Event characteristics per age group.

	Frequency N (%)				
	<1	**1-5**	**6-10**	**11-15**	**Total**
Cases	16	399	370	357	1142
Intent					
Unintentional	15 (93.8)	394 (98.7)	368 (99.5)	341 (95.5)	1118 (97.9)
Intentional/Assault	0 (0)	1 (0.3)	0 (0)	12 (3.4)	13 (1.1)
Unknown	1 (6.3)	4 (1.0)	2 (0.5)	4 (1.1)	11 (1.0)
Mechanism					
Road Traffic	0 (0)	10 (2.5)	10 (2.7)	8 (2.2)	28 (2.5)
Fall	7 (43.8)	199 (49.9)	172 (46.5)	138 (38.7)	516 (45.2)
Struck/hit by person or object	3 (18.8)	95 (23.8)	114 (30.8)	125 (35.0)	337 (29.5)

Others[1]	5 (31.3)	89 (22.3)	67 (18.1)	83 (23.2)	244 (21.4)
Unknown	1 (6.3)	6 (1.5)	7 (1.9)	3 (0.8)	17 (1.5)
Body Part					
Head	7 (43.8)	89 (22.3)	51 (13.8)	25 (7.0)	172 (15.1)
Face	3 (18.8)	127 (31.8)	81 (21.9)	41 (11.5)	252 (22.1)
Neck/Thorax	1 (6.3)	18 (4.5)	9 (2.4)	8 (2.2)	36 (3.2)
Abdomen	0 (0)	24 (6.0)	7 (1.9)	5 (1.4)	36 (3.2)
Spine	0 (0)	5 (1.3)	4 (1.1)	9 (2.5)	18 (1.6)
Upper Extremities	3 (18.8)	114 (28.6)	146 (39.5)	154 (43.1)	417 (36.5)
Lower Extremities	2 (12.5)	68 (17.0)	101 (27.3)	137 (38.4)	308 (27.0)
External (skin)	0 (0)	5 (1.3)	1 (0.3)	4 (1.1)	10 (0.9)
Other (non-anatomical injury)	0 (0)	4 (1.0)	1 (0.3)	0 (0)	5 (0.4)
Type					

[1] Others include: Stab or cut & Fire, flames or heat & Choking or hanging & Poisoning & Physical over-exertion & Others

Fracture	3 (18.8)	52 (13.0)	77 (20.8)	86 (24.1)	218 (19.1)
Sprain/Strain	1 (6.3)	38 (9.5)	79 (21.4)	117 (32.8)	235 (20.6)
Cuts, bites or open wound	6 (37.5)	154 (38.6)	116 (31.4)	70 (19.6)	346 (30.3)
Bruise or superficial injury	4 (25.0)	105 (26.3)	79 (21.4)	85 (23.8)	273 (23.9)
Burns	1 (6.3)	24 (6.0)	5 (1.4)	5 (1.4)	35 (3.1)
Concussion	2 (12.5)	13 (3.3)	12 (3.2)	8 (2.2)	35 (3.1)
Organ system injury	1 (6.3)	28 (7.0)	12 (3.2)	5 (1.4)	46 (4.0)
Other	0 (0)	1 (0.3)	1 (0.3)	0 (0)	2 (0.2)
Place					
Home	13 (81.3)	207 (51.9)	87 (23.5)	59 (16.5)	366 (32.0)
School	0 (0)	3 (0.8)	14 (3.8)	7 (2.0)	24 (2.1)
Street/highway	0 (0)	13 (3.3)	23 (6.2)	20 (5.6)	56 (4.9)
Residential institution	0 (0)	6 (1.5)	8 (2.2)	12 (3.4)	26 (2.3)
Sports/Athletics area	0 (0)	1 (0.3)	21 (5.7)	57 (16.0)	79 (6.9)

Recreational and cultural area and public building	0 (0)	13 (3.3)	18 (4.9)	9 (2.5)	40 (3.5)
Others[2]	0 (0)	5 (1.3)	5 (1.4)	7 (2.0)	17 (1.5)
Activity					
Education	0 (0)	0 (0)	2 (0.5)	2 (0.6)	4 (0.4)
Sports	0 (0)	0 (0)	24 (6.5)	56 (15.7)	80 (7.0)
Leisure/Play	13 (81.3)	366 (91.7)	310 (83.8)	258 (72.3)	947 (82.9)
Travelling not elsewhere classified	0 (0)	2 (0.5)	5 (1.4)	6 (1.7)	13 (1.1)
Arrival type					
Prehospital ambulance transport	0 (0)	3 (0.8)	3 (0.8)	7 (2.0)	13 (1.1)
Interhospital ambulance transport	0 (0)	0 (0)	1 (0.3)	1 (0.3)	2 (0.2)

[2] Others include: Industrial/construction; Farm, excluding home; Commercial; Countryside, water, sea; Medical service area

Prehospital transport using other vehicles (non-EMS)	15 (93.8)	383 (96.0)	353 (95.4)	343 (96.1)	1094 (95.8)
Interhospital transport using other vehicles (non-EMS)	0 (0)	7 (1.8)	6 (1.6)	3 (0.8)	16 (1.4)
Unknown	1 (6.3)	6 (1.5)	7 (1.9)	3 (0.8)	17 (1.5)

As for the anatomic location of injury, the leading body parts injured were upper extremities (n= 417, 36.5%), lower extremities (n=308, 27.0%), face (n=252, 22.1%) and head (n=172, 15.1%). Children 1-5 sustained more than half of the reported head (n= 89/172, 51.7%) and face (n= 127/252, 50.3%) injuries. Compared to the younger age group, children 6-10 and 11-15 suffered more injuries to extremities with 247 cases (66.8%) and 291 cases (81.5%) respectively (Table 2). In terms of patients' disposition, nearly 1,021 (89.4%) of the injured cases were treated and released at the ED while 47 children (4.1%) were admitted to hospitals. Unknown outcomes accounted for approximately 3.2% of cases. (Table 3)

Table 3: Pre-existing disability and outcome per Age group.

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	Frequency N (%)				
	<1	**1-5**	**6-10**	**11-15**	**Total**
Cases	16	399	370	357	1142
Pre-existing disability (GOS)					
Moderate disability[3]	0 (0)	1 (0.3)	3 (0.8)	1 (0.3)	5 (0.4)
Mild or no disability; no disability reported	16 (100)	393 (98.5)	362 (97.8)	354 (99.2)	1125 (98.5)
Unknown	0 (0)	5 (1.3)	5 (1.4)	2 (0.6)	12 (1.1)
ED Disposition					
Treated and discharged	9 (56.3)	350 (87.7)	333 (90.0)	329 (92.2)	1021 (89.4)
Transfer & AMA	4 (25.0)	15 (3.8)	10 (2.7)	8 (2.2)	37 (3.2)
Admitted	0 (0)	17 (4.3)	16 (4.3)	14 (3.9)	47 (4.1)
Unknown	3 (18.8)	17 (4.3)	11 (3.0)	6 (1.7)	37 (3.2)
Modified Rankin Score at Discharge					

[3] Independent activities of daily living are possible, but cannot resume work/school life

No symptoms at all	0 (0)	7 (1.8)	2 (0.5)	4 (1.1)	13 (1.1)
No significant disability despite symptoms; able to carry out all usual duties and activities	9 (56.3)	237 (59.4)	165 (44.6)	125 (35.0)	536 (46.9)
Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance	1 (6.3)	110 (27.6)	173 (46.8)	208 (58.3)	492 (43.1)
Moderate disability; requiring some help, but able to walk without assistance	1 (6.3)	9 (2.3)	9 (2.4)	6 (1.7)	25 (2.2)
Moderately severe disability; unable	0 (0)	10 (2.5)	4 (1.1)	5 (1.4)	19 (1.7)

to walk without assistance and unable to attend to own bodily needs without assistance					
Severe disability; bedridden, incontinent and requiring constant nursing care and attention	0 (0)	1 (0.3)	4 (1.1)	0 (0)	5 (0.4)
Unknown	5 (31.3)	25 (6.3)	13 (3.5)	9 (2.5)	52 (4.6)
GOS at discharge					
Severe disability[4]	0 (0)	3 (0.8)	2 (0.5)	4 (1.1)	9 (0.8)
Moderate disability[5]	1 (6.3)	39 (9.8)	35 (9.5)	27 (7.6)	102 (8.9)
Recovering state: Mild or no disability; can resume work/school life	11 (68.8)	328 (82.2)	317 (85.7)	316 (88.5)	972 (85.1)

[4] Independent activities of daily living are not possible
[5] Independent activities of daily living are possible, but cannot resume work/school life

Unknown	4 (25.0)	29 (7.3)	16 (4.3)	10 (2.8)	59 (5.2)

In the bivariate analysis (table not shown), the leading type of injury for admitted pediatric cases was fracture (55.3%) (p<0.001) followed by concussion (21.3%) (p<0.001), organ system injury (21.3%) (p<0.001) and cuts/open wound (17.0%) (p=0.035). The most common injured body part among admitted pediatric cases were upper extremities (53.2%) (p=0.016), head (36.2%) (p<0.001) and abdomen (14.9%) (p<0.001). Privately insured children were more likely to be admitted to the hospital (p= 0.004) as a result of their injuries.

In the multivariate analysis, significant factors that were positively associated with hospital admission included: body regions, namely head (OR =14.35 [95% CI 4.01– 51.34]), abdomen (OR =8.25 [1.11 – 61.24]), upper extremity (OR = 5.79 [95% CI 2.04 – 16.49]), and Lower Extremity (OR =5.55 [95% CI 2.02 – 15.20]), in addition to 'other insurance type' (OR = 8.33 [95% CI 2.19 – 31.67]). The three types of injury with the highest hospital admissions were fracture (OR =13.55 [95% CI 4.77 – 38.44]), concussion (OR = 13.60 [95% CI 2.83 – 65.41]), and organ system injury (OR =31.63 [95% CI 3.45 – 290.11]) (Table 4)

Table 4: Factors associated with hospital admission

Variable (Reference)	**Odds Ratio***	**95% CI**	**p-value**
Insurance Type (Private)			
Self	0.96	0.31 – 2.99	0.942

Others	8.33	2.19 – 31.67	0.002
Body Part – Head (No) Yes	14.35	4.01 – 51.34	<0.001
Body Part – Abdomen (No) Yes	8.25	1.11 – 61.24	0.039
Body Part – Upper Extremity (No) Yes	5.79	2.04 – 16.49	0.001
Body Part – Lower Extremity (No) Yes	5.55	2.02 – 15.20	0.001
Type of injury – Fracture (No) Yes	13.55	4.77 – 38.44	<0.001
Type of injury – Concussion (No) Yes	13.60	2.83 – 65.41	0.001
Type of injury - Organ system injury (No) Yes	31.63	3.45 – 290.11	0.002

*Adjusted for: age, gender, hospital type, nationality, insurance type, mechanism of injury, location of injury (head; face; neck/thorax; abdomen and pelvic contents; upper extremity; lower extremity including bony pelvis), type of injury (fracture; cuts, bites or open wound; bruise or superficial injury; concussion; organ system injury), place of injury (home, including garden and outbuildings; street/highway; sports and athletics area), activity (leisure/play).

Discussion

This study reports evidence on the characteristics, mechanisms, and clinical outcomes of pediatric injuries at multiple centers in Beirut. Pediatric injury is a global public health problem, particularly in low- and middle-income countries and a substantial challenge to limited healthcare systems. Pediatric trauma only recently was identified as a major health concern that warrants further investigation and response [21]. Evidence from this study would help to understand the epidemiology of pediatric injury in Lebanon, which in turn would guide the design and implementation of targeted interventions and effective child injury prevention strategies.

The study results underscore the substantial burden of pediatric injuries, accounting for nearly 23.8% of total traumatic cases presented to ED. These results are comparable to those generated in a local study and reported similar patterns of pediatric injuries among ED presentations at 3 hospitals in Beirut [22]. The high prevalence of child injuries is consistent with previous attempts to quantify the burden of childhood injuries in high-, middle- and low-income countries, regardless of countries' social and cultural disparities [1, 23-26]. A large number of these injuries were sustained by males, similar to existing literature that confirmed the predominance of injuries among males across all mechanisms of injuries along with the increased odds of sustaining repeated injuries [7, 27-30]. Moreover, this study highlighted the high frequency of injury occurrences among children aged 0 to 5. This age group sustained more than one-third of the total number of reported cases, almost 40.0% of the fall injuries and approximately 60.1% of home injuries. This highlights the vulnerability of young children as their physical, mental and cognitive development depends on their surrounding environment, which places them at an increased risk of getting injured. Moreover, the high prevalence of injury in non-Lebanese children less than 1 (mainly Palestinian and Syrian

refugees) hints to their low socio-economic status, dire living conditions and limited access to emergency care and appropriate treatment. Contrary to existing literature, the study findings shows that children less than one year sustaining injuries were predominantly females. This can be possibly explained by the patriarchal society where males are more taken care of compared to females. Multiple factors increase the likelihood of injury occurrence, namely child's curious attributes and discovery nature coupled with the lack of safe environments and the absence of parents direct supervision [31];[32]. This underscores parents' fundamental role in child active supervision to protect children as a vulnerable population as well as underlines the importance of securing built-in child safety in the surrounding environment (e.g. locked cabins, gated stairs) that prevents and reduces childhood injuries (Sharma et al., 2018). This study demonstrates that unintentional injuries had a large toll on children, particularly those less than 5 years of age compared to their older counterparts. Nonetheless, it is worth noting that intentional injuries are under-reported in the Lebanese society, particularly with the lack of adequate policies or laws to protect children from any forms of abuse. As a result, hospitals are constrained from reporting abuse even if observed during evaluation.

The present study confirms that the leading causes of injury across all age groups are falls followed by being hit by objects and road traffic injury (mainly pedestrians). An abundance of literature observed similar findings in low-, middle- and high-income countries and confirmed that fall injury is responsible for the excess hospital ED visits and admissions among children [3, 27-29]. This is mainly due to the onset of independent mobility and poor balance among young children which increases their risk of sustaining fall injuries [33, 34]. Hit by person/objects and Road Traffic Injury (RTIs) were other primary causes of injury among children, increasing with age and

peaking at the age of 11-15. The lack of proper injury documentation at the hospital level hinders the comprehensive understanding of the external causes of these injuries, their circumstances and the safety measures adopted. Hence, there is an urgent need to institute a national injury surveillance system or trauma registry at hospitals in Lebanon, which is essential to provide high-quality epidemiological data on the incidence and circumstances of injuries requiring medical attention. Timely collection of injury data is critical for the development, adoption and evaluation of cost-effective injury prevention programs, strategies and policies. This will help to guide future policy priorities for childhood injury prevention and to tailor the implementation of context-sensitive interventions to reduce injuries and mitigate their consequences on the pediatric population.

Similar to existing studies, our findings suggest that injuries in the 0-5 age group resulted mainly in head or face trauma comparable to the 6-15 y who suffered mainly from upper extremity injuries [35]. These body parts are mostly caused by falls and are strongly associated with increased hospital admissions ($p<0.001$). A plausible explanation for this observed pattern of different body parts affected by fall injuries is related to the ability of older children to protect themselves from serious injuries using their peripheral extremities during the injury impact. This further reflects the preponderance of cuts and open wounds in the younger age group 0-10 years old compared to sprain and strain sustained by the older age 10-15y.

To note, neck and thoracoabdominal injuries were among the least injuries observed across all ages. Neck injuries are usually less common in children and thoracoabdominal injuries are usually associated with high impact mechanisms and high injury severity which were not frequent in this study.

Pediatric admission to hospitals considerably varies by injury types and mechanisms, body part injuries, and interestingly by insurance type. Head, abdomen and extremities ranked the highest among body parts injured that require hospital admission. Patients with head, abdomen or upper extremity injuries are almost 14, 8 and 6 times more likely to be admitted to hospital as a result of their injuries. Fall is shown to be the leading mechanism of hospital admission, which consistently agrees with regional studies [24, 27, 28]. Fracture, organ system injury and concussion topped the list of injury types resulting in hospital admissions. Patients with fractures or concussions are 13 times more likely to be admitted to the hospital, and patients with organ injury are 31 times more at risk of being admitted. Unexpectedly, these injury patterns are inconsistent with international studies where sprains and open wounds are the leading types of child injuries [30] while agreeing with regional studies confirming that fracture, concussion and organ system injury are significant predictors of a child hospital admission [22, 36]. Although concussion cases constituted only 3.1% of the total pediatric cases, it comprises nearly 21% of the admitted cases ($p<0.001$). This present study showed that concussion and organ system injury is more common among the young age group while fractures are more prevalent among the older pediatric population [29, 35, 37, 38]. This is understandable as older children tend to be more actively involved in sports and leisure activities, and therefore relatively more prone to fractures of extremities than their counterparts. Regardless of child's age, knowledge of risk factors along with education, injury awareness programs and adequate intervention measures should be implemented to enhance environmental safety and prevent childhood injuries [6, 26, 39, 40].

A widening gap persists between developed and developing countries in terms of injury prevention and severity outcomes. Previous literature noted that high-income countries have actively and successfully devised numerous interventions to control for the burden of injury. Following the implementation of trauma registries, these countries observed major reductions in childhood injury morbidity and mortality as a result of reduced injury frequency and severity, enhanced patients care and subsequently improved patients outcomes [35, 37]. Contrary to high-income countries, injury remains the leading cause of child mortality in low- and middle-income countries (LMICs) [26]. Hence, a concerted endeavour is needed to transform child safety and wellbeing in LMICs, through a mixture of approaches ranging from improving emergency care to building a national surveillance system, to designing and developing education and awareness programs, to implementing and enforcing proper safety regulations and legislations.

This study has some limitations. First, injury studies usually report on mortality as an outcome. In our study population, no death cases were reported. This is potentially related to the fact that deaths would typically be coded differently at EDs in Lebanon, under 'cardiac arrest', without identifying a clear etiology such as traumatic death. Prehospital data on details surrounding the injury event and on causes of deaths are also missing in ED documentation since there is a lack of proper documentation in general in the prehospital field and these types of data are not usually shared with ED when the patient arrives at the hospital. Possibly, there were deaths among pediatric patients with 'Unknown outcomes' or among those who were transferred or who left AMA, however, this was not captured in our data. Second details on the injury mechanism, the circumstances and the adopted safety measures were missing from patients' medical records. This is mainly due to the lack of injury surveillance systems and the retrospective nature of the data

capturing process with its inherited limitations of available data variables in patients' medical records. Third, standardized coding of injuries (i.e. International Codes of Disease ICD) is lacking, which might have affected the accurate and reliable documentation and standardized reporting of injury cases. This information is essential to assess injury-associated risk factors and to design tailored and context-appropriate interventions. Fourth, this study used emergency department and admission data with limited follow-up information on the short- and long-term outcomes of multiple injuries including concussions and their impacts on a child's behavior and long-term disability. Lastly, this study collected data from hospitals in Beirut. It is possible that data collected from rural areas reflect different trends and patterns in injury.

Conclusion

Pediatric injury represents a persistent challenge to the pediatric population and the healthcare system in Lebanon. With the lack of proper and standardized documentation of injury mechanisms, establishing a high-quality surveillance system is crucial to help identify priorities and guide the adaptation of evidence-based injury prevention strategies. Safety policies, awareness campaigns and age-targeted interventions should be initiated to control for child injuries and improve safety. Future studies should examine in further detail the several factors associated with pediatric injuries including the role of parental injury educational programs, caregiver's direct and active supervision and the presence of a safe and injury-free environment.

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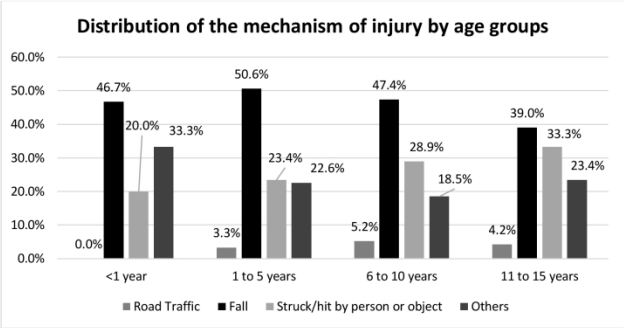
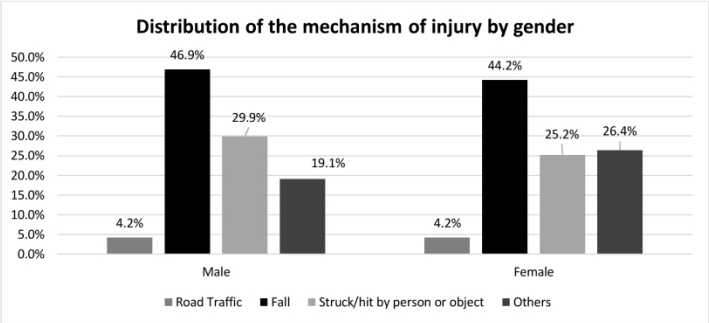
Figure 1: Distribution of the mechanism of injury by age groups.



215x279mm (300 x 300 DPI)

Figure 2: Distribution of the mechanism of injury by gender.



215x279mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract (Page 1-6)	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction (Page 7-8)		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods (Page 8-10)		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses
Results (page 11-22)		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data	15*	Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

Discussion (Page 22-27)		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information (Page 28)		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Pediatric Injury in Beirut: A Multi-Center Retrospective Chart Review study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-055639.R3
Article Type:	Original research
Date Submitted by the Author:	21-Feb-2022
Complete List of Authors:	Al-Hajj, Samar; American University of Beirut Ariss, Abdel-Badih; American University of Beirut Medical Center, Bachir, Rana; American University of Beirut Helou, Mariana; Rizk Hospital, Department of Emergency Medicine Zaghrini, Elie; Lebanese Hospital Geitawi, Department of Emergency Medicine Fatouh, Fathalla; Harriri University Hospital, Department of Emergency Medicine Rahme, Rachid; Sacre-Coeur Hospital El Sayed, Mazen; American University of Beirut Medical Center, Department of Emergency Medicine; American University of Beirut Medical Center
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Epidemiology
Keywords:	EPIDEMIOLOGY, PUBLIC HEALTH, ACCIDENT & EMERGENCY MEDICINE, TRAUMA MANAGEMENT

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Pediatric Injury in Beirut: A Multi-Center Retrospective Chart Review study

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Short title: Pediatric injury in Beirut, Lebanon.

Competing Interest: All authors have declared that they have no financial conflict of interest.

Word Count: 3236

Role of Funder/Sponsor (if any): Funded data collection and analysis

Data sharing: Raw data were generated at the different hospitals (AUBMC, LAUMC, RHUH, Sacre Coeur hospital, Geitawi hospital). Derived data supporting the findings of this study are available from the corresponding author on request.

Abbreviations: Emergency Department (ED), Eastern Mediterranean Region (EMR), disability-adjusted life year (DALY), Pan-Asia Trauma Outcomes Study (PATOS), International Classification of Disease 9th clinical modification (ICD – 9 - CM) or 10th edition (ICD – 10 - CM), Statistical Package for the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago, IL), Road Traffic Injury (RTIs), low- and middle- income countries (LMICs)

Abstract

Objective This study aims to assess the epidemiology of pediatric injury in Beirut, giving insights into their characteristics, contributing risk factors and outcomes.

Design and setting A retrospective study was conducted to review medical charts for children aged 0-15y presented to 5 hospital Emergency Departments (ED) located in Beirut over a one-year period (June 2017-May 2018).

Participants One thousand one hundred forty-two trauma-related visits for Children under 15 years of age were included. A descriptive analysis and a bivariate analysis were performed to investigate admitted and treated/discharged patients.

Primary outcome A logistic regression was conducted to identify factors associated with hospital admission among injured children.

Results A total of 1,142 cases of pediatric injury ED cases were sampled, mean age was 7.7 ± 4.35 years. Children 0-5 years accounted for more than one-third of the total cases, 40.0% (206/516) of the fall injuries and 60.1% (220/366) of home injuries. The leading cause of pediatric injury was fall (45.2%), nearly 4.1% of the cases were admitted to hospitals. Factors associated with admission included injury to abdomen (OR =8.25 [1.11 – 61.24]), to upper extremity (OR = 5.79 [CI 2.04 – 16.49]), to lower extremity (OR =5.55 [95% CI 2.02 – 15.20] and other insurance type (OR = 8.33 [CI 2.19 – 31.67]). The three types of injuries mostly associated with hospital

admission were fracture (OR =13.55 [CI 4.77 – 38.44]), concussion (OR = 13.60 [CI 2.83 – 65.41]), and organ system injury (OR =31.63 [CI 3.45 – 290.11]).

Conclusions Injury remains a major health problem among the pediatric population in Lebanon. Parental child safety educational programs and age-targeted injury prevention strategies should be initiated and implemented to mitigate the burden of child injuries and improve child safety and well-being.

Strength and limitations

- This study offers an insight into understanding the characteristics, mechanisms, and clinical outcomes of pediatric injuries at multiple centers in Beirut.
- Evidence generated from this study will inform the design of parents' child injury prevention and safety programs and strategies.
- Details on the etiology of the injury event and causes of injury deaths were missing in ED data due to the lack of proper documentation and universal coding among participating hospitals.
- The lack of existing injury surveillance systems in Lebanon and the inherited limitation of the retrospectively captured ED data hindered the accurate assessment of the injury mechanisms and associated risk factors.

Introduction

Pediatric injury represents the 3rd leading cause of death among children aged less than 15, surpassing major common childhood diseases [1, 2]. An estimated 6 million children die every year as a result of injuries [1], with millions others requiring medical care through emergency visits and hospitalization [3]. Pediatric injury constitutes a major contributor to the Global Burden of Disease, accounting for nearly 10.6% of the global number of deaths for individuals less than 20 years of age [1, 4]. The pediatric population is particularly vulnerable to all types of injuries. Children have limited abilities to rationally judge hazards and risks in their surrounding environment, ultimately increasing their vulnerability and exposure to multiple types of injuries. Pediatric injury persists as one of the leading causes of child deaths in low- and middle-income countries [2, 5-7]. The high injury mortality and morbidity rates are due to multiple contributing factors including but not limited to child's family socioeconomic and educational status and income level, hazardous environment, and the degree of child supervision [8-10]. The Eastern Mediterranean Region (EMR) which includes many low- and middle-income countries previously reported the highest rate of child and adolescent injury globally in 2017 with an estimated rate of 43.2 per 100,000 population. This high rate is equivalent to more than 130,000 child deaths in 2017, mainly caused by transport, violence, and regional conflicts and wars [11, 12]. Lebanon an upper- middle- income EMR country, suffers from a large burden of injury, especially among its pediatric population. The country's WHO 2000-2012 estimates suggest that injury is the 3rd leading cause of death and the 5th leading cause of disability-adjusted life year (DALY) in Lebanon [13]. Further to its substantial toll on children's physical and emotional well-being, injury results in a substantial economic burden on the injured child family and caregivers and above all

on the resource-limited Lebanese healthcare system [14]. Although children represent approximately 31% of the Lebanese population [15], the number of studies investigating pediatric injuries remains scarce with a limited impact of injury prevention programs and safety policies [16-19]. Additionally, the lack of hospital surveillance systems and trauma registries in Lebanon render it challenging to accurately assess the magnitude and the extent of the child injury problem and its associated risk factors.

The main objective of this study is to examine the pediatric injury epidemiology in Lebanon's capital city, Beirut, providing insights into understanding its magnitude, injury mechanisms and outcomes. Evidence generated from this study will help to inform the design of future parents' child educational safety programs and injury prevention strategies and policies to reduce the child injury burden and mitigate its impacts on children's health and well-being.

Methodology

Study Setting

Data were retrospectively collected from reviewed patients' charts at Emergency Departments at 5 hospitals located in the greater Beirut district area, which encompasses almost 30% of the Lebanese population (2.2 million). Data were captured from 5 urban hospitals: The American University of Beirut Medical Center (330 beds, 60,000 annual ED visits), Hariri Governmental Hospital (544 Beds, 17,000 annual ED visits), Geitawi hospital (250 beds, 11,000 annual ED visits), LAU medical center (120 beds, 6,000), and Sacre-Coeur hospital (155 beds, 4,000 annual ED visits). This study was approved by Internal Review Board (IRB) [BIO-2018-0061] at the

American University of Beirut (leading site) and the ethical committee at each participating hospital.

Data Collection

Data were collected on children aged 0-15 who sustained any type of injury and presented to one of the participating hospitals within the 12 months period from June 2017-May 2018. Both intentional and unintentional injuries were included in the database. Additional information was collected related to child socio-demographic information, injury mechanism, activity at the time of injury, injury location and body part injured, and injury anatomical and clinical outcomes. The Pan-Asia Trauma Outcomes Study (PATOS)[20] was adopted to design and develop the data collection form.

At each hospital, patients' ED medical records were reviewed. Injury cases were filtered by mechanisms coded according to the *International Classification of Disease 9th, clinical modification (ICD -9-CM)* or *10th edition (ICD -10-CM)* adopted at some hospitals or by keywords at hospitals with the absence of a proper coding scheme. Data were manually captured by a trained MD into the Redcap software based on the concomitant ICD-10-CM. To calculate the required sample size at each hospital, the injury prevalence for each month of the study period was calculated by dividing the number of ED injured patients by the total number of ED patients for the corresponding month. The desired precision between 5% and 10 % was used and a 95% confidence interval was adopted while calculating the sample size.

Data Analysis

A descriptive and inferential statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago, IL). Characteristics, trends and patterns of injury were described for the total sample and the four children's age-stratified groups (less than 1, 1-5, 6-10, and 11-15 years). Mean (standard deviation), median, and the interquartile range were calculated to summarize age and vital signs. Pearson's Chi-Square or Fisher's exact tests were used to assess the significance of the statistical association between all categorical variables and the outcome variable [ED disposition (admitted vs. treated and discharged)]. All clinically and statistically significant variables were included in a multivariate analysis using a stepwise logistic regression model to determine the factors associated with hospital admission. A p-value of ≤0.05 was used to indicate statistical significance. The final model was found to be a good fit to the data as the Hosmer-Lemeshow test indicated (p=0.957) and it discriminated perfectly the two categories of the outcome variable (area under the curve = 0.894 [95% CI: 0.848 – 0.940, p<0.001].

Patient and public involvement

Patients or members of the public were not involved in the study since it was a de-identified data and a retrospective chart review study.

Results

A total of 1,142 cases of pediatric cases were sampled from participating hospitals with a sustained injury during the one year (June 2017-May 2018), accounting for almost 23.5% of all traumatic ED cases. Children's ages ranged from 0 to15 with mean age 7.7 ± 4.35 years, mostly Lebanese (80.3 %, n=917), other nationalities were mainly Syrian and Palestinian. Reported injuries were

evenly distributed across age groups, with 399 (34.9%) among children 1-5, 370 (32.4%) among 6-10 and 357 (31.3%) among 11-15 years of age, with more males (n= 733, 64.2%) sustaining injuries compared to their female counterparts (n= 408, 35.7%). The male to female ratio was 1.8:1. For all injury mechanisms with one exception for children aged < 1 who were mostly females (n= 10, 62.5%) and accounted for 1.4% (n=16) of the total injuries. (Table 1)

Table 1: General Characteristics of the Studied Population.

	Frequency N (%)				
	<1	**1-5**	**6-10**	**11-15**	**Total**
Cases	16	399	370	357	1142
Gender					
Male	6 (37.5)	243 (60.9)	233 (63.0)	251 (70.3)	733 (64.2)
Female	10 (62.5)	156 (39.1)	137 (37.0)	105 (29.4)	408 (35.7)
Unknown	0 (0)	0 (0)	0 (0)	1 (0.3)	1 (0.1)
Nationality					
Lebanese	3 (18.8)	302 (75.7)	303 (81.9)	309 (86.6)	917 (80.3)
Non-Lebanese (Syrian, Palestinian, etc…)	13 (81.3)	96 (24.1)	66 (17.8)	46 (12.9)	221 (19.4)
Unknown	0 (0)	1 (0.3)	1 (0.3)	2 (0.6)	4 (0.4)
Hospital Type					
Private	3 (18.8)	309 (77.4)	308 (83.2)	298 (83.5)	918 (80.4)

Public	13 (81.3)	90 (22.6)	62 (16.8)	59 (16.5)	224 (19.6)
Insurance Type					
Private	13 (81.3)	330 (82.7)	322 (87.0)	312 (87.4)	977 (85.6)
Self	2 (12.5)	53 (13.3)	41 (11.1)	43 (12.0)	139 (12.2)
Others	1 (6.3)	16 (4.0)	7 (1.9)	2 (0.6)	26 (2.3)

The leading cause of pediatric injury was fall (n=516, 45.2%). Nearly 40.0% (206/516) of fall injuries were sustained by children 0-5. Children pedestrians hit by vehicles or motorcycles represented the majority of the road injury cases (29.2%) and showed a substantially higher prevalence with increasing child age. Almost 35 children (3.1%) sustained a burn injury.

No mortality was identified in the collected sample and most reported pediatric injuries (85.1%) were mild. Nonetheless, nine children suffered from a severe disability that affected their daily activities. These injuries were mainly reported among the older age group 6-15. (Table 2) (Figure 1 & 2)

Figure 1: Distribution of the mechanism of injury by age groups.

Figure 2: Distribution of the mechanism of injury by gender.

Home was the most common site for injury occurrence (n=366, 32.0%), particularly in young age groups 1-5 (n=207, 51.9%). More frequent injuries were reported in sports/recreational outdoor areas by 11-15 years old (n=57, 16.0%) and on streets (N=20, 5.6%). Regardless of the location, playing was the most common mechanism of injury sustained by children (n=947, 82.9%).

Table 2: Event characteristics per age group.

	Frequency N (%)				
	<1	**1-5**	**6-10**	**11-15**	**Total**
Cases	16	399	370	357	1142
Intent					
Unintentional	15 (93.8)	394 (98.7)	368 (99.5)	341 (95.5)	1118 (97.9)
Intentional/Assault	0 (0)	1 (0.3)	0 (0)	12 (3.4)	13 (1.1)
Unknown	1 (6.3)	4 (1.0)	2 (0.5)	4 (1.1)	11 (1.0)
Mechanism					
Road Traffic	0 (0)	10 (2.5)	10 (2.7)	8 (2.2)	28 (2.5)
Fall	7 (43.8)	199 (49.9)	172 (46.5)	138 (38.7)	516 (45.2)
Struck/hit by person or object	3 (18.8)	95 (23.8)	114 (30.8)	125 (35.0)	337 (29.5)

Others[1]	5 (31.3)	89 (22.3)	67 (18.1)	83 (23.2)	244 (21.4)
Unknown	1 (6.3)	6 (1.5)	7 (1.9)	3 (0.8)	17 (1.5)
Body Part					
Head	7 (43.8)	89 (22.3)	51 (13.8)	25 (7.0)	172 (15.1)
Face	3 (18.8)	127 (31.8)	81 (21.9)	41 (11.5)	252 (22.1)
Neck/Thorax	1 (6.3)	18 (4.5)	9 (2.4)	8 (2.2)	36 (3.2)
Abdomen	0 (0)	24 (6.0)	7 (1.9)	5 (1.4)	36 (3.2)
Spine	0 (0)	5 (1.3)	4 (1.1)	9 (2.5)	18 (1.6)
Upper Extremities	3 (18.8)	114 (28.6)	146 (39.5)	154 (43.1)	417 (36.5)
Lower Extremities	2 (12.5)	68 (17.0)	101 (27.3)	137 (38.4)	308 (27.0)
External (skin)	0 (0)	5 (1.3)	1 (0.3)	4 (1.1)	10 (0.9)
Other (non-anatomical injury)	0 (0)	4 (1.0)	1 (0.3)	0 (0)	5 (0.4)
Type					

[1] Others include: Stab or cut & Fire, flames or heat & Choking or hanging & Poisoning & Physical over-exertion & Others

Fracture	3 (18.8)	52 (13.0)	77 (20.8)	86 (24.1)	218 (19.1)
Sprain/Strain	1 (6.3)	38 (9.5)	79 (21.4)	117 (32.8)	235 (20.6)
Cuts, bites or open wound	6 (37.5)	154 (38.6)	116 (31.4)	70 (19.6)	346 (30.3)
Bruise or superficial injury	4 (25.0)	105 (26.3)	79 (21.4)	85 (23.8)	273 (23.9)
Burns	1 (6.3)	24 (6.0)	5 (1.4)	5 (1.4)	35 (3.1)
Concussion	2 (12.5)	13 (3.3)	12 (3.2)	8 (2.2)	35 (3.1)
Organ system injury	1 (6.3)	28 (7.0)	12 (3.2)	5 (1.4)	46 (4.0)
Other	0 (0)	1 (0.3)	1 (0.3)	0 (0)	2 (0.2)
Place					
Home	13 (81.3)	207 (51.9)	87 (23.5)	59 (16.5)	366 (32.0)
School	0 (0)	3 (0.8)	14 (3.8)	7 (2.0)	24 (2.1)
Street/highway	0 (0)	13 (3.3)	23 (6.2)	20 (5.6)	56 (4.9)
Residential institution	0 (0)	6 (1.5)	8 (2.2)	12 (3.4)	26 (2.3)
Sports/Athletics area	0 (0)	1 (0.3)	21 (5.7)	57 (16.0)	79 (6.9)

Recreational and cultural area and public building	0 (0)	13 (3.3)	18 (4.9)	9 (2.5)	40 (3.5)
Others[2]	0 (0)	5 (1.3)	5 (1.4)	7 (2.0)	17 (1.5)
Activity					
Education	0 (0)	0 (0)	2 (0.5)	2 (0.6)	4 (0.4)
Sports	0 (0)	0 (0)	24 (6.5)	56 (15.7)	80 (7.0)
Leisure/Play	13 (81.3)	366 (91.7)	310 (83.8)	258 (72.3)	947 (82.9)
Travelling not elsewhere classified	0 (0)	2 (0.5)	5 (1.4)	6 (1.7)	13 (1.1)
Arrival type					
Prehospital ambulance transport	0 (0)	3 (0.8)	3 (0.8)	7 (2.0)	13 (1.1)
Interhospital ambulance transport	0 (0)	0 (0)	1 (0.3)	1 (0.3)	2 (0.2)

[2] Others include: Industrial/construction; Farm, excluding home; Commercial; Countryside, water, sea; Medical service area

Prehospital transport using other vehicles (non-EMS)	15 (93.8)	383 (96.0)	353 (95.4)	343 (96.1)	1094 (95.8)
Interhospital transport using other vehicles (non-EMS)	0 (0)	7 (1.8)	6 (1.6)	3 (0.8)	16 (1.4)
Unknown	1 (6.3)	6 (1.5)	7 (1.9)	3 (0.8)	17 (1.5)

As for the anatomic location of injury, the leading body parts injured were upper extremities (n= 417, 36.5%), lower extremities (n=308, 27.0%), face (n=252, 22.1%) and head (n=172, 15.1%). Children 1-5 sustained more than half of the reported head (n= 89/172, 51.7%) and face (n= 127/252, 50.3%) injuries. Compared to the younger age group, children 6-10 and 11-15 suffered more injuries to extremities with 247 cases (66.8%) and 291 cases (81.5%) respectively (Table 2). In terms of patients' disposition, nearly 1,021 (89.4%) of the injured cases were treated and released at the ED while 47 children (4.1%) were admitted to hospitals. Unknown outcomes accounted for approximately 3.2% of cases. (Table 3)

Table 3: Pre-existing disability and outcome per Age group.

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	Frequency N (%)				
	<1	**1-5**	**6-10**	**11-15**	**Total**
Cases	16	399	370	357	1142
Pre-existing disability (GOS)					
Moderate disability[3]	0 (0)	1 (0.3)	3 (0.8)	1 (0.3)	5 (0.4)
Mild or no disability; no disability reported	16 (100)	393 (98.5)	362 (97.8)	354 (99.2)	1125 (98.5)
Unknown	0 (0)	5 (1.3)	5 (1.4)	2 (0.6)	12 (1.1)
ED Disposition					
Treated and discharged	9 (56.3)	350 (87.7)	333 (90.0)	329 (92.2)	1021 (89.4)
Transfer & AMA	4 (25.0)	15 (3.8)	10 (2.7)	8 (2.2)	37 (3.2)
Admitted	0 (0)	17 (4.3)	16 (4.3)	14 (3.9)	47 (4.1)
Unknown	3 (18.8)	17 (4.3)	11 (3.0)	6 (1.7)	37 (3.2)
Modified Rankin Score at Discharge					

[3] Independent activities of daily living are possible, but cannot resume work/school life

No symptoms at all	0 (0)	7 (1.8)	2 (0.5)	4 (1.1)	13 (1.1)
No significant disability despite symptoms; able to carry out all usual duties and activities	9 (56.3)	237 (59.4)	165 (44.6)	125 (35.0)	536 (46.9)
Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance	1 (6.3)	110 (27.6)	173 (46.8)	208 (58.3)	492 (43.1)
Moderate disability; requiring some help, but able to walk without assistance	1 (6.3)	9 (2.3)	9 (2.4)	6 (1.7)	25 (2.2)
Moderately severe disability; unable	0 (0)	10 (2.5)	4 (1.1)	5 (1.4)	19 (1.7)

to walk without assistance and unable to attend to own bodily needs without assistance					
Severe disability; bedridden, incontinent and requiring constant nursing care and attention	0 (0)	1 (0.3)	4 (1.1)	0 (0)	5 (0.4)
Unknown	5 (31.3)	25 (6.3)	13 (3.5)	9 (2.5)	52 (4.6)
GOS at discharge					
Severe disability[4]	0 (0)	3 (0.8)	2 (0.5)	4 (1.1)	9 (0.8)
Moderate disability[5]	1 (6.3)	39 (9.8)	35 (9.5)	27 (7.6)	102 (8.9)
Recovering state: Mild or no disability; can resume work/school life	11 (68.8)	328 (82.2)	317 (85.7)	316 (88.5)	972 (85.1)

[4] Independent activities of daily living are not possible
[5] Independent activities of daily living are possible, but cannot resume work/school life

Unknown	4 (25.0)	29 (7.3)	16 (4.3)	10 (2.8)	59 (5.2)

In the bivariate analysis (table not shown), the leading type of injury for admitted pediatric cases was fracture (55.3%) (p<0.001) followed by concussion (21.3%) (p<0.001), organ system injury (21.3%) (p<0.001) and cuts/open wound (17.0%) (p=0.035). The most common injured body part among admitted pediatric cases were upper extremities (53.2%) (p=0.016), head (36.2%) (p<0.001) and abdomen (14.9%) (p<0.001). Privately insured children were more likely to be admitted to the hospital (p= 0.004) as a result of their injuries.

In the multivariate analysis, significant factors that were positively associated with hospital admission included: body regions, namely head (OR =14.35 [95% CI 4.01– 51.34]), abdomen (OR =8.25 [1.11 – 61.24]), upper extremity (OR = 5.79 [95% CI 2.04 – 16.49]), and Lower Extremity (OR =5.55 [95% CI 2.02 – 15.20]), in addition to 'other insurance type' (OR = 8.33 [95% CI 2.19 – 31.67]). The three types of injury with the highest hospital admissions were fracture (OR =13.55 [95% CI 4.77 – 38.44]), concussion (OR = 13.60 [95% CI 2.83 – 65.41]), and organ system injury (OR =31.63 [95% CI 3.45 – 290.11]) (Table 4)

Table 4: Factors associated with hospital admission

Variable (Reference)	**Odds Ratio***	**95% CI**	**p-value**
Insurance Type (Private)			
Self	0.96	0.31 – 2.99	0.942

Others	8.33	2.19 – 31.67	0.002
Body Part – Head (No) Yes	14.35	4.01 – 51.34	<0.001
Body Part – Abdomen (No) Yes	8.25	1.11 – 61.24	0.039
Body Part – Upper Extremity (No) Yes	5.79	2.04 – 16.49	0.001
Body Part – Lower Extremity (No) Yes	5.55	2.02 – 15.20	0.001
Type of injury – Fracture (No) Yes	13.55	4.77 – 38.44	<0.001
Type of injury – Concussion (No) Yes	13.60	2.83 – 65.41	0.001
Type of injury - Organ system injury (No) Yes	31.63	3.45 – 290.11	0.002

*Adjusted for: age, gender, hospital type, nationality, insurance type, mechanism of injury, location of injury (head; face; neck/thorax; abdomen and pelvic contents; upper extremity; lower extremity including bony pelvis), type of injury (fracture; cuts, bites or open wound; bruise or superficial injury; concussion; organ system injury), place of injury (home, including garden and outbuildings; street/highway; sports and athletics area), activity (leisure/play).

Discussion

This study reports evidence on the characteristics, mechanisms, and clinical outcomes of pediatric injuries at multiple centers in Beirut. Pediatric injury is a global public health problem, particularly in low- and middle-income countries and a substantial challenge to limited healthcare systems. Pediatric trauma only recently was identified as a major health concern that warrants further investigation and response [21]. Evidence from this study would help to understand the epidemiology of pediatric injury in Lebanon, which in turn would guide the design and implementation of targeted interventions and effective child injury prevention strategies.

The study results underscore the substantial burden of pediatric injuries, accounting for nearly 23.8% of total traumatic cases presented to ED. These results are comparable to those generated in a local study and reported similar patterns of pediatric injuries among ED presentations at 3 hospitals in Beirut [22]. The high prevalence of child injuries is consistent with previous attempts to quantify the burden of childhood injuries in high-, middle- and low-income countries, regardless of countries' social and cultural disparities [1, 23-26]. A large number of these injuries were sustained by males, similar to existing literature that confirmed the predominance of injuries among males across all mechanisms of injuries along with the increased odds of sustaining repeated injuries [7, 27-30]. Moreover, this study highlighted the high frequency of injury occurrences among children aged 0 to 5. This age group sustained more than one-third of the total number of reported cases, almost 40.0% of the fall injuries and approximately 60.1% of home injuries. This highlights the vulnerability of young children as their physical, mental and cognitive development depends on their surrounding environment, which places them at an increased risk of getting injured. Moreover, the high prevalence of injury in non-Lebanese children less than 1 (mainly Palestinian and Syrian

refugees) hints to their low socio-economic status, dire living conditions and limited access to emergency care and appropriate treatment. Contrary to existing literature, the study findings shows that children less than one year sustaining injuries were predominantly females. This can be possibly explained by the patriarchal society where males are more taken care of compared to females. Multiple factors increase the likelihood of injury occurrence, namely child's curious attributes and discovery nature coupled with the lack of safe environments and the absence of parents direct supervision [31];[32]. This underscores parents' fundamental role in child active supervision to protect children as a vulnerable population as well as underlines the importance of securing built-in child safety in the surrounding environment (e.g. locked cabins, gated stairs) that prevents and reduces childhood injuries (Sharma et al., 2018). This study demonstrates that unintentional injuries had a large toll on children, particularly those less than 5 years of age compared to their older counterparts. Nonetheless, it is worth noting that intentional injuries are under-reported in the Lebanese society, particularly with the lack of adequate policies or laws to protect children from any forms of abuse. As a result, hospitals are constrained from reporting abuse even if observed during evaluation.

The present study confirms that the leading causes of injury across all age groups are falls followed by being hit by objects and road traffic injury (mainly pedestrians). An abundance of literature observed similar findings in low-, middle- and high-income countries and confirmed that fall injury is responsible for the excess hospital ED visits and admissions among children [3, 27-29]. This is mainly due to the onset of independent mobility and poor balance among young children which increases their risk of sustaining fall injuries [33, 34]. Hit by person/objects and Road Traffic Injury (RTIs) were other primary causes of injury among children, increasing with age and

peaking at the age of 11-15. The lack of proper injury documentation at the hospital level hinders the comprehensive understanding of the external causes of these injuries, their circumstances and the safety measures adopted. Hence, there is an urgent need to institute a national injury surveillance system or trauma registry at hospitals in Lebanon, which is essential to provide high-quality epidemiological data on the incidence and circumstances of injuries requiring medical attention. Timely collection of injury data is critical for the development, adoption and evaluation of cost-effective injury prevention programs, strategies and policies. This will help to guide future policy priorities for childhood injury prevention and to tailor the implementation of context-sensitive interventions to reduce injuries and mitigate their consequences on the pediatric population.

Similar to existing studies, our findings suggest that injuries in the 0-5 age group resulted mainly in head or face trauma comparable to the 6-15 y who suffered mainly from upper extremity injuries [35]. These body parts are mostly caused by falls and are strongly associated with increased hospital admissions ($p<0.001$). A plausible explanation for this observed pattern of different body parts affected by fall injuries is related to the ability of older children to protect themselves from serious injuries using their peripheral extremities during the injury impact. This further reflects the preponderance of cuts and open wounds in the younger age group 0-10 years old compared to sprain and strain sustained by the older age 10-15y.

To note, neck and thoracoabdominal injuries were among the least injuries observed across all ages. Neck injuries are usually less common in children and thoracoabdominal injuries are usually associated with high impact mechanisms and high injury severity which were not frequent in this study.

Pediatric admission to hospitals considerably varies by injury types and mechanisms, body part injuries, and interestingly by insurance type. Head, abdomen and extremities ranked the highest among body parts injured that require hospital admission. Patients with head, abdomen or upper extremity injuries are almost 14, 8 and 6 times more likely to be admitted to hospital as a result of their injuries. Fall is shown to be the leading mechanism of hospital admission, which consistently agrees with regional studies [24, 27, 28]. Fracture, organ system injury and concussion topped the list of injury types resulting in hospital admissions. Patients with fractures or concussions are 13 times more likely to be admitted to the hospital, and patients with organ injury are 31 times more at risk of being admitted. Unexpectedly, these injury patterns are inconsistent with international studies where sprains and open wounds are the leading types of child injuries [30] while agreeing with regional studies confirming that fracture, concussion and organ system injury are significant predictors of a child hospital admission [22, 36]. Although concussion cases constituted only 3.1% of the total pediatric cases, it comprises nearly 21% of the admitted cases ($p<0.001$). This present study showed that concussion and organ system injury is more common among the young age group while fractures are more prevalent among the older pediatric population [29, 35, 37, 38]. This is understandable as older children tend to be more actively involved in sports and leisure activities, and therefore relatively more prone to fractures of extremities than their counterparts. Regardless of child's age, knowledge of risk factors along with education, injury awareness programs and adequate intervention measures should be implemented to enhance environmental safety and prevent childhood injuries [6, 26, 39, 40].

A widening gap persists between developed and developing countries in terms of injury prevention and severity outcomes. Previous literature noted that high-income countries have actively and successfully devised numerous interventions to control for the burden of injury. Following the implementation of trauma registries, these countries observed major reductions in childhood injury morbidity and mortality as a result of reduced injury frequency and severity, enhanced patients care and subsequently improved patients outcomes [35, 37]. Contrary to high-income countries, injury remains the leading cause of child mortality in low- and middle-income countries (LMICs) [26]. Hence, a concerted endeavour is needed to transform child safety and wellbeing in LMICs, through a mixture of approaches ranging from improving emergency care to building a national surveillance system, to designing and developing education and awareness programs, to implementing and enforcing proper safety regulations and legislations.

This study has some limitations. First, injury studies usually report on mortality as an outcome. In our study population, no death cases were reported. This is potentially related to the fact that deaths would typically be coded differently at EDs in Lebanon, under 'cardiac arrest', without identifying a clear etiology such as traumatic death. Prehospital data on details surrounding the injury event and on causes of deaths are also missing in ED documentation due to the lack of proper documentation in general in the prehospital field and these types of data are not usually shared with ED when the patient arrives at the hospital. Possibly, there were deaths among pediatric patients with 'Unknown outcomes' or among those who were transferred or who left AMA, however, this was not captured in our data. Second details on the injury mechanism, the circumstances and the adopted safety measures were missing from patients' medical records. This is mainly due to the lack of injury surveillance systems and the retrospective nature of the data

capturing process with its inherited limitations of available data variables in patients' medical records. Third, standardized coding of injuries (i.e. International Codes of Disease ICD) is lacking, which might have affected the accurate and reliable documentation and standardized reporting of injury cases. This information is essential to assess injury-associated risk factors and to design tailored and context-appropriate interventions. Fourth, this study used emergency department and admission data with limited follow-up information on the short- and long-term outcomes of multiple injuries including concussions and their impacts on a child's behavior and long-term disability. Lastly, this study collected data from hospitals in Beirut. It is possible that data collected from rural areas reflect different trends and patterns in injury.

Conclusion

Pediatric injury represents a persistent challenge to the pediatric population and the healthcare system in Lebanon. With the lack of proper and standardized documentation of injury mechanisms, establishing a high-quality surveillance system is crucial to help identify priorities and guide the adaptation of evidence-based injury prevention strategies. Safety policies, awareness campaigns and age-targeted interventions should be initiated to control for child injuries and improve safety. Future studies should examine in further detail the several factors associated with pediatric injuries including the role of parental injury educational programs, caregiver's direct and active supervision and the presence of a safe and injury-free environment.

Reference

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Funding/Support

National Council for Scientific Research (CNRS): BIO-0061

Contributions

SA and ME conceptualized the study, provided insights into the discussion section and contributed to the write-up and editing of the manuscript. AA carried out the literature reviews, provided insights into the discussion section and contributed the write-up of the manuscript. RB was the lead statistician of this study, provided insight into data interpretation and contributed to the write-up. MH, EZ, FF, and RR all contributed to the data access, revision, and final editing of the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Figure 1: Distribution of the mechanism of injury by age groups.

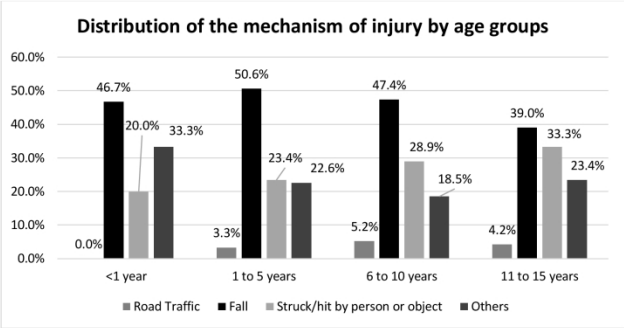

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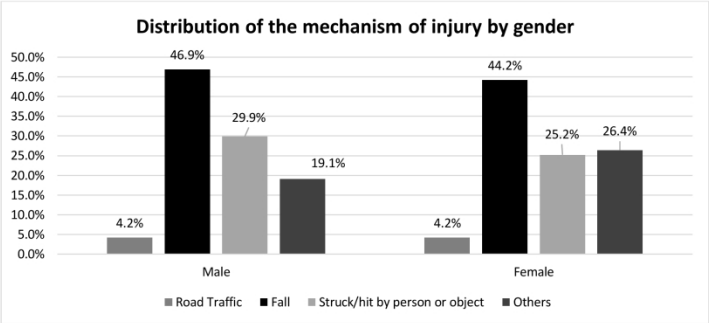
Figure 2: Distribution of the mechanism of injury by gender.



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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract (Page 1-6)	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction (Page 7-8)		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods (Page 8-10)		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses
Results (page 11-22)		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data	15*	Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

Discussion (Page 22-27)		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information (Page 28)		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.