

# BMJ Open Paediatric injury in Beirut: a multicentre retrospective chart review study

Samar Al-Hajj <sup>1</sup>, Abdel-Badih Ariss <sup>2</sup>, Rana Bachir,<sup>1,2</sup> Mariana Helou,<sup>3</sup> Elie Zaghrini,<sup>4</sup> Fathalla Fatouh,<sup>5</sup> Rachid Rahme,<sup>6</sup> Mazen J El Sayed<sup>2</sup>

**To cite:** Al-Hajj S, Ariss A-B, Bachir R, *et al.* Paediatric injury in Beirut: a multicentre retrospective chart review study. *BMJ Open* 2022;**12**:e055639. doi:10.1136/bmjopen-2021-055639

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2021-055639>).

Received 23 July 2021

Accepted 28 February 2022



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

<sup>1</sup>American University of Beirut, Beirut, Lebanon

<sup>2</sup>Department of Emergency Medicine, American University of Beirut Medical Center, Beirut, Lebanon

<sup>3</sup>Department of Emergency Medicine, Rizk Hospital, Beirut, Lebanon

<sup>4</sup>Department of Emergency Medicine, Lebanese Hospital Geitawi, Beirut, Lebanon

<sup>5</sup>Department of Emergency Medicine, Harriri University Hospital, Beirut, Lebanon

<sup>6</sup>Sacre-Coeur Hospital, Baabda, Mont-Liban, Lebanon

## Correspondence to

Mazen J El Sayed; [melsayed@aub.edu.lb](mailto:melsayed@aub.edu.lb)

## ABSTRACT

**Objective** This study aims to assess the epidemiology of paediatric 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 0–15 years presented to five hospital emergency departments (ED) located in Beirut over a 1-year period (June 2017–May 2018).

**Participants** A total of 1142 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 1142 cases of paediatric injury ED cases were sampled, mean age was 7.7±4.35 years. Children aged 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 paediatric 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 (CI 1.11 to 61.24)), to upper extremity (OR=5.79 (CI 2.04 to 16.49)), to lower extremity (OR=5.55 (95% CI 2.02 to 15.20) and other insurance type (OR=8.33 (CI 2.19 to 31.67)). The three types of injuries mostly associated with hospital admission were fracture (OR=13.55 (CI 4.77 to 38.44)), concussion (OR=13.60 (CI 2.83 to 65.41)) and organ system injury (OR=31.63 (CI 3.45 to 290.11)).

**Conclusions** Injury remains a major health problem among the paediatric population in Lebanon. Parental child safety educational programmes 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.

## INTRODUCTION

Paediatric injury represents the third leading cause of death among children aged less than 15, surpassing major common childhood diseases.<sup>1,2</sup> An estimated 6 million children die every year as a result of injuries,<sup>1</sup> with million others requiring medical care through emergency visits and hospitalisation.<sup>3</sup> Paediatric injury constitutes a major contributor to the Global Burden of Disease, accounting for

## Strength and limitations of this study

- This study offers an insight into understanding the characteristics, mechanisms and clinical outcomes of paediatric injuries at multiple centres in Beirut.
- Evidence generated from this study will inform the design of parents' child injury prevention and safety programmes and strategies.
- Details on the aetiology of the injury event and causes of injury deaths were missing in emergency department (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.

nearly 10.6% of the global number of deaths for individuals less than 20 years of age.<sup>1,4</sup> The paediatric 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.

Paediatric injury persists as one of the leading causes of child deaths in low-income and middle-income countries (LMICs).<sup>2 5–7</sup> 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.<sup>8–10</sup> The Eastern Mediterranean Region (EMR) which includes many LMICs 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.<sup>11 12</sup> Lebanon an upper-middle-income EMR country suffers from a large burden of injury, especially among its paediatric population. The

country's WHO 2000–2012 estimates suggest that injury is the third leading cause of death and the fifth leading cause of disability-adjusted life year in Lebanon.<sup>13</sup> 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.<sup>14</sup> Although children represent approximately 31% of the Lebanese population,<sup>15</sup> the number of studies investigating paediatric injuries remains scarce with a limited impact of injury prevention programmes and safety policies.<sup>16–19</sup> 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 paediatric 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 programmes 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 five hospitals located in the greater Beirut district area, which encompasses almost 30% of the Lebanese population (2.2 million). Data were captured from five 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, 6000) and Sacre-Coeur hospital (155 beds, 4000 annual ED visits).

### 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 to May 2018. Both intentional and unintentional injuries were included in the database. Additional information was collected related to child sociodemographic 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<sup>20</sup> 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 ninth, 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% CI 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; V.24.0; 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 (SD), median and the IQR were calculated to summarise age and vital signs. Pearson's  $\chi^2$  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  $\leq 0.05$  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 to 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 deidentified data and a retrospective chart review study.

## RESULTS

A total of 1142 cases of paediatric cases were sampled from participating hospitals with a sustained injury during the 1 year (June 2017–May 2018), accounting for almost 23.5% of all traumatic ED cases. Children's ages ranged from 0 to 15 with mean age  $7.7 \pm 4.35$  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 with 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).

The leading cause of paediatric 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

**Table 1** General characteristics of the studied population

	Frequency N (%)				
	<1	1–5	6–10	11–15	Total
Cases	16	399	370	357	1142
<b>Gender</b>					
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)
<b>Nationality</b>					
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)
<b>Hospital type</b>					
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)
<b>Insurance type</b>					
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)

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 paediatric 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) (figures 1 and 2)

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%).

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 aged 1–5 sustained more than half of the reported head (n=89/172, 51.7%) and face (n=127/252, 50.3%) injuries. Compared with the younger age group, children aged 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 to hospitals. Unknown outcomes accounted for approximately 3.2% of cases (table 3)

In the bivariate analysis, the leading type of injury for admitted paediatric 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 paediatric 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 to 51.34)), abdomen (OR=8.25 (CI 1.11 to 61.24)), upper extremity (OR=5.79 (95% CI 2.04 to 16.49)) and lower extremity (OR=5.55 (95% CI 2.02 to 15.20)), in addition to 'other insurance type' (OR=8.33 (95% CI 2.19 to 31.67)). The three types of injury with the highest hospital admissions were fracture (OR=13.55 (95% CI 4.77 to 38.44)), concussion (OR=13.60 (95% CI 2.83 to 65.41)) and organ system injury (OR=31.63 (95% CI 3.45 to 290.11)) (table 4)

## DISCUSSION

This study reports evidence on the characteristics, mechanisms and clinical outcomes of paediatric injuries at multiple centres in Beirut. Paediatric injury is a global public health problem, particularly in LMICs and a substantial challenge to limited healthcare systems. Paediatric trauma only recently was identified as a major health concern that warrants further investigation and response.<sup>21</sup> Evidence from this study would help to understand the epidemiology of paediatric injury in Lebanon, which in turn would guide the design and

**Table 2** Event characteristics per age group

	Frequency N (%)				
	<1	1–5	6–10	11–15	Total
<b>Cases</b>	16	399	370	357	1142
<b>Intent</b>					
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)
<b>Mechanism</b>					
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*	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)
<b>Body part</b>					
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)
<b>Type</b>					
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)
<b>Place</b>					
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†	0 (0)	5 (1.3)	5 (1.4)	7 (2.0)	17 (1.5)
<b>Activity</b>					
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)
<b>Arrival type</b>					

Continued

Table 2 Continued

	Frequency N (%)				
	<1	1–5	6–10	11–15	Total
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)
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)

\*Others include stab or cut and fire, flames or heat and choking or hanging and poisoning and physical over-exertion and others.

†Others include industrial/construction; farm, excluding home; commercial; countryside, water, sea; medical service area. EMS, Emergency Medical Services.

implementation of targeted interventions and effective child injury prevention strategies.

The study results underscore the substantial burden of paediatric 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 paediatric injuries among ED presentations at three hospitals in Beirut.<sup>22</sup> The high prevalence of child injuries is consistent with previous attempts to quantify the burden of childhood injuries in high-income countries, LMICs, regardless of countries' social and cultural disparities.<sup>1 23–26</sup> 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.<sup>7 27–30</sup> Moreover, this study highlighted the high frequency of injury occurrences among children aged 0–5. 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 socioeconomic 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 1 year sustaining injuries were predominantly females. This can be possibly explained by the patriarchal society where males are more taken care of compared with 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.<sup>31 32</sup> This underscores parents' fundamental role in

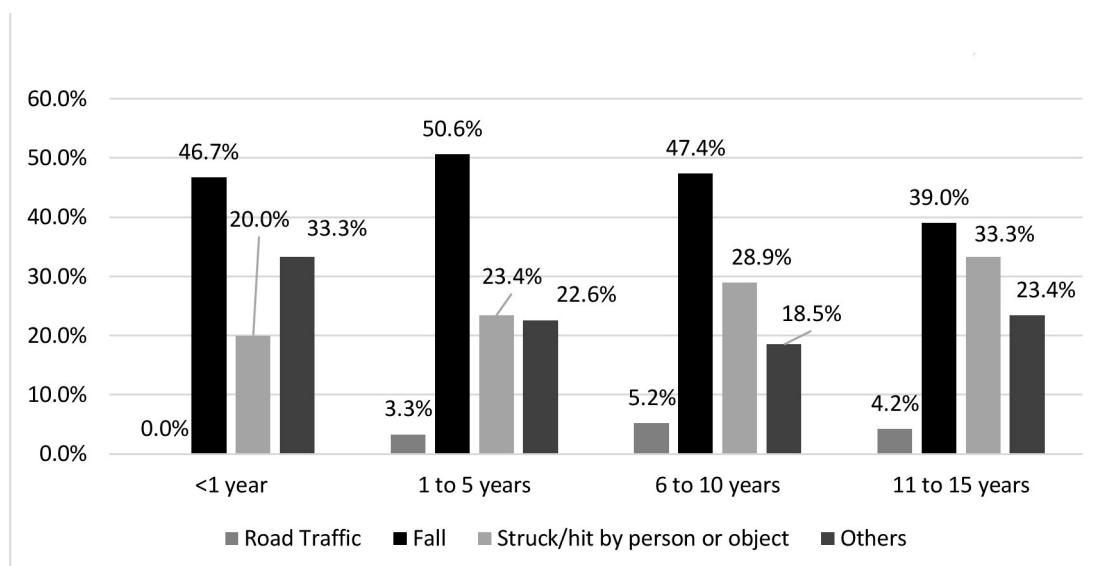
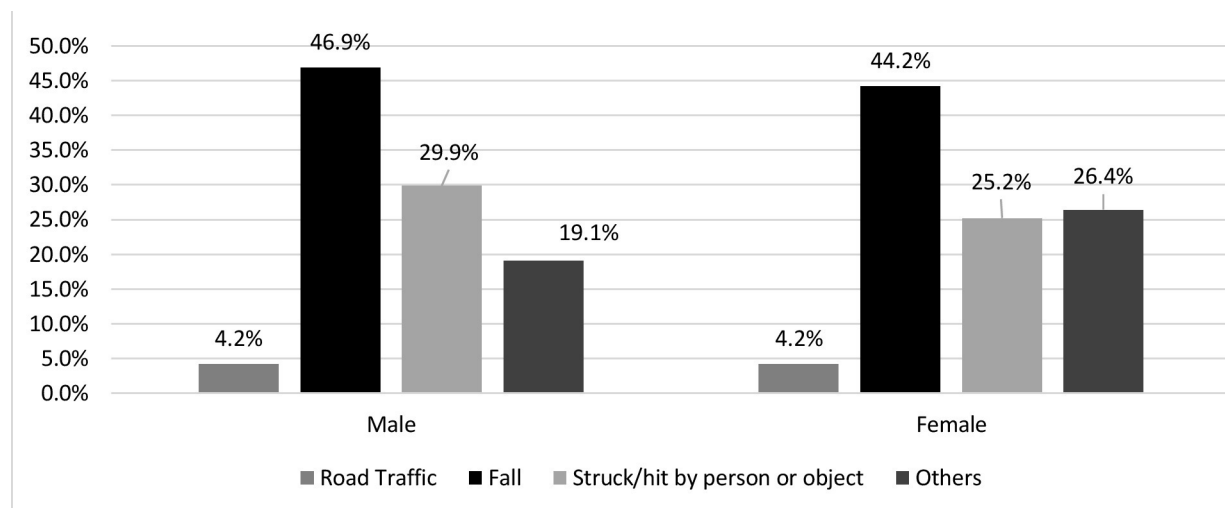


Figure 1 Distribution of the mechanism of injury by age groups



**Figure 2** Distribution of the mechanism of injury by gender

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 (eg, locked cabins, gated stairs) that prevents and reduces childhood injuries. This study demonstrates that unintentional injuries had a large toll on children, particularly those less than 5 years of age compared with 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 (RTI, mainly pedestrians). An abundance of literature observed similar findings in LMICs and high-income countries and confirmed that fall injury is responsible for the excess hospital ED visits and admissions among children.<sup>3 27–29</sup> This is mainly due to the onset of independent mobility and poor balance among young children which increases their risk of sustaining fall injuries.<sup>33 34</sup> Hit by person/objects and 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 programmes, 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 paediatric 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 years who suffered mainly from upper extremity injuries.<sup>35</sup> 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 with sprain and strain sustained by the older age 10–15 years.

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.

Paediatric 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.<sup>24 27 28</sup> 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,<sup>30</sup>

**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
<b>Pre-existing disability (GOS)</b>					
Moderate disability*	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)
<b>ED disposition</b>					
Treated and discharged	9 (56.3)	350 (87.7)	333 (90.0)	329 (92.2)	1021 (89.4)
Transfer and 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)
<b>Modified Rankin Score at discharge</b>					
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)
<b>GOS at discharge</b>					
Severe disability†	0 (0)	3 (0.8)	2 (0.5)	4 (1.1)	9 (0.8)
Moderate disability*	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)

\*Independent activities of daily living are possible, but cannot resume work/school life

†Independent activities of daily living are not possible.

AMA, Against Medical Advice; ED, emergency department; GOS, Glasgow Outcome Scale.

while agreeing with regional studies confirming that fracture, concussion and organ system injury are significant predictors of a child hospital admission.<sup>22 36</sup> Although concussion cases constituted only 3.1% of the total paediatric 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 paediatric population.<sup>29 35 37 38</sup> 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 programmes and adequate intervention measures should be implemented

to enhance environmental safety and prevent childhood injuries.<sup>6 26 39 40</sup>

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.<sup>35 37</sup> Contrary to high-income countries, injury remains the leading cause of child mortality in LMICs.<sup>26</sup> Hence, a concerted endeavour is needed to transform child safety and

**Table 4** Factors associated with hospital admission

Variable (reference)	OR*	95% CI	P-value
<b>Insurance type</b> (private)	0.96	0.31 to 2.99	0.942
Self	8.33	2.19 to 31.67	0.002
Others			
<b>Body part: head</b> (no)	14.35	4.01 to 51.34	<0.001
Yes			
<b>Body part: abdomen</b> (no)	8.25	1.11 to 61.24	0.039
Yes			
<b>Body part: upper extremity</b> (no)	5.79	2.04 to 16.49	0.001
Yes			
<b>Body part: lower extremity</b> (no)	5.55	2.02 to 15.20	0.001
Yes			
<b>Type of injury: fracture</b> (no)	13.55	4.77 to 38.44	<0.001
Yes			
<b>Type of injury: concussion</b> (no)	13.60	2.83 to 65.41	0.001
Yes			
<b>Type of injury: organ system injury</b> (no)	31.63	3.45 to 290.11	0.002
Yes			

\*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).

well-being 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 programmes, 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 aetiology 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 paediatric patients with 'Unknown outcomes' or among those who were transferred or who left Against Medical Advice (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, standardised coding of injuries (ie, ICD) is lacking, which might have affected the accurate and reliable documentation and standardised 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-term and long-term outcomes of multiple injuries including concussions and their impacts on a child's behaviour and long-term disability. Finally, 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

Paediatric injury represents a persistent challenge to the paediatric population and the healthcare system in Lebanon. With the lack of proper and standardised 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 the several factors associated with paediatric injuries including the role of parental injury educational programmes, caregiver's direct and active supervision and the presence of a safe and injury-free environment in further detail.

**Twitter** Samar Al-Hajj @DrSamarHajj

**Contributors** SA-H and MJES conceptualised the study, provided insights into the discussion section and contributed to the write-up and editing of the manuscript. A-BA 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 agreed to



be accountable for all aspects of the work. MJES served as the guarantor of overall content.

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

**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

**Patient consent for publication** Not required.

**Ethics approval** 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.

**Provenance and peer review** Not commissioned; externally peer reviewed.

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

**Open access** This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

#### ORCID iDs

Samar Al-Hajj <http://orcid.org/0000-0002-4736-021X>

Abdel-Badih Ariss <http://orcid.org/0000-0003-0269-3130>

#### REFERENCES

- James SL, Abate D, Abate KH, *et al*. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the global burden of disease study 2017. *The Lancet* 2018;392:1789–858.
- Baker Set *al*. *The injury fact book*. USA: Oxford University Press, 1992.
- Borse NN, Gilchrist J, Dellinger AM, *et al*. Unintentional childhood injuries in the United States: key findings from the CDC childhood injury report. *J Safety Res* 2009;40:71–4.
- Peden M, McGee K, Krug E. World Health Organization. Injury: a leading cause of the global burden of disease 2000.
- Pecllet MH, Newman KD, Eichelberger MR, *et al*. Patterns of injury in children. *J Pediatr Surg* 1990;25:85–91.
- Alonge O, Hyder AA. Reducing the global burden of childhood unintentional injuries. *Arch Dis Child* 2014;99:62–9.
- Sharma GK, Krug EG, Lozano R. Injury: a leading cause of the burden of disease. *Inj Control Saf Promot* 2000;7:261–7.
- Marcin JP, Schembri MS, He J, *et al*. A population-based analysis of socioeconomic status and insurance status and their relationship with pediatric trauma hospitalization and mortality rates. *Am J Public Health* 2003;93:461–6.
- Morrongiello BA, Schell SL. *Child injury: The role of supervision in prevention*. *Am J Lifestyle Med* 2010;4:65–74.
- Kendrick D, Mulvaney C, Burton P, *et al*. Relationships between child, family and neighbourhood characteristics and childhood injury: a cohort study. *Soc Sci Med* 2005;61:1905–15.
- Al-Hajj S, El Bcheraoui C, Daoud F, *et al*. Child and adolescent injury burden in the eastern mediterranean region: Findings from the Global Burden of Disease 1990–2017. *BMC Public Health* 2020;20:1–10.
- Mokdad AH, GBD 2015 Eastern Mediterranean Region Intentional Injuries Collaborators. Intentional injuries in the eastern Mediterranean region, 1990–2015: findings from the global burden of disease 2015 study. *Int J Public Health* 2018;63:39–46.
- WHO. H.O. Lebanon - Country Profile. [Webpage], 2006. Available: <https://www.who.int/countries/lbn/en/>
- Nuwayhid I, Fayad R, Tamim H, *et al*. Work-Related injuries in Lebanon: does nationality make a difference? *Am J Ind Med* 2003;44:172–81.
- Tutelian M. Children in Lebanon. Statistics in focus SIF 2013.
- Al-Hajj Set *al*. History of injury in a developing country: a scoping review of injury literature in Lebanon. *Journal of Public Health* 2020.
- Rohlman DS, Nuwayhid I, Ismail A, *et al*. Using epidemiology and neurotoxicology to reduce risks to young workers. *Neurotoxicology* 2012;33:817–22.
- Saddik B, Nuwayhid I, Williamson A, *et al*. Evidence of neurotoxicity in working children in Lebanon. *Neurotoxicology* 2003;24:733–9.
- Al-Hajj S, Nehme R, Hatoum F, *et al*. Child school injury in Lebanon: a study to assess injury incidence, severity and risk factors. *PLoS One* 2020;15:e0233465.
- Kong SY, Shin SD, Tanaka H, *et al*. Pan-Asian trauma outcomes study (PATOS): rationale and methodology of an international and multicenter trauma registry. *Prehosp Emerg Care* 2018;22:58–83.
- Mooney DP, Gutierrez IM, Chen Q, *et al*. Impact of trauma system development on pediatric injury care. *Pediatr Surg Int* 2013;29:263–8.
- Nuwayhid I, Kambris MA-K, Mahfoud M. Childhood injuries in the city of Beirut: the experience of three major emergency services. *Leb Sci J* 2002;3:29–48.
- Alyafei KA, Toaimah F, El Menyar A, *et al*. Analysis of pediatric trauma data from a hospital based trauma registry in Qatar. *Int J Crit Illn Inj Sci* 2015;5:21.
- Gad A, AL-Eid R, Al-Ansary S, *et al*. Pattern of injuries among children and adolescents in Riyadh, Saudi Arabia: a household survey. *J Trop Pediatr* 2011;57:179–84.
- Mehmood A, Agrawal P, Allen KA, *et al*. Childhood injuries in Oman: retrospective review of a multicentre trauma registry data. *BMJ Paediatr Open* 2018;2:e000310.
- Street EJ, Jacobsen KH. Injury incidence among middle school students aged 13–15 years in 47 low-income and middle-income countries. *Inj Prev* 2016;22:432–6.
- Birgul P, Esin Ocaktan M, Akdur R, *et al*. Evaluation of unintentional injuries sustained by children: a hospital based study from Ankara-Turkey. *Pak J Med Sci* 2013;29:832.
- Mutto M, Lawoko S, Nansamba C, *et al*. Unintentional childhood injury patterns, odds, and outcomes in Kampala City: an analysis of surveillance data from the National pediatric emergency unit. *J Inj Violence Res* 2011;3:13–18.
- Santagati G, Vezzosi L, Angelillo IF. Unintentional injuries in children up to six years of age and related parental knowledge, attitudes, and behaviors in Italy. *J Pediatr* 2016;177:e2:267–72.
- Spady DW, Saunders DL, Schopflocher DP, *et al*. Patterns of injury in children: a population-based approach. *Pediatrics* 2004;113:522–9.
- Soubhi H, Raina P, Kohen DE. Effects of neighbourhood, family, and child behaviour on childhood injury in Canada. *Applied Research Branch, Human Resources Development Canada* 2001.
- Prinz RJ. In Handbook of injury and violence prevention. In: *Parenting and the prevention of childhood injuries*. Springer, 2008: 333–46.
- Agran PF, Anderson C, Winn D, *et al*. Rates of pediatric injuries by 3-month intervals for children 0 to 3 years of age. *Pediatrics* 2003;111:e683–92.
- Ferrante P, Marinaccio A, Iavicoli S. Home injuries in Italy: patterns of injury and the most exposed people. *Int J Inj Contr Saf Promot* 2013;20:36–41.
- Aoki M, Abe T, Saitoh D, *et al*. Epidemiology, patterns of treatment, and mortality of pediatric trauma patients in Japan. *Sci Rep* 2019;9:1–7.
- Bradshaw CJ, Bandi AS, Muktar Z, *et al*. International study of the epidemiology of paediatric trauma: PAPSA research study. *World J Surg* 2018;42:1885–94.
- Nesje E, Valøy NN, Krüger AJ, *et al*. Epidemiology of paediatric trauma in Norway: a single-trauma centre observational study. *Int J Emerg Med* 2019;12:18.
- Fang Y, Zhang X, Chen W, *et al*. Epidemiological characteristics and burden of childhood and adolescent injuries: a survey of elementary and secondary students in Xiamen, China. *BMC Public Health* 2015;15:357.
- Mock C, Abantanga F, Goosen J, *et al*. Strengthening care of injured children globally. *Bull World Health Organ* 2009;87:382–9.
- Nansel TR, Weaver NL, Jacobsen HA, *et al*. Preventing unintentional pediatric injuries: a tailored intervention for parents and providers. *Health Educ Res* 2008;23:656–69.