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## Pediatric Injuries in Beirut: A Multi-Center study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-055639
Article Type:	Original research
Date Submitted by the Author:	23-Jul-2021
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
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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24 Beirut 1107 2020

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For peer review only

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45 48 **Short title:** Pediatric injury in Beirut, Lebanon.  
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78 49  
910 50  
1112 51 **Abbreviations:** Emergency Department (ED), Eastern Mediterranean Region (EMR), disability-13  
14 52 adjusted life year (DALY), Pan-Asia Trauma Outcomes Study (PATOS), International15  
16  
17 53 Classification of Disease 9<sup>th</sup> clinical modification (ICD – 9 - CM) or 10<sup>th</sup> edition (ICD – 10 -18  
19 54 CM), Statistical Package for the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago,20  
21 55 IL), Road Traffic Injury (RTIs), low- and middle- income countries (LMICs)  
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## 71 Abstract

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

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76 **Methodology:** We conducted a retrospective review study of charts of children aged 0-15y at 5  
77 hospital Emergency Departments (ED) located in Beirut for a one-year period (June 2017-May  
78 2018). We performed descriptive analysis and a bivariate analysis comparing admitted and  
79 treated/discharged patients. This was followed by a logistic regression to identify the factors  
80 associated with hospital admission in pediatric.

81

82 **Results:** A total of 1,142 cases of pediatric injury ED cases were sampled, mean age was  $7.7 \pm$   
83 4.35 years. Children 0-5 years sustained more than one-third of the total cases, (206/516) 40.0%  
84 of the fall injuries and (220/366) 60.1% of home injuries. The leading cause of pediatric injury  
85 was fall (45.2%) Nearly 4.1% of the cases were admitted to hospitals with major contributing  
86 factors, including other insurance type (OR = 8.33 [CI 2.19 – 31.67]), head (OR =14.35 [CI 4.01–  
87 51.34]), abdomen (OR =8.25 [1.11 – 61.24]), upper extremity (OR = 5.79 [CI 2.04 – 16.49]), and  
88 lower extremity (OR =5.55 [95% CI 2.02 – 15.20]). The three types of injury with the highest  
89 hospital admission risk were fracture (OR =13.55 [CI 4.77 – 38.44]), concussion (OR = 13.60 [CI  
90 2.83 – 65.41]), and organ system injury (OR =31.63 [CI 3.45 – 290.11]).

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3 92 **Conclusion:** Pediatric injury a major health problem in Lebanon. Safety policies, parental  
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5 93 awareness campaigns and child age-targeted injury interventions should be initiated to help reduce  
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7 94 childhood injuries and improve child safety and well-being.  
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3 115 **Article summary:** Strengths and limitations of this study  
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8 117 • This study presents evidence on the characteristics, mechanisms and clinical outcomes of  
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10 118 pediatric injuries at multiple centers in Beirut.

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15 120 • Lebanon an upper- middle- income EMR country suffers from a large burden of injury,  
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17 121 especially among the pediatric population. The number of studies investigating their  
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19 122 injuries remains scarce with a limited impact of child injury prevention programs and  
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21 123 safety policies.

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26 125 • Evidence generated from this study will inform the design of parents' child safety  
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28 126 awareness programs and injury prevention strategies.

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32 128 • The study was a retrospective chart review study thus has its own inherited limitations of  
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34 129 data variable availability in the original patients' records.

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38 131 • Third, this study used emergency department and admission data with no follow up on  
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40 132 information on the short- and long- term outcomes of multiple injuries including  
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42 133 concussions and their impact on child's behavior and long-term impact  
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## 138 Introduction

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

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

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

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3 161 in Lebanon [12]. Further to its substantial toll on children's physical and emotional well-being,  
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5 162 pediatric injury places a substantial economic burden on injured children, their families and above  
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8 163 all on the resource-limited Lebanese healthcare system [13]. Although children constitute  
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10 164 approximately 31% of the Lebanese population [14], the number of studies investigating their  
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12 165 injuries remains scarce with a limited impact of child injury prevention programs and safety  
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14 166 policies [15-18]. Additionally, the lack of hospital surveillance systems and trauma registries in  
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16 167 Lebanon render it challenging to accurately assess the magnitude of the child injury problem and  
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18 168 its associated risk factors.

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21 169 The main objective of this study is to illustrate pediatric injury epidemiology in Lebanon's capital  
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23 170 city, Beirut. The study findings will offer an understanding of the magnitude, the mechanisms and  
24  
25 171 the outcome of child injury. Evidence generated from this study will inform the design of parents'  
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27 172 child safety awareness programs and injury prevention strategies and policies to protect children's  
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29 173 lives and safeguard their health and well-being.  
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## 44 177 Methodology

### 45 46 47 178 Study Setting

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49 179 We retrospectively reviewed and collected data from patients' charts at 5 hospitals Emergency  
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51 180 Department in the greater Beirut district area, which houses almost 30% of the Lebanon population  
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53 181 (2.2 million). We captured data from 5 local hospitals: The American University of Beirut Medical  
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3 182 Center (330 beds, 60,000 annual ED visits), Hariri Governmental Hospital (544 Beds, 17,000  
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5 183 annual ED visits), Geitawi hospital (250 beds, 11,000 annual ED visits), LAU medical center (120  
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8 184 beds, 6,000), and Sacre-Coeur hospital (155 beds, 4,000 annual ED visits). This study was  
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10 185 approved by the American University of Beirut Internal Review Board (IRB) [BIO-2018-0061]  
11  
12 186 and by each participating hospital ethical committee.  
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15 187

### 17 188 **Patient Involvement**

19 189 Patients or the member of the public were not involved in the study since it was a de-identified  
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21 190 data and a retrospective chart review study.  
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### 26 192 **Data Collection**

28 193 Data was collected on children aged 0-15 who sustained any type of injury and presented to one  
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30 194 of the participating hospitals within the 12-month period from June 2017-May 2018. We included  
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33 195 both intentional and unintentional injuries in the database. We collected data on child socio-  
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35 196 demographic information, injury mechanism, activity at the time of injury, injury location and  
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37 197 body part injured, and injury anatomical and clinical outcomes. We adopted the Pan-Asia Trauma  
38  
39 198 Outcomes Study (PATOS)[19] to design and develop the data collection form.

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42 199 At each hospital, we retrieved ED data, reviewed patients' medical records, and filter injury cases  
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44 200 by mechanisms coded according to the *International Classification of Disease 9<sup>th</sup>, clinical*  
45  
46 201 *modification (ICD -9-CM) or 10<sup>th</sup> edition (ICD -10-CM)* adopted at some hospitals or by keywords  
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48 202 in case of a lack of proper coding. Data were captured into the Redcap software to do the data  
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50 203 entry. To calculate the required sample size at each hospital, the prevalence for each month of the  
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52 204 study period was calculated by dividing the number of ED injured patients by the total number of  
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205 ED patients for the corresponding month. A desired precision between 5% and 10 % was used and  
206 a 95% confidence interval was adopted while calculating the sample size.

207

## 208 **Data Analysis**

209 We performed descriptive and inferential statistical analysis using the Statistical Package for the  
210 Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago, IL). The characteristics, trends and  
211 patterns of injury were described for the total sample and the four children's age groups (less than  
212 1, 1-5, 6-10, and 11-15 years). Mean (standard deviation), median, and the interquartile range were  
213 calculated to summarize the age and the vital signs. Pearson's Chi-Square or Fisher's exact tests  
214 were used to assess the significance of the statistical association between all categorical variables  
215 and the outcome variable [ED disposition (admitted vs. treated and discharged)]. All clinically and  
216 statistically significant variables were included in a multivariate analysis using a stepwise logistic  
217 regression model to determine the factors associated with hospital admission. A p-value of  $\leq 0.05$   
218 was used to indicate statistical significance. The final model was found to be a good fit to the data  
219 as the Hosmer-Lemeshow test indicated ( $p=0.957$ ) and it discriminated perfectly the two categories  
220 of the outcome variable (area under the curve = 0.894 [95% CI: 0.848 – 0.940,  $p<0.001$ ].

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## 226 Results

227 A total of 1,142 cases of pediatric cases presented to participating hospitals with an injury during  
 228 the one-year period (June 2017-May 2018), accounting for almost 23.5% of all traumatic ED cases.  
 229 Children ages range from 0 to 15 with mean age  $7.7 \pm 4.35$  years, mostly Lebanese (80.3 %, n=917).  
 230 Reported injuries were evenly distributed across age groups, with 399 (34.9%) among children  
 231 aged 1-5 years, 370 (32.4%) among 6-10 years and 357 (31.3%) among 11-15 years of age, with  
 232 an overwhelming number of males (n= 733, 64.2%) sustaining injuries compared to their female  
 233 counterparts (n= 408, 35.7%). For all injury mechanisms, the male to female ratio was 1.8:1.  
 234 Exceptionally to this pattern were children less than 1 year of age who were mostly females (n=  
 235 10, 62.5%) and reporting 1.4% (n=16) of the total injuries (Table 1).

237 **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	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)

239

240 The leading cause of pediatric injury was fall (n=516, 45.2%). Nearly (206/516) 40.0% of fall  
 241 injuries sustained by children 0-5. Children pedestrians hit by vehicles or motorcycles represented  
 242 the majority of the road injury cases (29.2%) and showed a substantially increased pattern with  
 243 child age increase. Almost 35 children (3.1%) sustained a burn injury (Figure 1 and 2).  
 244 Most sustained injuries (85.1%) were mild injuries. Nonetheless, 9 children suffered from severe  
 245 disability that affected their daily activities, these injuries were mainly reported among the older  
 246 age group 6-15. (Table 2)

247

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

249

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

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252

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

258

259 **Table 2:** Event characteristics per age group.

260

261

	Frequency N (%)				
	<1	1-5	6-10	11-15	Total
Cases	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 <sup>1</sup>	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>					

<sup>1</sup> 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)
<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 <sup>2</sup>	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>					
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)

<sup>2</sup> 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)

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263

264 As for the anatomic injuries, the leading body parts injured were upper extremities (n= 417, 36.5%),  
 265 lower extremities (n=308, 27.0%), face (n=252, 22.1%) and head (n=172, 15.1%). Children 1-5  
 266 sustained more than half of the reported head 89 (n= 89/172 51.7%) and face 127 (n= 127/252,  
 267 50.3%) injuries. Compared to the younger age group, children 6-10 and 11-15 suffered more  
 268 injuries to extremities with 247 cases (66.8%) and 291 cases (81.5%) respectively (Table 2).

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

271

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

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274

	Frequency N (%)
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	<1	1-5	6-10	11-15	Total
Cases	16	399	370	357	1142
<b>Pre-existing disability (GOS)</b>					
Moderate disability <sup>3</sup>	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 & 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)

<sup>3</sup> 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)
<b>GOS at discharge</b>					
Severe disability <sup>4</sup>	0 (0)	3 (0.8)	2 (0.5)	4 (1.1)	9 (0.8)
Moderate disability <sup>5</sup>	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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<sup>4</sup> Independent activities of daily living are not possible

<sup>5</sup> Independent activities of daily living are possible, but cannot resume work/school life

276

277 The leading type of injury for admitted pediatric cases was fracture (55.3%) (p<0.001) followed

278 by concussion (21.3%) (p<0.001), organ system injury (21.3%) (p<0.001) and cuts/open wound

279 (17.0%) (p=0.035). The most common body part among admitted pediatric cases were upper

280 extremities (53.2%) (p=0.016), head (36.2%) (p<0.001) and abdomen (14.9%) (p<0.001).

281 Unexpectedly, the type of insurance affected child's injury disposition status. Privately insured

282 children were more likely to be admitted into the hospital (p= 0.004) as a result of their injuries

283 (Table not shown).

284 Significant factors that were positively associated with hospital admission included: other

285 insurance type (OR = 8.33 [95% CI 2.19 – 31.67]), body regions, namely head (OR =14.35 [95%

286 CI 4.01– 51.34]), abdomen (OR =8.25 [1.11 – 61.24]), upper extremity (OR = 5.79 [95% CI 2.04

287 – 16.49]), Lower Extremity (OR =5.55 [95% CI 2.02 – 15.20]). The three types of injury with the

288 highest hospital admission risk were fracture (OR =13.55 [95% CI 4.77 – 38.44]), concussion (OR

289 = 13.60 [95% CI 2.83 – 65.41]), and organ system injury (OR =31.63 [95% CI 3.45 – 290.11])

290 (Table 4)

291

292 **Table 4:** Factors associated with hospital admission

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



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

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

300

## 301 Discussion

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

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

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3 324 surrounding environment, which places them at an increased risk of undergoing injuries. Multiple  
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5 325 factors increase the likelihood of their injury occurrence, namely child's curious attributes and  
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8 326 discovery nature coupled with the lack of safe environment and parents direct supervision [30];[31].  
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10 327 This highlights parents' fundamental role in child active supervision to protect children as a  
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12 328 vulnerable population as well as underscores the importance of ensuring a surrounding  
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14 329 environment with built in child safety (e.g. locked cabins, gated stairs) that prevents and reduce  
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16 330 childhood injuries (Sharma et al., 2018).  
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21 332 The present study has confirmed that the leading causes of injury across all age groups were falls  
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23 333 followed by hit by objects and road traffic injury (mainly pedestrians). An abundance of literature  
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25 334 observed similar findings in low-, middle- and high-income countries and confirmed that fall  
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27 335 injury is responsible for the excess hospital ED visits and admissions among children [3, 26-28].  
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29 336 This is mainly due to the onset of independent mobility and poor balance among young children  
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31 337 which increases their risk of sustaining fall injuries [32, 33]. Hit by person/objects and Road  
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33 338 Traffic Injury (RTIs) were the other primary cause of injury among children, increasing with age  
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35 339 and peaking at the age of 11-15. The lack of proper injury documentation at the hospital level  
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37 340 hinders the comprehensive understanding of the external causes of these injuries, their  
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39 341 circumstances and the safety measures adopted. Hence, there is an urgent need to institute a  
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41 342 national injury surveillance system or trauma registry at hospitals in Lebanon, which are essential  
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43 343 to provide high-quality epidemiological data on the incidence and circumstances of injuries  
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45 344 requiring medical attention. Timely collection of injury data is critical for the development,  
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47 345 adoption and evaluation of cost-effective injury prevention programs, strategies and policies. The  
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49 346 generated evidence will serve to guide future policy priorities for childhood injury prevention and  
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3 347 to tailor the implementation of context-sensitive interventions to reduce injuries and mitigate their  
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5 348 consequences on the pediatric population.  
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10 350 Similar to existing studies, our findings suggest that injuries in the 0-5 age group resulted mainly  
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12 351 in the head or face trauma comparable to the 6-15 y who suffered mainly from upper extremity  
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14 352 injuries [34]. These body parts are mostly caused by falls and are strongly associated with  
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16 353 increased hospital admissions ( $p < 0.001$ ). A plausible explanation for this observed pattern of  
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18 354 different body parts affected by fall injuries is related to the ability of older children to protect  
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20 355 themselves from serious injuries using their peripheral extremities during the injury impact. This  
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22 356 further reflects the preponderance of cuts and open wound in the younger age group 0-10 years  
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24 357 old compared to sprain and strain sustained by the older age 10-15y.  
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31 359 Pediatric admission to hospitals considerably varies by injury types and mechanisms, body part  
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33 360 injuries, and interestingly by insurance type. Head, abdomen and extremities ranked the highest  
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35 361 among body parts injured that necessitate hospital admission. Patients with head, abdomen or  
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37 362 upper extremity injuries are almost 14, 8 and 6 times more likely to be admitted to hospital as a  
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39 363 result of their injuries. Fall is shown to be leading mechanism of hospital admission, which  
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41 364 consistently agrees with regional studies [23, 26, 27]. Fracture, organ system injury and concussion  
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43 365 topped the list of injury types resulting in hospital admissions. Patients with fracture or concussion  
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45 366 are 13 times more likely to be admitted to hospital, and patients with organ injury are 31 times  
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47 367 more risk of being admitted. Unexpectedly, these injury patterns are inconsistent with  
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49 368 international studies where sprains and open wounds are the leading types of child injuries [29]  
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51 369 while agreeing with regional studies confirming that fracture, concussion and organ system injury  
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3 370 are significant predictors of a child hospital admission [21, 35]. Although concussion cases  
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5 371 constituted only 3.1% of the total pediatric cases, it comprises nearly 21% of the admitted cases  
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7 372 ( $p < 0.001$ ). This present study showed that concussion and organ system injury are more common  
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10 373 among the young age group while fractures are more prevalent among the older pediatric  
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12 374 population [28, 34, 36, 37]. This is understandable as older children tend to be more actively  
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14 375 involved in sports and leisure activities, and therefore relatively more prone to fractures of  
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16 376 extremities than their counterparts. Regardless of child's age, knowledge of risk factors along with  
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18 377 education, injury awareness programs and adequate intervention measures should be implemented  
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20 378 to enhance environmental safety and prevent childhood injuries [6, 25, 38, 39]. Insurance  
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22 379 influenced hospitalization  
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28 381 A widening gap persists between developed and developing countries in terms of injury prevention  
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30 382 and severity outcomes. Previous literature noted that high income countries have actively and  
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32 383 successfully devised numerous interventions to control for the burden of injury. Following the  
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34 384 implementation of trauma registries, these countries observed major reductions in childhood  
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36 385 injury morbidity and mortality as a result of reduce injury frequency and severity, enhancement  
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38 386 patients care and subsequently improved patients' outcome [34, 36]. Contrary to high income  
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40 387 countries, injury remains the leading cause of child mortality in low- and middle- income countries  
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42 388 (LMICs) [25]. Hence, a concerted endeavor is needed to transform child safety and wellbeing in  
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44 389 LMICs, though a mixture of approaches ranging from improving emergency care, to building a  
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46 390 national surveillance system, to designing and developing education and awareness programs, to  
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48 391 implementing and enforcing proper safety regulations and legislations.  
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3 393 This study has some limitations. First, details on the injury mechanism, the circumstances and the  
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5 394 adopted safety measures were missing from injured patients' files. This is mainly due to the  
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8 395 retrospective nature of the study with its inherited limitations of data variable availability in the  
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10 396 original patients' records. Second, standardized coding of injuries (i.e. International Codes of  
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12 397 Disease ICD) is also lacking. This information is essential for accurate and reliable documentation  
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14 398 and standardized reporting of injury cases to assess their associated risk factors and to design  
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16 399 tailored and context-appropriate interventions. Third, this study used emergency department and  
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18 400 admission data with no follow up on information on the short- and long- term outcomes of multiple  
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20 401 injuries including concussions and their impact on child's behavior and long-term impact. Lastly,  
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22 402 this study collected data from hospitals in Beirut. It is possible that data collected from rural areas  
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24 403 reflect different findings.  
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## 36 406 Conclusion

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41 408 Pediatric injury represents a persistent challenge to the pediatric population and the healthcare  
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43 409 system in Lebanon. The lack of proper and standardized documentation of injury cases was  
44  
45 410 common. The establishment of a high-quality surveillance system is crucial to help identify key  
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47 411 injury priorities and guide the adaptation of evidence-based injury prevention strategies. Safety  
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49 412 policies, awareness campaigns and age-targeted interventions should be initiated to control for  
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51 413 childhood injuries and improve child safety. Future studies should examine several factors  
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53 414 associated with pediatric injuries including the role of parental injury education and awareness  
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415 programs, caregiver’s direct and active supervision and the presence of a safe and injury free  
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For peer review only

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3 **Conflict of Interest Disclosures:** All authors have declared that they have no financial conflict  
4  
5 of interest.  
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7  
8 **Ethical approval:** This study was approved by the American University of Beirut Internal  
9  
10 **Review Board (IRB) [BIO-2018-0061] and by each participating hospital ethical**  
11  
12 **committee:**  
13

14 **American University of Beirut Medical Center IRB**

15  
16 **Geitawi University Hospital ethical committee**

17  
18 **Sacre Coeur Hospital ethical committee**

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20 **Lebanese American University Medical Center IRB**

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22 **Rafic Hariri Hospital University Beirut IRB**  
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28 **Word Count:** 3193  
29

30  
31 **Funding/Support:** CNRS, (BIO-0061)  
32

33 **Role of Funder/Sponsor (if any):** Funded data collection and analysis  
34

35 **Data Sharing:** No additional data available  
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### 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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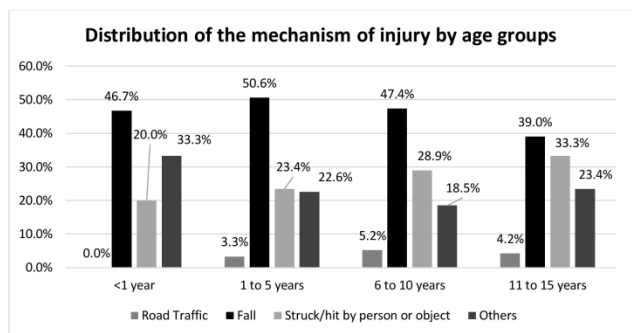
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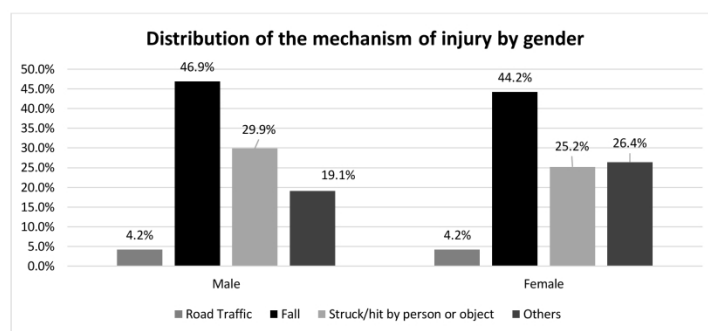
Figure 1: Distribution of the mechanism of injury by age groups.



215x279mm (300 x 300 DPI)

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



215x279mm (300 x 300 DPI)

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60STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation
<b>Title and abstract (Page 1-6)</b>	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
<b>Introduction ( Page 7-8)</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
<b>Methods ( Page 8-10)</b>		
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
<b>Results (page 11-22)</b>		
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

<b>Discussion (Page 22-27)</b>		
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
<b>Other information ( Page 28)</b>		
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](http://www.strobe-statement.org).



# BMJ Open

## Pediatric Injury in Beirut: A Multi-Center Retrospective study

Journal:	<i>BMJ Open</i>
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
<b>Primary Subject Heading</b>:	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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5 48 **Short title:** Pediatric injury in Beirut, Lebanon.  
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7 49  
8 50 **Conflict of Interest Disclosures:** All authors have declared that they have no financial conflict  
9 51 of interest.

10 52 **Word Count:**

11 53 **Funding/Support:** National Council for Scientific Research (CNRS)

12 54 **Role of Funder/Sponsor (if any):** Funded data collection and analysis

13 55 **Data availability:** Raw data were generated at the different hospitals (AUBMC, LAUMC,  
14 56 RHUH, Sacre Coeur hospital, Geitawi hospital). Derived data supporting the findings of this  
15 57 study are available from the corresponding author on request  
16 58

17 58  
18 59 **Abbreviations:** Emergency Department (ED), Eastern Mediterranean Region (EMR), disability-  
19 60 adjusted life year (DALY), Pan-Asia Trauma Outcomes Study (PATOS), International  
20 61 Classification of Disease 9<sup>th</sup> clinical modification (ICD – 9 - CM) or 10<sup>th</sup> edition (ICD – 10 -  
21 62 CM), Statistical Package for the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago,  
22 63 IL), Road Traffic Injury (RTIs), low- and middle- income countries (LMICs)  
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35 74 **Table of Contents Summary:** This study presents evidence on the characteristics, mechanisms  
36 74 and clinical outcomes of pediatric injuries at multiple centers in Beirut.  
37 75  
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#### 40 78 **What's known on This Subject?**

41 79 Lebanon an upper- middle- income EMR country suffers from a large burden of injury,  
42 80 particularly among its pediatric population. With the absence of injury surveillance systems and  
43 81 registries, the magnitude and extent of the pediatric injury burden remain ambiguous with a  
44 82 limited impact on child injury prevention programs and safety policies.  
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#### 49 86 **What This Study Adds?**

50 87 The study findings offered an insight into understanding the mechanisms and outcomes of child  
51 88 injury. Evidence generated from this study will inform the design of parents' child injury  
52 88 prevention and safety programs and strategies.  
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## 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  $7.7 \pm 4.35$  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

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

144  
145 **Conclusions** Injury remains a major health problem among the pediatric population in Lebanon.  
146 Parental child safety educational programs and age-targeted injury prevention strategies should be  
147 initiated and implemented to mitigate the burden of child injuries and improve child safety and  
148 well-being.

## 149 150 151 152 Strength and limitations

- 153  
154 • This study offers an insight into understanding the mechanisms and outcomes of child  
155 injury.
- 156  
157 • Evidence generated from this study will inform the design of parents' child injury  
158 prevention and safety programs and strategies
- 159  
160 • The data on details surrounding the injury event and on causes of deaths are also missing  
161 in ED documentation since there is a lack of proper documentation and universal coding  
162 among the hospitals at hand.

## 177 Introduction

178  
179 Pediatric injury represents the 3<sup>rd</sup> leading cause of death among children aged less than 15,  
180 surpassing major common childhood diseases [1, 2]. An estimated 6 million children die every  
181 year as a result of injuries [1], with millions others requiring medical care through emergency visits  
182 and hospitalization [3]. Pediatric injury constitutes a major contributor to the Global Burden of  
183 Disease, accounting for nearly 10.6% of the global number of deaths for individuals less than 20  
184 years of age [1, 4]. The pediatric population is particularly vulnerable to all types of injuries.  
185 Children have limited abilities to rationally judge hazards and risks in their surrounding  
186 environment, ultimately increasing their vulnerability and exposure to multiple types of injuries.  
187 Pediatric injury persists as one of the leading causes of child deaths in low- and middle-income  
188 countries [2, 5-7]. The high injury mortality and morbidity rates are due to multiple contributing  
189 factors including but not limited to child's family socioeconomic and educational status and  
190 income level, hazardous environment, and the degree of child supervision [8-10]. The Eastern  
191 Mediterranean Region (EMR) which includes many low- and middle-income countries previously  
192 reported the highest rate of child and adolescent injury globally in 2017 with an estimated rate of  
193 43.2 per 100,000 population. This high rate is equivalent to more than 130,000 child deaths in  
194 2017, mainly caused by transport, violence, and regional conflicts and wars [11, 12]. Lebanon an  
195 upper- middle- income EMR country, suffers from a large burden of injury, especially among its  
196 pediatric population. The country's WHO 2000-2012 estimates suggest that injury is the 3<sup>rd</sup>  
197 leading cause of death and the 5<sup>th</sup> leading cause of disability-adjusted life year (DALY) in  
198 Lebanon [13]. Further to its substantial toll on children's physical and emotional well-being, injury  
199 results in a substantial economic burden on the injured child family and caregivers and above all  
200 on the resource-limited Lebanese healthcare system [14]. Although children represent  
201 approximately 31% of the Lebanese population [15], the number of studies investigating pediatric  
202 injuries remains scarce with a limited impact of injury prevention programs and safety policies  
203 [16-19]. Additionally, the lack of hospital surveillance systems and trauma registries in Lebanon  
204 render it challenging to accurately assess the magnitude and the extent of the child injury problem  
205 and its associated risk factors.  
206 The main objective of this study is to examine the pediatric injury epidemiology in Lebanon's  
207 capital city, Beirut, providing insights into understanding its magnitude, injury mechanisms and  
208 outcomes. Evidence generated from this study will help to inform the design of future parents'  
209 child educational safety programs and injury prevention strategies and policies to reduce the child  
210 injury burden and mitigate its impacts on children's health and well-being.

## 214 Methodology

### 215 Study Setting

216 Data were retrospectively collected from reviewed patients' charts at Emergency Departments at  
217 5 hospitals located in the greater Beirut district area, which encompasses almost 30% of the  
218 Lebanese population (2.2 million). Data were captured from 5 urban hospitals: The American  
219 University of Beirut Medical Center (330 beds, 60,000 annual ED visits), Hariri Governmental  
220 Hospital (544 Beds, 17,000 annual ED visits), Geitawi hospital (250 beds, 11,000 annual ED visits),  
221 LAU medical center (120 beds, 6,000), and Sacre-Coeur hospital (155 beds, 4,000 annual ED  
222 visits). This study was approved by Internal Review Board (IRB) [BIO-2018-0061] at the

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

225

### 226 **Patient Involvement**

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

229

### 230 **Data Collection**

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

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

247

### 248 **Data Analysis**

249 A descriptive and inferential statistical analysis was performed using the Statistical Package for  
250 the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago, IL). Characteristics, trends and  
251 patterns of injury were described for the total sample and the four children's age-stratified groups  
252 (less than 1, 1-5, 6-10, and 11-15 years). Mean (standard deviation), median, and the interquartile  
253 range were calculated to summarize age and vital signs. Pearson's Chi-Square or Fisher's exact  
254 tests were used to assess the significance of the statistical association between all categorical  
255 variables and the outcome variable [ED disposition (admitted vs. treated and discharged)]. All  
256 clinically and statistically significant variables were included in a multivariate analysis using a  
257 stepwise logistic regression model to determine the factors associated with hospital admission. A  
258 p-value of  $\leq 0.05$  was used to indicate statistical significance. The final model was found to be a  
259 good fit to the data as the Hosmer-Lemeshow test indicated ( $p=0.957$ ) and it discriminated  
260 perfectly the two categories of the outcome variable (area under the curve = 0.894 [95% CI: 0.848  
261 – 0.940,  $p<0.001$ ].

262

### 263 **Results**

264 A total of 1,142 cases of pediatric cases were sampled from participating hospitals with a sustained  
265 injury during the one year (June 2017-May 2018), accounting for almost 23.5% of all traumatic  
266 ED cases. Children's ages ranged from 0 to 15 with mean age  $7.7 \pm 4.35$  years, mostly Lebanese  
267 (80.3 %,  $n=917$ ), other nationalities were mainly Syrian and Palestinian. Reported injuries were  
268 evenly distributed across age groups, with 399 (34.9%) among children 1-5, 370 (32.4%) among



269 6-10 and 357 (31.3%) among 11-15 years of age, with more males (n= 733, 64.2%) sustaining  
 270 injuries compared to their female counterparts (n= 408, 35.7%). The male to female ratio was 1.8:1.  
 271 For all injury mechanisms with one exception for children aged < 1 who were mostly females (n=  
 272 10, 62.5%) and accounted for 1.4% (n=16) of the total injuries.

273

274 **Table 1:** General Characteristics of the Studied Population.

275

	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)

276

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

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

284

285

286

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

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289

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

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292

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

295

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298

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

297  
 298 **Table 2:** Event characteristics per age group.  
 299

300

	Frequency N (%)				
	<1	1-5	6-10	11-15	Total
Cases	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 <sup>1</sup>	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>					

<sup>1</sup> 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)
<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 <sup>2</sup>	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>					
Prehospital ambulance transport	0 (0)	3 (0.8)	3 (0.8)	7 (2.0)	13 (1.1)

<sup>2</sup> 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
<b>Pre-existing disability (GOS)</b>					
Moderate disability <sup>3</sup>	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 & AMA	4 (25.0)	15 (3.8)	10 (2.7)	8 (2.2)	37 (3.2)

<sup>3</sup> 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)
<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 <sup>4</sup>	0 (0)	3 (0.8)	2 (0.5)	4 (1.1)	9 (0.8)

<sup>4</sup> Independent activities of daily living are not possible

Moderate disability <sup>5</sup>	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)

316

317

318 In the bivariate analysis (table not shown), the leading type of injury for admitted pediatric cases  
 319 was fracture (55.3%) (p<0.001) followed by concussion (21.3%) (p<0.001), organ system injury  
 320 (21.3%) (p<0.001) and cuts/open wound (17.0%) (p=0.035). The most common injured body part  
 321 among admitted pediatric cases were upper extremities (53.2%) (p=0.016), head (36.2%) (p<0.001)  
 322 and abdomen (14.9%) (p<0.001). Privately insured children were more likely to be admitted to the  
 323 hospital (p= 0.004) as a result of their injuries.

324 In the multivariate analysis, significant factors that were positively associated with hospital  
 325 admission included: body regions, namely head (OR =14.35 [95% CI 4.01– 51.34]), abdomen (OR  
 326 =8.25 [1.11 – 61.24]), upper extremity (OR = 5.79 [95% CI 2.04 – 16.49]), and Lower Extremity  
 327 (OR =5.55 [95% CI 2.02 – 15.20]), in addition to ‘other insurance type’ (OR = 8.33 [95% CI 2.19  
 328 – 31.67]). The three types of injury with the highest hospital admissions were fracture (OR =13.55  
 329 [95% CI 4.77 – 38.44]), concussion (OR = 13.60 [95% CI 2.83 – 65.41]), and organ system injury  
 330 (OR =31.63 [95% CI 3.45 – 290.11])

331

332 **Table 4:** Factors associated with hospital admission

333

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

<sup>5</sup> Independent activities of daily living are possible, but cannot resume work/school life

<b>Type of injury - Organ system injury (No)</b>			
Yes	31.63	3.45 – 290.11	0.002

334  
335 \*Adjusted for: age, gender, hospital type, nationality, insurance type, mechanism of injury,  
336 location of injury (head; face; neck/thorax; abdomen and pelvic contents; upper extremity; lower  
337 extremity including bony pelvis), type of injury (fracture; cuts, bites or open wound; bruise or  
338 superficial injury; concussion; organ system injury), place of injury (home, including garden and  
339 outbuildings; street/highway; sports and athletics area), activity (leisure/play).

340

## 341 Discussion

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

349

350 The study results underscore the substantial burden of pediatric injuries, accounting for nearly 23.8%  
351 of total traumatic cases presented to ED. These results are comparable to those generated in a local  
352 study and reported similar patterns of pediatric injuries among ED presentations at 3 hospitals in  
353 Beirut [22]. The high prevalence of child injuries is consistent with previous attempts to quantify  
354 the burden of childhood injuries in high-, middle- and low-income countries, regardless of  
355 countries' social and cultural disparities [1, 23-26]. A large number of these injuries were sustained  
356 by males, similar to existing literature that confirmed the predominance of injuries among males  
357 across all mechanisms of injuries along with the increased odds of sustaining repeated injuries [7,  
358 27-30]. Moreover, this study highlighted the high frequency of injury occurrences among children  
359 aged 0 to 5. This age group sustained more than one-third of the total number of reported cases,  
360 almost 40.0% of the fall injuries and approximately 60.1% of home injuries. This highlights the  
361 vulnerability of young children as their physical, mental and cognitive development depends on  
362 their surrounding environment, which places them at an increased risk of getting injured. Moreover,  
363 the high prevalence of injury in non-Lebanese children less than 1 (mainly Palestinian and Syrian  
364 refugees) hints to their low socio-economic status, dire living conditions and limited access to  
365 emergency care and appropriate treatment. Contrary to existing literature, the study findings shows  
366 that children less than one year sustaining injuries were predominantly females. This can be  
367 possibly explained by the patriarchal society where males are more taken care of compared to  
368 females. Multiple factors increase the likelihood of injury occurrence, namely child's curious  
369 attributes and discovery nature coupled with the lack of safe environments and the absence of  
370 parents direct supervision [31];[32]. This underscores parents' fundamental role in child active  
371 supervision to protect children as a vulnerable population as well as underlines the importance of  
372 securing built-in child safety in the surrounding environment (e.g. locked cabins, gated stairs) that  
373 prevents and reduces childhood injuries (Sharma et al., 2018). This study demonstrates that  
374 unintentional injuries had a large toll on children, particularly those less than 5 years of age  
375 compared to their older counterparts. Nonetheless, it is worth noting that intentional injuries are  
376 under-reported in the Lebanese society, particularly with the lack of adequate policies or laws to

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

379  
380 The present study confirms that the leading causes of injury across all age groups are falls followed  
381 by being hit by objects and road traffic injury (mainly pedestrians). An abundance of literature  
382 observed similar findings in low-, middle- and high-income countries and confirmed that fall  
383 injury is responsible for the excess hospital ED visits and admissions among children [3, 27-29].  
384 This is mainly due to the onset of independent mobility and poor balance among young children  
385 which increases their risk of sustaining fall injuries [33, 34]. Hit by person/objects and Road  
386 Traffic Injury (RTIs) were other primary causes of injury among children, increasing with age and  
387 peaking at the age of 11-15. The lack of proper injury documentation at the hospital level hinders  
388 the comprehensive understanding of the external causes of these injuries, their circumstances and  
389 the safety measures adopted. Hence, there is an urgent need to institute a national injury  
390 surveillance system or trauma registry at hospitals in Lebanon, which is essential to provide high-  
391 quality epidemiological data on the incidence and circumstances of injuries requiring medical  
392 attention. Timely collection of injury data is critical for the development, adoption and evaluation  
393 of cost-effective injury prevention programs, strategies and policies. This will help to guide future  
394 policy priorities for childhood injury prevention and to tailor the implementation of context-  
395 sensitive interventions to reduce injuries and mitigate their consequences on the pediatric  
396 population.

397  
398 Similar to existing studies, our findings suggest that injuries in the 0-5 age group resulted mainly  
399 in head or face trauma comparable to the 6-15 y who suffered mainly from upper extremity injuries  
400 [35]. These body parts are mostly caused by falls and are strongly associated with increased  
401 hospital admissions ( $p<0.001$ ). A plausible explanation for this observed pattern of different body  
402 parts affected by fall injuries is related to the ability of older children to protect themselves from  
403 serious injuries using their peripheral extremities during the injury impact. This further reflects the  
404 preponderance of cuts and open wounds in the younger age group 0-10 years old compared to  
405 sprain and strain sustained by the older age 10-15y.

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

410  
411 Pediatric admission to hospitals considerably varies by injury types and mechanisms, body part  
412 injuries, and interestingly by insurance type. Head, abdomen and extremities ranked the highest  
413 among body parts injured that require hospital admission. Patients with head, abdomen or upper  
414 extremity injuries are almost 14, 8 and 6 times more likely to be admitted to hospital as a result of  
415 their injuries. Fall is shown to be the leading mechanism of hospital admission, which consistently  
416 agrees with regional studies [24, 27, 28]. Fracture, organ system injury and concussion topped the  
417 list of injury types resulting in hospital admissions. Patients with fractures or concussions are 13  
418 times more likely to be admitted to the hospital, and patients with organ injury are 31 times more  
419 at risk of being admitted. Unexpectedly, these injury patterns are inconsistent with international  
420 studies where sprains and open wounds are the leading types of child injuries [30] while agreeing  
421 with regional studies confirming that fracture, concussion and organ system injury are significant  
422 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

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2  
3 468 Pediatric injury represents a persistent challenge to the pediatric population and the healthcare  
4 469 system in Lebanon. With the lack of proper and standardized documentation of injury mechanisms,  
5 470 establishing a high-quality surveillance system is crucial to help identify priorities and guide the  
6 471 adaptation of evidence-based injury prevention strategies. Safety policies, awareness campaigns  
7 472 and age-targeted interventions should be initiated to control for child injuries and improve safety.  
8 473 Future studies should examine in further detail the several factors associated with pediatric injuries  
9 474 including the role of parental injury educational programs, caregiver's direct and active  
10 475 supervision and the presence of a safe and injury-free environment.  
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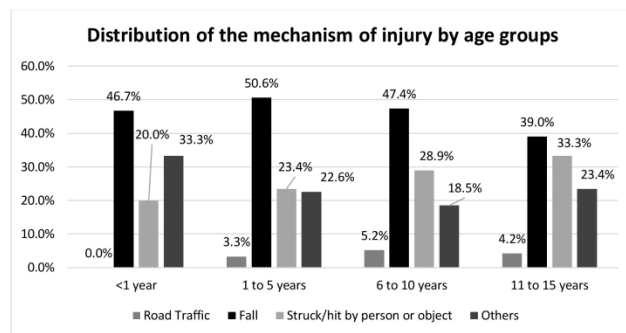
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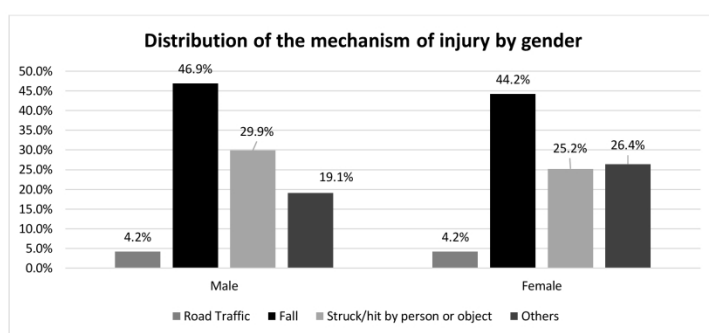
**Figure 1:** Distribution of the mechanism of injury by age groups.



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



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

	Item No	Recommendation
<b>Title and abstract (Page 1-6)</b>	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
<b>Introduction ( Page 7-8)</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
<b>Methods ( Page 8-10)</b>		
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
<b>Results (page 11-22)</b>		
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

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<b>Discussion (Page 22-27)</b>		
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
<b>Other information ( Page 28)</b>		
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](http://www.strobe-statement.org).

# BMJ Open

## Pediatric Injury in Beirut: A Multi-Center Retrospective study

Journal:	<i>BMJ Open</i>
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
<b>Primary Subject Heading</b>:	Emergency medicine
Secondary Subject Heading:	Epidemiology
Keywords:	EPIDEMIOLOGY, PUBLIC HEALTH, ACCIDENT & EMERGENCY MEDICINE, TRAUMA MANAGEMENT

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# 1 Pediatric Injury in Beirut: A Multi-Center Retrospective 2 study

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For peer review only



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8 48 **Short title:** Pediatric injury in Beirut, Lebanon.9  
10 4911  
12 50 **Conflict of Interest Disclosures:** All authors have declared that they have no financial conflict  
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15 51 of interest.16  
17 52 **Word Count:**18  
19 53 **Funding/Support:** National Council for Scientific Research (CNRS)20  
21 54 **Role of Funder/Sponsor (if any):** Funded data collection and analysis22  
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24 55 **Data availability:** Raw data were generated at the different hospitals (AUBMC, LAUMC,  
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26 56 RHUH, Sacre Coeur hospital, Geitawi hospital). Derived data supporting the findings of this  
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28 57 study are available from the corresponding author on request29  
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31 5832  
33 59 **Abbreviations:** Emergency Department (ED), Eastern Mediterranean Region (EMR), disability-  
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35 60 adjusted life year (DALY), Pan-Asia Trauma Outcomes Study (PATOS), International  
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38 61 Classification of Disease 9<sup>th</sup> clinical modification (ICD – 9 - CM) or 10<sup>th</sup> edition (ICD – 10 -  
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40 62 CM), Statistical Package for the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago,  
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**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.

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### 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.

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119 **Abstract**

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

123

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

127

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

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

134

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

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3 137 the fall injuries and 60.1% (220/366) of home injuries. The leading cause of pediatric injury was  
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5 138 fall (45.2%), nearly 4.1% of the cases were admitted to hospitals. Factors associated with  
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7  
8 139 admission included injury to abdomen (OR =8.25 [1.11 – 61.24]), to upper extremity (OR = 5.79  
9  
10 140 [CI 2.04 – 16.49]), to lower extremity (OR =5.55 [95% CI 2.02 – 15.20] and other insurance type  
11  
12 141 (OR = 8.33 [CI 2.19 – 31.67]). The three types of injuries mostly associated with hospital  
13  
14 142 admission were fracture (OR =13.55 [CI 4.77 – 38.44]), concussion (OR = 13.60 [CI 2.83 – 65.41]),  
15  
16 143 and organ system injury (OR =31.63 [CI 3.45 – 290.11]).  
17  
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20  
21 145 **Conclusions** Injury remains a major health problem among the pediatric population in Lebanon.  
22  
23 146 Parental child safety educational programs and age-targeted injury prevention strategies should be  
24  
25 147 initiated and implemented to mitigate the burden of child injuries and improve child safety and  
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27 148 well-being.  
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## 34 152 Strength and limitations

35 153

- 36 154 • This study offers an insight into understanding the mechanisms and outcomes of child  
37 155 injury.  
38 156
- 39 157 • Evidence generated from this study will inform the design of parents' child injury  
40 158 prevention and safety programs and strategies  
41 159

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

For peer review only

## 177 Introduction

178  
179 Pediatric injury represents the 3<sup>rd</sup> leading cause of death among children aged less than 15,  
180 surpassing major common childhood diseases [1, 2]. An estimated 6 million children die every  
181 year as a result of injuries [1], with millions others requiring medical care through emergency visits  
182 and hospitalization [3]. Pediatric injury constitutes a major contributor to the Global Burden of  
183 Disease, accounting for nearly 10.6% of the global number of deaths for individuals less than 20  
184 years of age [1, 4]. The pediatric population is particularly vulnerable to all types of injuries.  
185 Children have limited abilities to rationally judge hazards and risks in their surrounding  
186 environment, ultimately increasing their vulnerability and exposure to multiple types of injuries.  
187 Pediatric injury persists as one of the leading causes of child deaths in low- and middle-income  
188 countries [2, 5-7]. The high injury mortality and morbidity rates are due to multiple contributing  
189 factors including but not limited to child's family socioeconomic and educational status and  
190 income level, hazardous environment, and the degree of child supervision [8-10]. The Eastern  
191 Mediterranean Region (EMR) which includes many low- and middle-income countries previously  
192 reported the highest rate of child and adolescent injury globally in 2017 with an estimated rate of  
193 43.2 per 100,000 population. This high rate is equivalent to more than 130,000 child deaths in  
194 2017, mainly caused by transport, violence, and regional conflicts and wars [11, 12]. Lebanon an  
195 upper- middle- income EMR country, suffers from a large burden of injury, especially among its  
196 pediatric population. The country's WHO 2000-2012 estimates suggest that injury is the 3<sup>rd</sup>  
197 leading cause of death and the 5<sup>th</sup> leading cause of disability-adjusted life year (DALY) in  
198 Lebanon [13]. Further to its substantial toll on children's physical and emotional well-being, injury  
199 results in a substantial economic burden on the injured child family and caregivers and above all

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3 200 on the resource-limited Lebanese healthcare system [14]. Although children represent  
4  
5 201 approximately 31% of the Lebanese population [15], the number of studies investigating pediatric  
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8 202 injuries remains scarce with a limited impact of injury prevention programs and safety policies  
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10 203 [16-19]. Additionally, the lack of hospital surveillance systems and trauma registries in Lebanon  
11  
12 204 render it challenging to accurately assess the magnitude and the extent of the child injury problem  
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15 205 and its associated risk factors.

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17 206 The main objective of this study is to examine the pediatric injury epidemiology in Lebanon's  
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19 207 capital city, Beirut, providing insights into understanding its magnitude, injury mechanisms and  
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21 208 outcomes. Evidence generated from this study will help to inform the design of future parents'  
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23 209 child educational safety programs and injury prevention strategies and policies to reduce the child  
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26 210 injury burden and mitigate its impacts on children's health and well-being.  
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## 31 214 Methodology

### 32 215 Study Setting

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36 216 Data were retrospectively collected from reviewed patients' charts at Emergency Departments at  
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38 217 5 hospitals located in the greater Beirut district area, which encompasses almost 30% of the  
39  
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41 218 Lebanese population (2.2 million). Data were captured from 5 urban hospitals: The American  
42  
43 219 University of Beirut Medical Center (330 beds, 60,000 annual ED visits), Hariri Governmental  
44  
45 220 Hospital (544 Beds, 17,000 annual ED visits), Geitawi hospital (250 beds, 11,000 annual ED visits),  
46  
47 221 LAU medical center (120 beds, 6,000), and Sacre-Coeur hospital (155 beds, 4,000 annual ED  
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50 222 visits). This study was approved by Internal Review Board (IRB) [BIO-2018-0061] at the  
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223 American University of Beirut (leading site) and the ethical committee at each participating  
224 hospital.

225

### 226 **Patient Involvement**

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

229

### 230 **Data Collection**

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

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

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

247

## 248 **Data Analysis**

249 A descriptive and inferential statistical analysis was performed using the Statistical Package for  
250 the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago, IL). Characteristics, trends and  
251 patterns of injury were described for the total sample and the four children's age-stratified groups  
252 (less than 1, 1-5, 6-10, and 11-15 years). Mean (standard deviation), median, and the interquartile  
253 range were calculated to summarize age and vital signs. Pearson's Chi-Square or Fisher's exact  
254 tests were used to assess the significance of the statistical association between all categorical  
255 variables and the outcome variable [ED disposition (admitted vs. treated and discharged)]. All  
256 clinically and statistically significant variables were included in a multivariate analysis using a  
257 stepwise logistic regression model to determine the factors associated with hospital admission. A  
258 p-value of  $\leq 0.05$  was used to indicate statistical significance. The final model was found to be a  
259 good fit to the data as the Hosmer-Lemeshow test indicated ( $p=0.957$ ) and it discriminated  
260 perfectly the two categories of the outcome variable (area under the curve = 0.894 [95% CI: 0.848  
261 – 0.940,  $p<0.001$ ].

262

## 263 **Results**

264 A total of 1,142 cases of pediatric cases were sampled from participating hospitals with a sustained  
265 injury during the one year (June 2017-May 2018), accounting for almost 23.5% of all traumatic  
266 ED cases. Children's ages ranged from 0 to 15 with mean age  $7.7 \pm 4.35$  years, mostly Lebanese  
267 (80.3 %,  $n=917$ ), other nationalities were mainly Syrian and Palestinian. Reported injuries were

268 evenly distributed across age groups, with 399 (34.9%) among children 1-5, 370 (32.4%) among  
 269 6-10 and 357 (31.3%) among 11-15 years of age, with more males (n= 733, 64.2%) sustaining  
 270 injuries compared to their female counterparts (n= 408, 35.7%). The male to female ratio was 1.8:1.  
 271 For all injury mechanisms with one exception for children aged < 1 who were mostly females (n=  
 272 10, 62.5%) and accounted for 1.4% (n=16) of the total injuries. (Table 1)

274 **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)

276

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

281 No mortality was identified in the collected sample and most reported pediatric injuries (85.1%)  
 282 were mild. Nonetheless, nine children suffered from a severe disability that affected their daily  
 283 activities. These injuries were mainly reported among the older age group 6-15. (Table 2) ( Figure  
 284 1 & 2)

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287

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

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290

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

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293

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

299 **Table 2:** Event characteristics per age group.

	Frequency N (%)				
	<1	1-5	6-10	11-15	Total
Cases	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 <sup>1</sup>	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>					

<sup>1</sup> 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)
<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 <sup>2</sup>	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>					
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)

<sup>2</sup> 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)

302

303

304 As for the anatomic location of injury, the leading body parts injured were upper extremities (n= 305 417, 36.5%), lower extremities (n=308, 27.0%), face (n=252, 22.1%) and head (n=172, 15.1%).

306 Children 1-5 sustained more than half of the reported head (n= 89/172, 51.7%) and face (n= 307 127/252, 50.3%) injuries. Compared to the younger age group, children 6-10 and 11-15 suffered 308 more injuries to extremities with 247 cases (66.8%) and 291 cases (81.5%) respectively (Table 2).

309 In terms of patients' disposition, nearly 1,021 (89.4%) of the injured cases were treated and 310 released at the ED while 47 children (4.1%) were admitted to hospitals. Unknown outcomes 311 accounted for approximately 3.2% of cases. (Table 3)

312

313

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

315

316

	Frequency N (%)				
	<1	1-5	6-10	11-15	Total
Cases	16	399	370	357	1142
<b>Pre-existing disability (GOS)</b>					
Moderate disability <sup>3</sup>	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 & 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>					

<sup>3</sup> 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)
<b>GOS at discharge</b>					
Severe disability <sup>4</sup>	0 (0)	3 (0.8)	2 (0.5)	4 (1.1)	9 (0.8)
Moderate disability <sup>5</sup>	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)

<sup>4</sup> Independent activities of daily living are not possible

<sup>5</sup> 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)
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318  
319 In the bivariate analysis (table not shown), the leading type of injury for admitted pediatric cases  
320 was fracture (55.3%) ( $p < 0.001$ ) followed by concussion (21.3%) ( $p < 0.001$ ), organ system injury  
321 (21.3%) ( $p < 0.001$ ) and cuts/open wound (17.0%) ( $p = 0.035$ ). The most common injured body part  
322 among admitted pediatric cases were upper extremities (53.2%) ( $p = 0.016$ ), head (36.2%) ( $p < 0.001$ )  
323 and abdomen (14.9%) ( $p < 0.001$ ). Privately insured children were more likely to be admitted to the  
324 hospital ( $p = 0.004$ ) as a result of their injuries.

325 In the multivariate analysis, significant factors that were positively associated with hospital  
326 admission included: body regions, namely head (OR = 14.35 [95% CI 4.01– 51.34]), abdomen (OR  
327 = 8.25 [1.11 – 61.24]), upper extremity (OR = 5.79 [95% CI 2.04 – 16.49]), and Lower Extremity  
328 (OR = 5.55 [95% CI 2.02 – 15.20]), in addition to ‘other insurance type’ (OR = 8.33 [95% CI 2.19  
329 – 31.67]). The three types of injury with the highest hospital admissions were fracture (OR = 13.55  
330 [95% CI 4.77 – 38.44]), concussion (OR = 13.60 [95% CI 2.83 – 65.41]), and organ system injury  
331 (OR = 31.63 [95% CI 3.45 – 290.11]) (Table 4)

332  
333 **Table 4:** Factors associated with hospital admission

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

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

335

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

341

## 342 Discussion

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

350  
351 The study results underscore the substantial burden of pediatric injuries, accounting for nearly 23.8%  
352 of total traumatic cases presented to ED. These results are comparable to those generated in a local  
353 study and reported similar patterns of pediatric injuries among ED presentations at 3 hospitals in  
354 Beirut [22]. The high prevalence of child injuries is consistent with previous attempts to quantify  
355 the burden of childhood injuries in high-, middle- and low-income countries, regardless of  
356 countries' social and cultural disparities [1, 23-26]. A large number of these injuries were sustained  
357 by males, similar to existing literature that confirmed the predominance of injuries among males  
358 across all mechanisms of injuries along with the increased odds of sustaining repeated injuries [7,  
359 27-30]. Moreover, this study highlighted the high frequency of injury occurrences among children  
360 aged 0 to 5. This age group sustained more than one-third of the total number of reported cases,  
361 almost 40.0% of the fall injuries and approximately 60.1% of home injuries. This highlights the  
362 vulnerability of young children as their physical, mental and cognitive development depends on  
363 their surrounding environment, which places them at an increased risk of getting injured. Moreover,  
364 the high prevalence of injury in non-Lebanese children less than 1 (mainly Palestinian and Syrian

1  
2  
3 365 refugees) hints to their low socio-economic status, dire living conditions and limited access to  
4  
5 366 emergency care and appropriate treatment. Contrary to existing literature, the study findings shows  
6  
7 367 that children less than one year sustaining injuries were predominantly females. This can be  
8  
9  
10 368 possibly explained by the patriarchal society where males are more taken care of compared to  
11  
12 369 females. Multiple factors increase the likelihood of injury occurrence, namely child's curious  
13  
14 370 attributes and discovery nature coupled with the lack of safe environments and the absence of  
15  
16 371 parents direct supervision [31];[32]. This underscores parents' fundamental role in child active  
17  
18 372 supervision to protect children as a vulnerable population as well as underlines the importance of  
19  
20 373 securing built-in child safety in the surrounding environment (e.g. locked cabins, gated stairs) that  
21  
22 374 prevents and reduces childhood injuries (Sharma et al., 2018). This study demonstrates that  
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24 375 unintentional injuries had a large toll on children, particularly those less than 5 years of age  
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26 376 compared to their older counterparts. Nonetheless, it is worth noting that intentional injuries are  
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28 377 under-reported in the Lebanese society, particularly with the lack of adequate policies or laws to  
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30 378 protect children from any forms of abuse. As a result, hospitals are constrained from reporting  
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32 379 abuse even if observed during evaluation.  
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40 381 The present study confirms that the leading causes of injury across all age groups are falls followed  
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42 382 by being hit by objects and road traffic injury (mainly pedestrians). An abundance of literature  
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44 383 observed similar findings in low-, middle- and high-income countries and confirmed that fall  
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46 384 injury is responsible for the excess hospital ED visits and admissions among children [3, 27-29].  
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48 385 This is mainly due to the onset of independent mobility and poor balance among young children  
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50 386 which increases their risk of sustaining fall injuries [33, 34]. Hit by person/objects and Road  
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52 387 Traffic Injury (RTIs) were other primary causes of injury among children, increasing with age and  
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3 388 peaking at the age of 11-15. The lack of proper injury documentation at the hospital level hinders  
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5 389 the comprehensive understanding of the external causes of these injuries, their circumstances and  
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8 390 the safety measures adopted. Hence, there is an urgent need to institute a national injury  
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10 391 surveillance system or trauma registry at hospitals in Lebanon, which is essential to provide high-  
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12 392 quality epidemiological data on the incidence and circumstances of injuries requiring medical  
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14 393 attention. Timely collection of injury data is critical for the development, adoption and evaluation  
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16 394 of cost-effective injury prevention programs, strategies and policies. This will help to guide future  
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18 395 policy priorities for childhood injury prevention and to tailor the implementation of context-  
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20 396 sensitive interventions to reduce injuries and mitigate their consequences on the pediatric  
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22 397 population.  
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28 399 Similar to existing studies, our findings suggest that injuries in the 0-5 age group resulted mainly  
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30 400 in head or face trauma comparable to the 6-15 y who suffered mainly from upper extremity injuries  
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32 401 [35]. These body parts are mostly caused by falls and are strongly associated with increased  
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34 402 hospital admissions ( $p < 0.001$ ). A plausible explanation for this observed pattern of different body  
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36 403 parts affected by fall injuries is related to the ability of older children to protect themselves from  
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38 404 serious injuries using their peripheral extremities during the injury impact. This further reflects the  
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40 405 preponderance of cuts and open wounds in the younger age group 0-10 years old compared to  
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42 406 sprain and strain sustained by the older age 10-15y.  
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46 407 To note, neck and thoracoabdominal injuries were among the least injuries observed across all  
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48 408 ages. Neck injuries are usually less common in children and thoracoabdominal injuries are usually  
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50 409 associated with high impact mechanisms and high injury severity which were not frequent in this  
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52 410 study.  
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6 412 Pediatric admission to hospitals considerably varies by injury types and mechanisms, body part  
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8 413 injuries, and interestingly by insurance type. Head, abdomen and extremities ranked the highest  
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10 414 among body parts injured that require hospital admission. Patients with head, abdomen or upper  
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12 415 extremity injuries are almost 14, 8 and 6 times more likely to be admitted to hospital as a result of  
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14 416 their injuries. Fall is shown to be the leading mechanism of hospital admission, which consistently  
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16 417 agrees with regional studies [24, 27, 28]. Fracture, organ system injury and concussion topped the  
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18 418 list of injury types resulting in hospital admissions. Patients with fractures or concussions are 13  
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20 419 times more likely to be admitted to the hospital, and patients with organ injury are 31 times more  
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22 420 at risk of being admitted. Unexpectedly, these injury patterns are inconsistent with international  
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24 421 studies where sprains and open wounds are the leading types of child injuries [30] while agreeing  
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26 422 with regional studies confirming that fracture, concussion and organ system injury are significant  
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28 423 predictors of a child hospital admission [22, 36]. Although concussion cases constituted only 3.1%  
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30 424 of the total pediatric cases, it comprises nearly 21% of the admitted cases ( $p < 0.001$ ). This present  
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32 425 study showed that concussion and organ system injury is more common among the young age  
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34 426 group while fractures are more prevalent among the older pediatric population [29, 35, 37, 38].  
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36 427 This is understandable as older children tend to be more actively involved in sports and leisure  
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38 428 activities, and therefore relatively more prone to fractures of extremities than their counterparts.  
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40 429 Regardless of child's age, knowledge of risk factors along with education, injury awareness  
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42 430 programs and adequate intervention measures should be implemented to enhance environmental  
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44 431 safety and prevent childhood injuries [6, 26, 39, 40].  
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3 433 A widening gap persists between developed and developing countries in terms of injury prevention  
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5 434 and severity outcomes. Previous literature noted that high-income countries have actively and  
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7 435 successfully devised numerous interventions to control for the burden of injury. Following the  
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9 436 implementation of trauma registries, these countries observed major reductions in childhood injury  
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11 437 morbidity and mortality as a result of reduced injury frequency and severity, enhanced patients  
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13 438 care and subsequently improved patients outcomes [35, 37]. Contrary to high-income countries,  
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15 439 injury remains the leading cause of child mortality in low- and middle-income countries (LMICs)  
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17 440 [26]. Hence, a concerted endeavour is needed to transform child safety and wellbeing in LMICs,  
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19 441 through a mixture of approaches ranging from improving emergency care to building a national  
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21 442 surveillance system, to designing and developing education and awareness programs, to  
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23 443 implementing and enforcing proper safety regulations and legislations.  
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31 445 This study has some limitations. First, injury studies usually report on mortality as an outcome. In  
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33 446 our study population, no death cases were reported. This is potentially related to the fact that deaths  
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35 447 would typically be coded differently at EDs in Lebanon, under ‘cardiac arrest’, without identifying  
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37 448 a clear etiology such as traumatic death. Prehospital data on details surrounding the injury event  
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39 449 and on causes of deaths are also missing in ED documentation since there is a lack of proper  
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41 450 documentation in general in the prehospital field and these types of data are not usually shared  
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43 451 with ED when the patient arrives at the hospital. Possibly, there were deaths among pediatric  
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45 452 patients with ‘Unknown outcomes’ or among those who were transferred or who left AMA,  
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47 453 however, this was not captured in our data. Second details on the injury mechanism, the  
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49 454 circumstances and the adopted safety measures were missing from patients’ medical records. This  
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51 455 is mainly due to the lack of injury surveillance systems and the retrospective nature of the data  
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3 456 capturing process with its inherited limitations of available data variables in patients' medical  
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5 457 records. Third, standardized coding of injuries (i.e. International Codes of Disease ICD) is lacking,  
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7 458 which might have affected the accurate and reliable documentation and standardized reporting of  
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9 459 injury cases. This information is essential to assess injury-associated risk factors and to design  
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11 460 tailored and context-appropriate interventions. Fourth, this study used emergency department and  
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13 461 admission data with limited follow-up information on the short- and long-term outcomes of  
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15 462 multiple injuries including concussions and their impacts on a child's behavior and long-term  
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17 463 disability. Lastly, this study collected data from hospitals in Beirut. It is possible that data collected  
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19 464 from rural areas reflect different trends and patterns in injury.  
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## 29 467 Conclusion

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33 469 Pediatric injury represents a persistent challenge to the pediatric population and the healthcare  
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35 470 system in Lebanon. With the lack of proper and standardized documentation of injury mechanisms,  
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37 471 establishing a high-quality surveillance system is crucial to help identify priorities and guide the  
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39 472 adaptation of evidence-based injury prevention strategies. Safety policies, awareness campaigns  
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41 473 and age-targeted interventions should be initiated to control for child injuries and improve safety.  
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43 474 Future studies should examine in further detail the several factors associated with pediatric injuries  
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45 475 including the role of parental injury educational programs, caregiver's direct and active  
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47 476 supervision and the presence of a safe and injury-free environment.  
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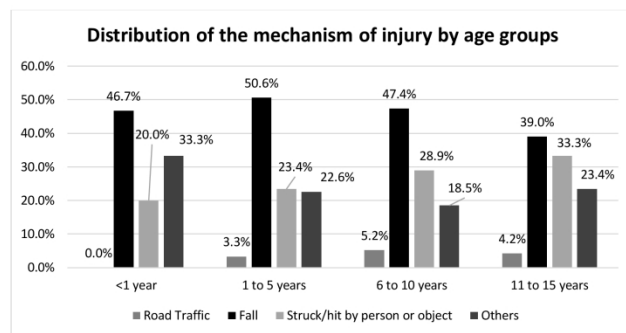
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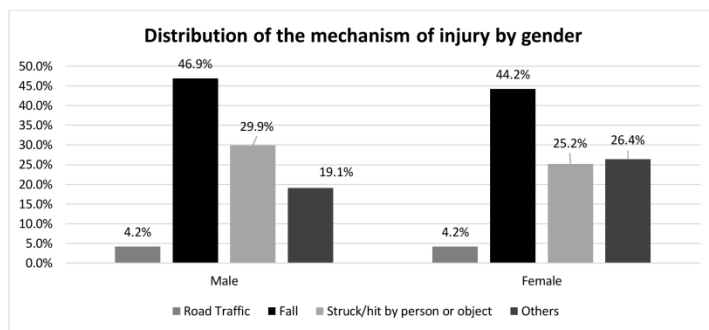
**Figure 1:** Distribution of the mechanism of injury by age groups.



215x279mm (300 x 300 DPI)

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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
<b>Title and abstract (Page 1-6)</b>	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
<b>Introduction ( Page 7-8)</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
<b>Methods ( Page 8-10)</b>		
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
<b>Results (page 11-22)</b>		
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

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<b>Discussion (Page 22-27)</b>		
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
<b>Other information ( Page 28)</b>		
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](http://www.strobe-statement.org).

# BMJ Open

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

Journal:	<i>BMJ Open</i>
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
<b>Primary Subject Heading</b>:	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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American University of Beirut Medical Center

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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 9<sup>th</sup> clinical modification (ICD – 9 - CM) or 10<sup>th</sup> 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)

## 68 Abstract

69  
70 **Objective** This study aims to assess the epidemiology of pediatric injury in Beirut, giving insights  
71 into their characteristics, contributing risk factors and outcomes.

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

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

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

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

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3 91 admission were fracture (OR =13.55 [CI 4.77 – 38.44]), concussion (OR = 13.60 [CI 2.83 – 65.41]),  
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5 92 and organ system injury (OR =31.63 [CI 3.45 – 290.11]).  
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10 94 **Conclusions** Injury remains a major health problem among the pediatric population in Lebanon.  
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12 95 Parental child safety educational programs and age-targeted injury prevention strategies should be  
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14 96 initiated and implemented to mitigate the burden of child injuries and improve child safety and  
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16 97 well-being.  
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## 27 101 Strength and limitations

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- 32 103 • This study offers an insight into understanding the characteristics, mechanisms, and clinical  
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34 104 outcomes of pediatric injuries at multiple centers in Beirut.
- 35 105 • Evidence generated from this study will inform the design of parents' child injury  
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37 106 prevention and safety programs and strategies.
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39 107 • Details on the etiology of the injury event and causes of injury deaths were missing in ED  
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41 108 data due to the lack of proper documentation and universal coding among participating  
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43 109 hospitals.
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45 110 • The lack of existing injury surveillance systems in Lebanon and the inherited limitation of  
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47 111 the retrospectively captured ED data hindered the accurate assessment of the injury  
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49 112 mechanisms and associated risk factors.  
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For peer review only

## 127 Introduction

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129 Pediatric injury represents the 3<sup>rd</sup> leading cause of death among children aged less than 15,  
130 surpassing major common childhood diseases [1, 2]. An estimated 6 million children die every  
131 year as a result of injuries [1], with millions others requiring medical care through emergency visits  
132 and hospitalization [3]. Pediatric injury constitutes a major contributor to the Global Burden of  
133 Disease, accounting for nearly 10.6% of the global number of deaths for individuals less than 20  
134 years of age [1, 4]. The pediatric population is particularly vulnerable to all types of injuries.  
135 Children have limited abilities to rationally judge hazards and risks in their surrounding  
136 environment, ultimately increasing their vulnerability and exposure to multiple types of injuries.  
137 Pediatric injury persists as one of the leading causes of child deaths in low- and middle-income  
138 countries [2, 5-7]. The high injury mortality and morbidity rates are due to multiple contributing  
139 factors including but not limited to child's family socioeconomic and educational status and  
140 income level, hazardous environment, and the degree of child supervision [8-10]. The Eastern  
141 Mediterranean Region (EMR) which includes many low- and middle-income countries previously  
142 reported the highest rate of child and adolescent injury globally in 2017 with an estimated rate of  
143 43.2 per 100,000 population. This high rate is equivalent to more than 130,000 child deaths in  
144 2017, mainly caused by transport, violence, and regional conflicts and wars [11, 12]. Lebanon an  
145 upper- middle- income EMR country, suffers from a large burden of injury, especially among its  
146 pediatric population. The country's WHO 2000-2012 estimates suggest that injury is the 3<sup>rd</sup>  
147 leading cause of death and the 5<sup>th</sup> leading cause of disability-adjusted life year (DALY) in  
148 Lebanon [13]. Further to its substantial toll on children's physical and emotional well-being, injury  
149 results in a substantial economic burden on the injured child family and caregivers and above all

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3 150 on the resource-limited Lebanese healthcare system [14]. Although children represent  
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5 151 approximately 31% of the Lebanese population [15], the number of studies investigating pediatric  
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8 152 injuries remains scarce with a limited impact of injury prevention programs and safety policies  
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10 153 [16-19]. Additionally, the lack of hospital surveillance systems and trauma registries in Lebanon  
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12 154 render it challenging to accurately assess the magnitude and the extent of the child injury problem  
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15 155 and its associated risk factors.

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17 156 The main objective of this study is to examine the pediatric injury epidemiology in Lebanon's  
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19 157 capital city, Beirut, providing insights into understanding its magnitude, injury mechanisms and  
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21 158 outcomes. Evidence generated from this study will help to inform the design of future parents'  
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23 159 child educational safety programs and injury prevention strategies and policies to reduce the child  
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26 160 injury burden and mitigate its impacts on children's health and well-being.  
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## 34 35 164 Methodology

### 36 37 38 165 Study Setting

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41 166 Data were retrospectively collected from reviewed patients' charts at Emergency Departments at  
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43 167 5 hospitals located in the greater Beirut district area, which encompasses almost 30% of the  
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45 168 Lebanese population (2.2 million). Data were captured from 5 urban hospitals: The American  
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47 169 University of Beirut Medical Center (330 beds, 60,000 annual ED visits), Hariri Governmental  
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49 170 Hospital (544 Beds, 17,000 annual ED visits), Geitawi hospital (250 beds, 11,000 annual ED visits),  
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51 171 LAU medical center (120 beds, 6,000), and Sacre-Coeur hospital (155 beds, 4,000 annual ED  
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54 172 visits). This study was approved by Internal Review Board (IRB) [BIO-2018-0061] at the  
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3 173 American University of Beirut (leading site) and the ethical committee at each participating  
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5 174 hospital.

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10 176 **Data Collection**

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12 177 Data were collected on children aged 0-15 who sustained any type of injury and presented to one  
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14 178 of the participating hospitals within the 12 months period from June 2017-May 2018. Both  
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16 179 intentional and unintentional injuries were included in the database. Additional information was  
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18 180 collected related to child socio-demographic information, injury mechanism, activity at the time  
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20 181 of injury, injury location and body part injured, and injury anatomical and clinical outcomes. The  
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22 182 Pan-Asia Trauma Outcomes Study (PATOS)[20] was adopted to design and develop the data  
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24 183 collection form.

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26 184 At each hospital, patients' ED medical records were reviewed. Injury cases were filtered by  
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28 185 mechanisms coded according to the *International Classification of Disease 9<sup>th</sup>, clinical*  
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30 186 *modification (ICD -9-CM) or 10<sup>th</sup> edition (ICD -10-CM)* adopted at some hospitals or by keywords  
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32 187 at hospitals with the absence of a proper coding scheme. Data were manually captured by a trained  
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34 188 MD into the Redcap software based on the concomitant ICD-10-CM. To calculate the required  
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36 189 sample size at each hospital, the injury prevalence for each month of the study period was  
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38 190 calculated by dividing the number of ED injured patients by the total number of ED patients for  
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40 191 the corresponding month. The desired precision between 5% and 10 % was used and a 95%  
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42 192 confidence interval was adopted while calculating the sample size.

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47 194 **Data Analysis**

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3 195 A descriptive and inferential statistical analysis was performed using the Statistical Package for  
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5 196 the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago, IL). Characteristics, trends and  
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7 197 patterns of injury were described for the total sample and the four children's age-stratified groups  
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10 198 (less than 1, 1-5, 6-10, and 11-15 years). Mean (standard deviation), median, and the interquartile  
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12 199 range were calculated to summarize age and vital signs. Pearson's Chi-Square or Fisher's exact  
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14 200 tests were used to assess the significance of the statistical association between all categorical  
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16 201 variables and the outcome variable [ED disposition (admitted vs. treated and discharged)]. All  
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18 202 clinically and statistically significant variables were included in a multivariate analysis using a  
19  
20 203 stepwise logistic regression model to determine the factors associated with hospital admission. A  
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22 204 p-value of  $\leq 0.05$  was used to indicate statistical significance. The final model was found to be a  
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24 205 good fit to the data as the Hosmer-Lemeshow test indicated ( $p=0.957$ ) and it discriminated  
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26 206 perfectly the two categories of the outcome variable (area under the curve = 0.894 [95% CI: 0.848  
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28 207 – 0.940,  $p<0.001$ ].  
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### 35 209 **Patient and public involvement**

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37 210 Patients or members of the public were not involved in the study since it was a de-identified data  
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39 211 and a retrospective chart review study.  
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## 45 213 **Results**

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47 214 A total of 1,142 cases of pediatric cases were sampled from participating hospitals with a sustained  
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49 215 injury during the one year (June 2017-May 2018), accounting for almost 23.5% of all traumatic  
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51 216 ED cases. Children's ages ranged from 0 to 15 with mean age  $7.7 \pm 4.35$  years, mostly Lebanese  
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53 217 (80.3 %,  $n=917$ ), other nationalities were mainly Syrian and Palestinian. Reported injuries were  
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218 evenly distributed across age groups, with 399 (34.9%) among children 1-5, 370 (32.4%) among  
 219 6-10 and 357 (31.3%) among 11-15 years of age, with more males (n= 733, 64.2%) sustaining  
 220 injuries compared to their female counterparts (n= 408, 35.7%). The male to female ratio was 1.8:1.  
 221 For all injury mechanisms with one exception for children aged < 1 who were mostly females (n=  
 222 10, 62.5%) and accounted for 1.4% (n=16) of the total injuries. (Table 1)

223  
 224 **Table 1:** General Characteristics of the Studied Population.  
 225

	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)

226

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

231 No mortality was identified in the collected sample and most reported pediatric injuries (85.1%)  
 232 were mild. Nonetheless, nine children suffered from a severe disability that affected their daily  
 233 activities. These injuries were mainly reported among the older age group 6-15. (Table 2) ( Figure  
 234 1 & 2)

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237

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

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240

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

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

248

249 **Table 2:** Event characteristics per age group.

250

251

	Frequency N (%)				
	<1	1-5	6-10	11-15	Total
Cases	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 <sup>1</sup>	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>					

<sup>1</sup> 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)
<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 <sup>2</sup>	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>					
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)

<sup>2</sup> 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)

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254 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%).

256 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).

259 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)

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

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266

	Frequency N (%)				
	<1	1-5	6-10	11-15	Total
Cases	16	399	370	357	1142
<b>Pre-existing disability (GOS)</b>					
Moderate disability <sup>3</sup>	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 & 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>					

<sup>3</sup> 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)
<b>GOS at discharge</b>					
Severe disability <sup>4</sup>	0 (0)	3 (0.8)	2 (0.5)	4 (1.1)	9 (0.8)
Moderate disability <sup>5</sup>	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)

<sup>4</sup> Independent activities of daily living are not possible

<sup>5</sup> 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)
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269 In the bivariate analysis (table not shown), the leading type of injury for admitted pediatric cases  
 270 was fracture (55.3%) ( $p < 0.001$ ) followed by concussion (21.3%) ( $p < 0.001$ ), organ system injury  
 271 (21.3%) ( $p < 0.001$ ) and cuts/open wound (17.0%) ( $p = 0.035$ ). The most common injured body part  
 272 among admitted pediatric cases were upper extremities (53.2%) ( $p = 0.016$ ), head (36.2%) ( $p < 0.001$ )  
 273 and abdomen (14.9%) ( $p < 0.001$ ). Privately insured children were more likely to be admitted to the  
 274 hospital ( $p = 0.004$ ) as a result of their injuries.

275 In the multivariate analysis, significant factors that were positively associated with hospital  
 276 admission included: body regions, namely head (OR = 14.35 [95% CI 4.01– 51.34]), abdomen (OR  
 277 = 8.25 [1.11 – 61.24]), upper extremity (OR = 5.79 [95% CI 2.04 – 16.49]), and Lower Extremity  
 278 (OR = 5.55 [95% CI 2.02 – 15.20]), in addition to ‘other insurance type’ (OR = 8.33 [95% CI 2.19  
 279 – 31.67]). The three types of injury with the highest hospital admissions were fracture (OR = 13.55  
 280 [95% CI 4.77 – 38.44]), concussion (OR = 13.60 [95% CI 2.83 – 65.41]), and organ system injury  
 281 (OR = 31.63 [95% CI 3.45 – 290.11]) (Table 4)

282

283 **Table 4:** Factors associated with hospital admission

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

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

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

291

## 292 Discussion

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

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301 The study results underscore the substantial burden of pediatric injuries, accounting for nearly 23.8%  
302 of total traumatic cases presented to ED. These results are comparable to those generated in a local  
303 study and reported similar patterns of pediatric injuries among ED presentations at 3 hospitals in  
304 Beirut [22]. The high prevalence of child injuries is consistent with previous attempts to quantify  
305 the burden of childhood injuries in high-, middle- and low-income countries, regardless of  
306 countries' social and cultural disparities [1, 23-26]. A large number of these injuries were sustained  
307 by males, similar to existing literature that confirmed the predominance of injuries among males  
308 across all mechanisms of injuries along with the increased odds of sustaining repeated injuries [7,  
309 27-30]. Moreover, this study highlighted the high frequency of injury occurrences among children  
310 aged 0 to 5. This age group sustained more than one-third of the total number of reported cases,  
311 almost 40.0% of the fall injuries and approximately 60.1% of home injuries. This highlights the  
312 vulnerability of young children as their physical, mental and cognitive development depends on  
313 their surrounding environment, which places them at an increased risk of getting injured. Moreover,  
314 the high prevalence of injury in non-Lebanese children less than 1 (mainly Palestinian and Syrian

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3 315 refugees) hints to their low socio-economic status, dire living conditions and limited access to  
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5 316 emergency care and appropriate treatment. Contrary to existing literature, the study findings shows  
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7 317 that children less than one year sustaining injuries were predominantly females. This can be  
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10 318 possibly explained by the patriarchal society where males are more taken care of compared to  
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12 319 females. Multiple factors increase the likelihood of injury occurrence, namely child's curious  
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14 320 attributes and discovery nature coupled with the lack of safe environments and the absence of  
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16 321 parents direct supervision [31];[32]. This underscores parents' fundamental role in child active  
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18 322 supervision to protect children as a vulnerable population as well as underlines the importance of  
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20 323 securing built-in child safety in the surrounding environment (e.g. locked cabins, gated stairs) that  
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22 324 prevents and reduces childhood injuries (Sharma et al., 2018). This study demonstrates that  
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24 325 unintentional injuries had a large toll on children, particularly those less than 5 years of age  
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26 326 compared to their older counterparts. Nonetheless, it is worth noting that intentional injuries are  
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28 327 under-reported in the Lebanese society, particularly with the lack of adequate policies or laws to  
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30 328 protect children from any forms of abuse. As a result, hospitals are constrained from reporting  
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32 329 abuse even if observed during evaluation.  
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40 331 The present study confirms that the leading causes of injury across all age groups are falls followed  
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42 332 by being hit by objects and road traffic injury (mainly pedestrians). An abundance of literature  
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44 333 observed similar findings in low-, middle- and high-income countries and confirmed that fall  
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46 334 injury is responsible for the excess hospital ED visits and admissions among children [3, 27-29].  
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48 335 This is mainly due to the onset of independent mobility and poor balance among young children  
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50 336 which increases their risk of sustaining fall injuries [33, 34]. Hit by person/objects and Road  
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52 337 Traffic Injury (RTIs) were other primary causes of injury among children, increasing with age and  
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3 338 peaking at the age of 11-15. The lack of proper injury documentation at the hospital level hinders  
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5 339 the comprehensive understanding of the external causes of these injuries, their circumstances and  
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8 340 the safety measures adopted. Hence, there is an urgent need to institute a national injury  
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10 341 surveillance system or trauma registry at hospitals in Lebanon, which is essential to provide high-  
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12 342 quality epidemiological data on the incidence and circumstances of injuries requiring medical  
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14 343 attention. Timely collection of injury data is critical for the development, adoption and evaluation  
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16 344 of cost-effective injury prevention programs, strategies and policies. This will help to guide future  
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18 345 policy priorities for childhood injury prevention and to tailor the implementation of context-  
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20 346 sensitive interventions to reduce injuries and mitigate their consequences on the pediatric  
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22 347 population.  
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28 349 Similar to existing studies, our findings suggest that injuries in the 0-5 age group resulted mainly  
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30 350 in head or face trauma comparable to the 6-15 y who suffered mainly from upper extremity injuries  
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32 351 [35]. These body parts are mostly caused by falls and are strongly associated with increased  
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34 352 hospital admissions ( $p < 0.001$ ). A plausible explanation for this observed pattern of different body  
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36 353 parts affected by fall injuries is related to the ability of older children to protect themselves from  
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38 354 serious injuries using their peripheral extremities during the injury impact. This further reflects the  
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40 355 preponderance of cuts and open wounds in the younger age group 0-10 years old compared to  
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42 356 sprain and strain sustained by the older age 10-15y.  
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46 357 To note, neck and thoracoabdominal injuries were among the least injuries observed across all  
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48 358 ages. Neck injuries are usually less common in children and thoracoabdominal injuries are usually  
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50 359 associated with high impact mechanisms and high injury severity which were not frequent in this  
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52 360 study.  
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6 362 Pediatric admission to hospitals considerably varies by injury types and mechanisms, body part  
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8 363 injuries, and interestingly by insurance type. Head, abdomen and extremities ranked the highest  
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10 364 among body parts injured that require hospital admission. Patients with head, abdomen or upper  
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12 365 extremity injuries are almost 14, 8 and 6 times more likely to be admitted to hospital as a result of  
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14 366 their injuries. Fall is shown to be the leading mechanism of hospital admission, which consistently  
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16 367 agrees with regional studies [24, 27, 28]. Fracture, organ system injury and concussion topped the  
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18 368 list of injury types resulting in hospital admissions. Patients with fractures or concussions are 13  
19  
20 369 times more likely to be admitted to the hospital, and patients with organ injury are 31 times more  
21  
22 370 at risk of being admitted. Unexpectedly, these injury patterns are inconsistent with international  
23  
24 371 studies where sprains and open wounds are the leading types of child injuries [30] while agreeing  
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26 372 with regional studies confirming that fracture, concussion and organ system injury are significant  
27  
28 373 predictors of a child hospital admission [22, 36]. Although concussion cases constituted only 3.1%  
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30 374 of the total pediatric cases, it comprises nearly 21% of the admitted cases ( $p < 0.001$ ). This present  
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32 375 study showed that concussion and organ system injury is more common among the young age  
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34 376 group while fractures are more prevalent among the older pediatric population [29, 35, 37, 38].  
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36 377 This is understandable as older children tend to be more actively involved in sports and leisure  
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38 378 activities, and therefore relatively more prone to fractures of extremities than their counterparts.  
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40 379 Regardless of child's age, knowledge of risk factors along with education, injury awareness  
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42 380 programs and adequate intervention measures should be implemented to enhance environmental  
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44 381 safety and prevent childhood injuries [6, 26, 39, 40].  
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3 383 A widening gap persists between developed and developing countries in terms of injury prevention  
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5 384 and severity outcomes. Previous literature noted that high-income countries have actively and  
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8 385 successfully devised numerous interventions to control for the burden of injury. Following the  
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10 386 implementation of trauma registries, these countries observed major reductions in childhood injury  
11  
12 387 morbidity and mortality as a result of reduced injury frequency and severity, enhanced patients  
13  
14 388 care and subsequently improved patients outcomes [35, 37]. Contrary to high-income countries,  
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16 389 injury remains the leading cause of child mortality in low- and middle-income countries (LMICs)  
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19 390 [26]. Hence, a concerted endeavour is needed to transform child safety and wellbeing in LMICs,  
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21 391 through a mixture of approaches ranging from improving emergency care to building a national  
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23 392 surveillance system, to designing and developing education and awareness programs, to  
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25 393 implementing and enforcing proper safety regulations and legislations.  
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31 395 This study has some limitations. First, injury studies usually report on mortality as an outcome. In  
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33 396 our study population, no death cases were reported. This is potentially related to the fact that deaths  
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35 397 would typically be coded differently at EDs in Lebanon, under ‘cardiac arrest’, without identifying  
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37 398 a clear etiology such as traumatic death. Prehospital data on details surrounding the injury event  
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39 399 and on causes of deaths are also missing in ED documentation due to the lack of proper  
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41 400 documentation in general in the prehospital field and these types of data are not usually shared  
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43 401 with ED when the patient arrives at the hospital. Possibly, there were deaths among pediatric  
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45 402 patients with ‘Unknown outcomes’ or among those who were transferred or who left AMA,  
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47 403 however, this was not captured in our data. Second details on the injury mechanism, the  
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49 404 circumstances and the adopted safety measures were missing from patients’ medical records. This  
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51 405 is mainly due to the lack of injury surveillance systems and the retrospective nature of the data  
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3 406 capturing process with its inherited limitations of available data variables in patients' medical  
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5 407 records. Third, standardized coding of injuries (i.e. International Codes of Disease ICD) is lacking,  
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7 408 which might have affected the accurate and reliable documentation and standardized reporting of  
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9 409 injury cases. This information is essential to assess injury-associated risk factors and to design  
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11 410 tailored and context-appropriate interventions. Fourth, this study used emergency department and  
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13 411 admission data with limited follow-up information on the short- and long-term outcomes of  
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15 412 multiple injuries including concussions and their impacts on a child's behavior and long-term  
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17 413 disability. Lastly, this study collected data from hospitals in Beirut. It is possible that data collected  
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19 414 from rural areas reflect different trends and patterns in injury.  
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## 29 417 Conclusion

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33 419 Pediatric injury represents a persistent challenge to the pediatric population and the healthcare  
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35 420 system in Lebanon. With the lack of proper and standardized documentation of injury mechanisms,  
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37 421 establishing a high-quality surveillance system is crucial to help identify priorities and guide the  
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39 422 adaptation of evidence-based injury prevention strategies. Safety policies, awareness campaigns  
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41 423 and age-targeted interventions should be initiated to control for child injuries and improve safety.  
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43 424 Future studies should examine in further detail the several factors associated with pediatric injuries  
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45 425 including the role of parental injury educational programs, caregiver's direct and active  
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47 426 supervision and the presence of a safe and injury-free environment.  
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### 18 **Funding/Support**

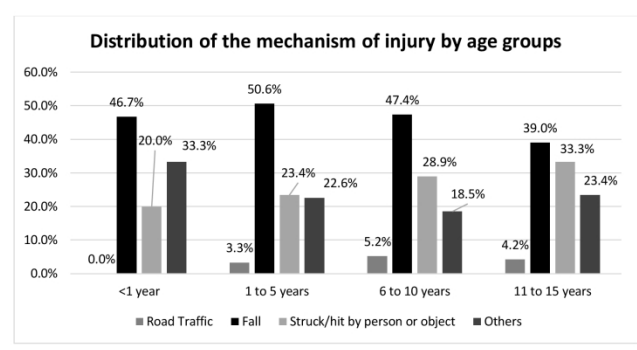
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20 National Council for Scientific Research (CNRS): BIO-0061  
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### 22 **Contributions**

23  
24 SA and ME conceptualized the study, provided insights into the discussion section and contributed  
25 to the write-up and editing of the manuscript. AA carried out the literature reviews, provided  
26 insights into the discussion section and contributed the write-up of the manuscript. RB was the  
27 lead statistician of this study, provided insight into data interpretation and contributed to the write-  
28 up. MH, EZ, FF, and RR all contributed to the data access, revision, and final editing of the  
29 manuscript. All authors approved the final manuscript as submitted and agree to be accountable  
30 for all aspects of the work.  
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**Figure 1:** Distribution of the mechanism of injury by age groups.

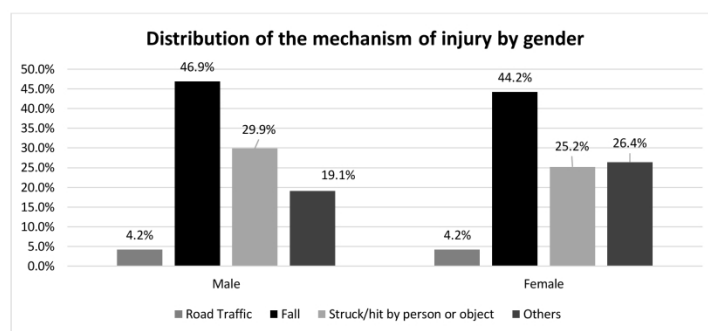


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Figure 2: Distribution of the mechanism of injury by gender.



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60STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation
<b>Title and abstract (Page 1-6)</b>	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
<b>Introduction ( Page 7-8)</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
<b>Methods ( Page 8-10)</b>		
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
<b>Results (page 11-22)</b>		
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

<b>Discussion (Page 22-27)</b>		
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
<b>Other information ( Page 28)</b>		
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](http://www.strobe-statement.org).