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Children and adolescents admitted to a university-level trauma centre in Denmark 2002-2011

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ABSTRACT

INTRODUCTION: The epidemiology of children or adolescents admitted to a Scandinavian trauma centre is largely unknown. The aim of this paper was to describe the epidemiology and severity of potentially severely injured children and adolescents admitted to a university hospital trauma centre.

METHODS: This was a descriptive study of all children and adolescents aged 0-17 admitted to the university level trauma centre at Odense University Hospital, Denmark in the 2002-2011 period. Data were extracted from the Southern Danish Trauma Register and from medical records.

RESULTS: A total of 950 children and adolescents were included. The median age was 13 (range: 0-17) years. Boys accounted for 60.6% of the cases. Accidents accounted for 97.2%, violence 1.4% and self-inflicted injuries 0.4%. More than three fourths of the injuries occurred either in traffic or at home. The occurrence was greatest in the summer (34.0%), during weekends (48.9%) and in the hours between 12.00 and 20.00 (59.2%). Overall, 58.5% of the injuries were due to traffic. Of these injuries, 39.7% were injuries suffered by passengers in motor vehicles, 27.5% drivers/passengers of a scooter/MC, 21.8% bicyclists and 10.3% pedestrians. The median Injury Severity Score (ISS) and Abbreviated Injury Scale was 4 (range: 1-75) and 2 (range: 1-6), respectively. Head/face injuries accounted for 36.5% and injuries to the extremities for 30.9% of all injuries. A total of 153 (16.1%) suffered from severe injuries (ISS > 15). Overall, 49 (5.2%) died due to their injuries.

CONCLUSIONS: Based on a local trauma register, we described the epidemiology and severity of potentially severely injured children and adolescents admitted to a university trauma centre.

FUNDING: none.

TRIAL REGISTRATION: not relevant.

Severe injury in young adolescents and children is relatively rare. However, from infancy to adulthood, injuries are the main reason of death in the industrial countries [1-3]. In 2002 and 2011, 68 and 62 deaths due to injuries in the age group 0-19 years were registered in Denmark, corresponding to 12% and 16% of all deaths in that the age group, respectively [4].

The epidemiology of children or adolescents admitted to a Scandinavian trauma centre is largely unknown. Only one Scandinavian study describing the epidemiology of severe injuries among children and adolescents has been published [5]. In this Swedish study from the Intensive Care Unit Database in Gothenburg, the majority of the injured patients were boys (68%), 40% of injuries were traffic-related and 34% were due to fall accidents [5]. Head injuries accounted for 30% of the injuries and the overall mortality was 3%.

Some non-Scandinavian studies have been published. These studies have shown that severe injuries are most frequent among boys [6-9]. The median age varies between 7.9 and 13 years due to differences in inclusion criteria [6-10]. Traffic-related injuries are the most common [6, 7, 9, 11], and head injuries are the most common type of injury in most studies [5, 6, 10]. The mortality varied between 1.5% and 8% [6, 7, 9, 11].

The clinical implication of this information is improved preparedness owing to enhanced knowledge about which types of injury and impacts may be expected as a receiving traumatologist and how specialist competence may be organised for treatment of acute trauma patients.

The aim of this study was to describe the epidemiology and severity for different age groups of potentially severely injured children and adolescents admitted to a university-level trauma centre.

METHODS

In the study period from 2002-2011, all injured children and adolescents aged 0-17 years who were received by trauma teams at the university level trauma centre at Odense University Hospital (OUH), Denmark, were included. Included were patients primarily brought to the hospital as well as those transferred from another hospital within 24 hours after their trauma occurred. Trauma team reception was given based on strict criteria (Table 1). In all patients, a total score of two points or more according to the criteria in Table 1 triggered trauma team reception. In the study period, minor revisions of the criteria were implemented. High-energy trauma was defined as a fall from more than six metres, pedestrian/bicyclist hit by a car, dead person in same car, person thrown from car/motorcycle, car turned over, person trapped for more than 20 minutes or larger deformity of the car. Excluded according to the UTSTEIN
criteria were persons who died prior to arrival to the hospital and persons who were strangled, drowned or seriously burned [12, 13].

The university hospital trauma centre at OUH provides services for the Region of Southern Denmark with a population of approximately 1,000,000 and is located in the city centre of Odense with a population of 190,000 inhabitants. In addition to the university level trauma centre, four regional trauma centres provide services for the region. Occasionally, the university level trauma centre also receives trauma patients from other parts of Denmark.

Since 1996, all trauma patients admitted to the trauma centre have been registered in the South Danish Trauma Register. The register contains detailed information about demography, the circumstances leading to injury, place of injury, diagnoses, treatment and outcome. The trauma patients are registered prospectively and consecutively on admission to the trauma centre. The trauma register includes self-reported information from the patient, information from the police/paramedics and information from the medical records. All registration were made by trained staff. Trained physicians determine the diagnoses according to the International Classification of Diseases, tenth version (ICD10) with a maximum of ten diagnoses in each patient. For those patients who die, diagnoses are obtained from the autopsy reports. All autopsies of trauma patients are made at the Institute of Forensic Medicine, University of Southern Denmark.

The injury severity is coded using the Abbreviated Injury Scale (AIS) after which the Injury Severity Score (ISS) is calculated [14]. AIS is a numerical scale where the last digit indicates the severity of every injury [14]. It ranges from 1 (abrasions and small wounds) to 6 (deadly lesion) [14]. The ISS is calculated from the AIS as the sum of the square root of the highest AIS value (last number) in the three most wounded anatomic regions of the body. In this study, severely injured children are defined as ISS > 15.

The data were analysed following stratification into age groups: 0-3 years (infants), 4-9 years (small children), 10-15 years (older children) and 15-16 years (adolescents). These groups were made after the initial analyses of the data. Patients within each group have several similarities regarding place of injury, injury pattern, etc. Non-parametric statistics with STATA 10 was used in all statistical analyses and p < 0.05 was considered statistically significant. The study was approved by the Danish Data Protection Agency.

**Trial registration:** not relevant.

**RESULTS**

In the study period, we included 950 potentially severely injured children and adolescents aged 0-17 years, corresponding to 95 patients per year. Overall, 779 (82%) were primary admissions and 171 (18%) were transferred from other hospitals. In total, 923 (97%) of the casualties were accidents, 13 (1%) were caused by violence, four (< 1%) were self-inflicted injuries, and in ten (1%) cases the cause of injury was unknown.

In all, 60.6% were boys (gender ratio: 1.5). The overall median age was 13 years (range: 0-17 years), whereas the median age among boys and girls was 14 years (range: 0-17) and 13 years (range: 0-17 years) (Wilcoxon, p = 0.0003), respectively. Almost two thirds of the injuries occurred in traffic areas (Table 2). However, for infants (0-3 years) most injuries occurred in residential areas.

The 950 injured persons suffered from a total of 2,125 lesions corresponding to 2.2 lesions per patient. The majority of lesions were to the head, face and limbs (Table 3). The median ISS was 4 (range: 1-75). Overall, 16.1% suffered from severe injuries (ISS > 15). The proportion of severe injuries was highest among adolescents (20.2%). 64% of the severely injured (ISS > 15) had head injuries compared with 34% of those with less severe (ISS ≤ 15) injuries. Conversely, the proportion of
The median period in hospital was two days (range: 1-133) with no significant difference between age groups (Kruskal-Wallis, p = 0.5826). Overall, 5.2% died due to their injuries. The mortality was 5.9% for boys and 4.0% for girls. More than half of all deaths among boys and girls was 15 (range: 0-17) years, respectively (Wilcoxon, p < 0.005). The majority of children and adolescents were passengers in vehicles (≥ 4 wheels). The median ISS among traffic injuries was 4 (range: 1-75). Overall, 17.8% suffered from severe injuries (ISS > 15). The proportion of severe injuries was highest among adolescents aged 16-17 years (20.5%). The overall mortality was 6.3%.

**DISCUSSION**

Based on a local trauma register, we described the epidemiology and severity of potentially severely injured children and adolescents admitted to a Danish university level trauma centre with all medical specialties. The distribution of age and gender was similar to the findings reported in previous studies [5-10].

In line with results reported from other studies, boys accounted for the highest number of traumas [5-9]. Additionally, we found that traumas among the youngest children were less common, which corresponds with the findings reported from other studies [5, 6, 7, 9]. Only 15.5% of the traumas occurred at school and institutional areas. This is a relative small proportion compared with the amount of time children spend within these areas. However, the location of traumas seemed to vary with age groups. In the age group 0-3 years, half of the traumas occurred within the residential area. With increasing age, traffic area becomes the predominant site of trauma. A previous study describes a similar trend [6]. The highest frequency of multi trauma occurred in the summer time, in the weekends (Friday-Sunday) and in the day time between 12.00-19.59. These findings are in line with the findings reported by most other studies [5, 6, 9, 15]. School holidays with long days of leisure activities is a possible explanation for this, since schools, according to this study, seem to be a relatively safe institution. In our study, the mean number of injuries was 2.2 injuries per child. The mean number increased with age as did the proportion of lesions in the limbs and spine. This may be explained by the increased number of traffic accidents among older children, as spinal injuries are generally associated with high-energy traumas. The median ISS was 4 and only 16.1% of the trauma patients in our study were severely injured (ISS > 15), which indicates that the majority of the trauma patients in our study were mildly injured. This is owed to the criteria of the multi trauma register, where just a suspicion of multiple traumas is sufficient to fulfil the prerequisites of trauma team activation and subsequent registration in the trauma registry.

Among traumas related to traffic, 39.7% were passengers in a motor vehicle (≥ 4 wheels). Pedestrians...
Traffic-related injuries, gender, role in traffic, Injury Severity Score, and mortality. The values are n (%).

<table>
<thead>
<tr>
<th>Gender</th>
<th>0-3 yrs</th>
<th>4-9 yrs</th>
<th>10-15 yrs</th>
<th>16-17 yrs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>16 (48.5)</td>
<td>44 (57.1)</td>
<td>126 (58.1)</td>
<td>168 (73.4)</td>
<td>354 (63.7)</td>
</tr>
<tr>
<td>Female</td>
<td>17 (51.5)</td>
<td>33 (42.9)</td>
<td>91 (41.9)</td>
<td>61 (26.6)</td>
<td>202 (36.3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role of traffic</th>
<th>0-3 yrs</th>
<th>4-9 yrs</th>
<th>10-15 yrs</th>
<th>16-17 yrs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian</td>
<td>8 (24.2)</td>
<td>17 (22.1)</td>
<td>26 (12.0)</td>
<td>6 (2.6)</td>
<td>57 (10.3)</td>
</tr>
<tr>
<td>Bicycle</td>
<td>0</td>
<td>17 (22.1)</td>
<td>70 (32.3)</td>
<td>34 (14.8)</td>
<td>121 (21.8)</td>
</tr>
<tr>
<td>Moped</td>
<td>0</td>
<td>0</td>
<td>41 (18.9)</td>
<td>112 (48.9)</td>
<td>153 (27.5)</td>
</tr>
<tr>
<td>Vehicle ≥ 4 wheels</td>
<td>23 (69.7)</td>
<td>41 (53.2)</td>
<td>80 (36.9)</td>
<td>77 (33.6)</td>
<td>221 (39.7)</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>1 (1.3)</td>
<td>0</td>
<td>0</td>
<td>1 (0.2)</td>
</tr>
<tr>
<td>Unknown</td>
<td>2 (6.1)</td>
<td>1 (1.3)</td>
<td>0</td>
<td>0</td>
<td>3 (0.5)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Injury Severity Score</th>
<th>0-3 yrs</th>
<th>4-9 yrs</th>
<th>10-15 yrs</th>
<th>16-17 yrs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-6: mild</td>
<td>21 (63.6)</td>
<td>56 (72.1)</td>
<td>131 (60.4)</td>
<td>135 (59.0)</td>
<td>343 (61.7)</td>
</tr>
<tr>
<td>7-15: moderate</td>
<td>6 (18.2)</td>
<td>12 (15.6)</td>
<td>49 (22.6)</td>
<td>47 (20.5)</td>
<td>114 (20.5)</td>
</tr>
<tr>
<td>&gt; 15: severe</td>
<td>6 (18.2)</td>
<td>9 (11.7)</td>
<td>37 (17.1)</td>
<td>47 (20.5)</td>
<td>99 (17.8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mortality</th>
<th>0-3 yrs</th>
<th>4-9 yrs</th>
<th>10-15 yrs</th>
<th>16-17 yrs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survived</td>
<td>31 (93.9)</td>
<td>76 (98.7)</td>
<td>202 (93.1)</td>
<td>212 (92.6)</td>
<td>521 (93.7)</td>
</tr>
<tr>
<td>Died</td>
<td>2 (6.1)</td>
<td>1 (1.3)</td>
<td>15 (6.9)</td>
<td>17 (7.4)</td>
<td>35 (6.3)</td>
</tr>
</tbody>
</table>

Total 33 (100.0) | 77 (100.0) | 217 (100.0) | 229 (100.0) | 556 (100.0)
LITERATURE