Analysis of pedestrian injuries in pedestrian-car collisions with focus on age and gender

Christoph Leo, Corina Klug, Maria Ohlin, Astrid Linder

I. INTRODUCTION

Pedestrians represent the majority of fatally injured vulnerable road users, accounting for about 23% of all fatally injured road users worldwide [1]. A detailed analysis of their injuries is needed to understand which ones are the most common, and to design measures to prevent these injuries.

While other studies have mainly focused on the relevance of various body regions using the AIS (Abbreviated Injury Scale) [2-4], the current study was carried out to investigate injuries in more detail. It was aimed to answer the following questions: Which injuries are the most important for the evaluation of pedestrian safety measures? And are there significant differences in the injuries sustained by pedestrians affected by their gender?

II. METHODS

Data from STRADA (Swedish Traffic Accident Data Acquisition) for the years 2016–2018 were used to analyse pedestrian-to-passerger car collisions. STRADA is a Swedish database with national coverage that includes information on road traffic accidents that is collected from emergency care hospitals and police reports [5]. Only information about accidents that was found in both police reports and hospital records was included in the present study. This information was available for 1,311 injured persons involved in 1,272 pedestrian-to-passerger car collisions; these persons sustained 3,198 injuries to which 442 different AIS codes were assigned.

To identify the most frequent pedestrian injuries, the full AIS 2005 codes were evaluated according to the AIS Codebook [6]. Injuries that affected an entire body area (e.g., affecting the skin and subcutaneous tissue, such as abrasions or hematomas) were not included in the current study. To investigate whether the factor of age influenced the type of injury sustained, the dataset was split into two age groups: Injuries sustained by pedestrians younger than 60 years old (YO) and by those equal or more than 60 YO. Furthermore, the odds-ratio (OR) [7] and the p-value from the chi-squared test [8] were calculated to determine whether females and males sustained significantly different injuries. The AIS codes were grouped by their first four digits for the analysis of significant differences between males and females due to the small sample sizes for individual AIS injury codes. It is possible to identify the injured body region and theatomic structure using the four-digit AIS code (e.g., organs, skeletal structures). Due to small sample sizes, injuries greater than AIS3 were not analysed in detail.

III. INITIAL FINDINGS

The three most frequent injuries observed in pedestrian-to-passerger car collisions according to the analysis of injuries categorized by the full AIS code are summarized in Tables I, with their rankings shown in the first column. Column two in each table shows the three most frequent AIS codes without taking the injury severity into consideration. Columns four and six represent the three most common AIS codes when taking the injury severity into consideration. Columns three, five and seven give the percentage of each injury relative to the total number of injuries (overall or for the respective injury severity).

<table>
<thead>
<tr>
<th>Rank</th>
<th>AIS</th>
<th>% of AIS injuries (n = 2165)</th>
<th>AIS2</th>
<th>% of AIS2 injuries (n = 492)</th>
<th>AIS3</th>
<th>% of AIS3 injuries (n = 117)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1610011.1</td>
<td>1.8% 630020.2 4.7% 450203.3 8.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>640271.1</td>
<td>1.3% 854471.2 4.7% 150202.3 5.1%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>854471.2</td>
<td>1.1% 854251.2 3.0% 840013.3 5.1%</td>
<td></td>
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</tr>
</tbody>
</table>

The analysis showed that pedestrians < 60 YO sustained mild cerebral concussions without loss of consciousness as the most frequent injury (161001.1), followed by minor cervical spine injuries of the nerve root (640278.1) and then a moderate fibula fracture (854471.2). The three most frequent moderate injuries for this age group (AIS2) were lumbar spine fractures of the transverse process (650620.2), fibula fractures (854471.2) and simple fractures of the tibia shaft (854251.2). Among the serious injuries for this age group (AIS3), the rib cage fracture involving three or more ribs (450203.3) was the most frequent, followed by skull base fractures (150202.3) and open tibia fractures (854001.3).
For elderly pedestrians some differences were observed: The most frequent injury sustained by this age group was again a mild cerebral concussion without loss of consciousness (161001.1) followed by a moderate fibula fracture (854471.2) and a serious rib cage fracture that involved three or more ribs (450203.3), without taking the injury severity into account. If the injury severity were taken into account, the most frequent moderate injuries sustained by this age group were fibula fractures (854471.2) followed by metatarsal fractures (858153.2) and pelvic ring fractures (856151.2). Among the serious injuries for this age group, a rib cage fracture that involved three or more ribs (450203.3) was again most common followed by femur fractures (853151.3, 853161.3) and the cervical spine (6502**). Elderly males had higher odds of suffering disc injuries of the thoracic spine (6504**) and distal radius fractures (8542**) than females. Elderly females had higher odds of suffering distal tibia fractures (8543**), cerebellum injuries (1404**) and humerus shaft fractures (7512**) than females. Elderly females had higher odds of suffering distal tibia fractures (8543**), humerus fractures (7511**) and distal radius fractures (7523**) than elderly males. Elderly males had higher odds of suffering disc injuries of the thoracic spine (6504**) and the cervical spine (6502**) than elderly females.

Significant differences between males and females regarding their injuries were observed, with results listed in Tables II. This tables are split by age and by gender (OR greater than 1 = females and OR less than 1 = males). Females < 60 YO had higher odds of sustaining ankle joint injuries (8771**) and lumbar spine disc injuries (6506**) than males. Younger males had higher odds of sustaining thoracic injuries (4422**, 4414**), tibia shaft fractures (8542**), cerebellum injuries (1404**) and humerus shaft fractures (7512**) than females. Elderly females had higher odds of suffering distal tibia fractures (8543**), humerus fractures (7511**) and distal radius fractures (7523**) than elderly males. Elderly males had higher odds of suffering disc injuries of the thoracic spine (6504**) and the cervical spine (6502**) than elderly females.

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VI. REFERENCES