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Severe traffic injuries in the Helsinki Trauma Registry between 2009–2018

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ABSTRACT

Objective: The European Union (EU) has adopted the Vision Zero and Safe System approach to eliminate deaths and serious traffic injuries on European roads by 2050. Detailed information on serious injuries, injury mechanisms and consequences are needed. The aim of this study was to describe and compare by injury mechanism the demographics, injuries, injury severity, and treatment of seriously injured road traffic trauma patients.

Material and methods: We analysed data on severe traffic injury trauma patients aged ≥16 years of the Helsinki Trauma Registry (HTR) covering the years 2009–2018. The variables analysed were basic patient demographics, injury mechanism, Abbreviated Injury Scale (AIS) codes, injured body regions, patient Injury Severity Score (ISS) and New Injury Severity Score (NISS) values, NISS groups (NISS 16–24 and NISS ≥25), AIS 3+ injuries, trauma bay and 30-day mortality, length of stay (LOS) at ICU and in hospital, surgeries performed, pre-injury classification, and intention of injury.

Results: A total of 1 063 traffic injury patients were analysed; 38.6% were motor vehicle occupants, 28.5% motorcyclists or moped drivers, 17.2% bicyclists, and 15.7% pedestrians. The mean age of patients was 44.3 years (SD 20.2). Median ISS score was 22 and median NISS score was 27. Both scores were highest in pedestrians. Among all patients, total hospital LOS was 12 517 days (median 9) and total ICU LOS was 6 311 days (median 5). The most common AIS 3+ injuries according to ISS body regions were chest injuries (60%) and head or neck injuries (43.7%). Chest injuries occurred more frequently in motorcyclists and motor vehicle occupants, whereas head or neck injuries were most common among bicyclists and pedestrians.

Conclusions: Severely injured pedestrians and bicyclists were older and they had higher mortality than motorcyclists and motor vehicle occupants. According to NISS, the overall severity was highest among pedestrians followed by bicyclists. However, the both median ICU LOS and hospital LOS were highest for pedestrians but lowest for bicyclists. The most common AIS 3+ injuries were chest and head or neck injuries. To specify effective injury prevention measures, hospital data should be complemented with information on the circumstances of the accident.

Introduction

The European Union (EU) has adopted the Vision Zero and Safe System approach to eliminate deaths and serious injuries on European roads by 2050. To achieve this ambitious goal, the EU has set up the Road Safety Policy Framework 2021–2030, which defines the next steps towards the Vision Zero [1]. Achieving this target will require statistics, information, and monitoring of deaths and serious injuries based on common EU criteria. Traffic fatalities with related information are reasonably well known, but statistics and data regarding serious injuries still vary depending on the member states [2,3].

Traffic safety work in Finland consistently aims to the Vision Zero. Nonetheless, according to preliminary data from 2019, 205 individuals were killed, and 4 987 individuals were injured in road traffic accidents [4]. In addition, the total number of serious injuries was 956 in 2018 according to MAIS 3+ (Maximum Abbreviated Injury Scale value ≥ 3) criteria. However, about half

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(471/956) of these serious injuries were not included in official statistics, which are based only on police-recorded accidents [5]. Furthermore, the police statistics do not include medical data on injuries. Therefore, the overall information on serious traffic injuries is scattered. Thus, there is a need for detailed information on serious traffic injuries, injury mechanisms, and consequences. Furthermore, there are only a few earlier studies on non-fatal traffic injuries that are based on hospital data in Finland [6–11]. This is due to the lack of medical information available for research use.

Objectives

The aim of this study was to describe and compare, by injury mechanism, patient demographics, injuries, injury severity, injured body region, and the treatment of serious road traffic trauma patients recorded into the Helsinki Trauma Registry (HTR) during 2009–2018. The purpose was to provide information for the prevention of severe (NISS>15) traffic injuries.

Material and methods

The Helsinki Trauma Registry

The Helsinki Trauma Registry (HTR) is the trauma registry of the Helsinki University Hospital (HUH) Trauma Unit. The HTR was established in 2006 and has collected data on over 5000 severely injured patients (as of spring 2020). Inclusion criteria are admission <24 h since injury, New Injury Severity Score (NISS) >15, and treatment in the trauma bay of the HUH Trauma Unit. Exclusion criteria are asphyxia, drowning, isolated burn injury, and time of injury >24 h from admission. Both blunt and penetrating injuries are included and also patients transferred from other hospitals within the 24-hour time limit.

The HUH Trauma Unit is a tertiary trauma center with a catchment area of approximately 1.8 million inhabitants until 2017 and approximately 2.15 million inhabitants since 2018. It is the referral center of all head injuries requiring neurosurgeon assessment in this area. All patients with trauma and abnormal vital signs of the catchment area are treated in the HUH Trauma Unit.

Data in the HTR includes patient demographics, injury details, pre-hospital and in-hospital physiological variables, treatment methods, and outcome variables. Detailed information from autopsy is also included. For example, patient demographic information includes age, gender, pre-injury ASA, and residency. Injury details include injury intention, location, type of injury (motor vehicle accident, bicycle accident, fall, stabbing, gunshot, etc.), and time of accident. Physiological variables include blood pressure, heart rate, breath rate, Glasgow coma scale, pupil reaction, and blood sample values. Treatment methods include all procedures and operations, ICU length of stay (LOS), respirator time, and total hospital LOS. Outcome variables include Glasgow Outcome Scale (GOS) and discharge destination.

The injury severity of every trauma registry patient is calculated by one of the five certified registry coders (experienced trauma nurses) recording patient information in the registry within 3 months from admission. The injury severity is based on the Abbreviated Injury Scale (AIS) classification [12]. The Injury Severity Score (ISS) and the New Injury severity Score (NISS) are derived from these AIS points [13,14]. AIS severity is assessed on a scale from 1 to 6 and a common definition for serious injury is AIS ≥3 (or AIS 3+).

Study sample

Our data included HTR trauma patients injured in road traffic accidents and aged ≥16 years from 2009–2018 (10 years). Patients were pedestrians, bicyclists, motorcyclists, and motor vehicle occupants. In addition to demographics, the variables used in this study were all ICD-10 injury codes and AIS codes of the injuries, patient ISS and NISS values, injury mechanism, trauma bay and 30-day mortality, ICU LOS and hospital LOS, surgeries, pre-injury ASA (pre-injury classification according to the American Society of Anaesthesiology Physical Status), and injury intention. On the basis of AIS coding, the ISS body region [13] of injuries was defined as a new variable and the patients were classified as severely injured (NISS 16–24) or critically injured (NISS ≥25) on the basis of NISS values [15]. Furthermore, for bicyclist injuries it was recorded if the accident was a single accident (without crashing into another vehicle or pedestrian) and whether the accident occurred during a cycling race.

Statistical analyses

The normality of the distribution of continuous variables were tested and assessed using Kolmogorov-Smirnov test and histograms. Medians with interquartile ranges (IQR) for skewed distributions (ISS, NISS, ICU LOS and hospital LOS) and mean with SD for normal distributions (age) are presented. In addition, to facilitate comparison with other studies, mean (SD) were also calculated for variables with skewed distribution. Comparisons between groups were performed using Kruskal-Wallis H-test for variables with skewed distribution, and analysis of variance (ANOVA) for variables with normal distribution. Furthermore, χ^2 test was used to determine associations with categorial or classified variables. Regarding Kruskal-Wallis and ANOVA, the test result is significant if at least one group stochastically dominates another group. Comparisons between all individual groups were performed using Dunn-Bonferroni or Tamhane's T2 post hoc method. All statistical analyses were performed using SPSS version 26. *P*-values <0.05 were considered statistically significant.

Results

There was a total of 1 063 severe (NISS >15) traffic injury patients in the HTR between the years 2009 and 2018. The annual incidence of severely injured per million inhabitants varied between 51.9 – 57.8 with a slight growing trend (Fig. 1).

Characteristics of patients by injury mechanism are shown in Table 1. Of all patients, 410 (38.6%) were motor vehicle occupants, 303 (28.5%) motorcyclists or moped drivers, 183 (17.2%) bicyclists, and 167 (15.7%) pedestrians. The mean age of all patients was 44.3 years (SD 20.2) and was lowest among motorcyclists (36.9 years, SD 16.6) and highest among pedestrians (54.9 years, SD 22.4). There were significant differences between all individual groups except for cyclists vs. pedestrians. Most patients were men (70.6%) in each injury mechanism group (range 69.0%-88.8%) except for pedestrians (40.1%). A total of 5.5% of all traffic injuries were work related.

According to the American Society of Anesthesiology Physical Status Classification System, 55.7% of injured persons were normal healthy patients (pre-injury ASA 1). Pre-injury comorbidities occurred most frequently in pedestrians, of whom 47.9% had mild (pre-injury ASA 2) and 15.6% had severe (pre-injury ASA 3) systematic disease (Table 1).

According to Table 1, trauma bay and 30-day mortalities were highest among pedestrians (3.6% and 17.4%, respectively) and lowest (0.3% and 5.6%, respectively) among motorcyclists. The injury was intentional in 37 (3.7% of all) cases, most commonly among motor vehicle drivers and pedestrians. However, the intention remained unknown in 47 cases. The 30-day mortality of intentional injuries was 8.1%.

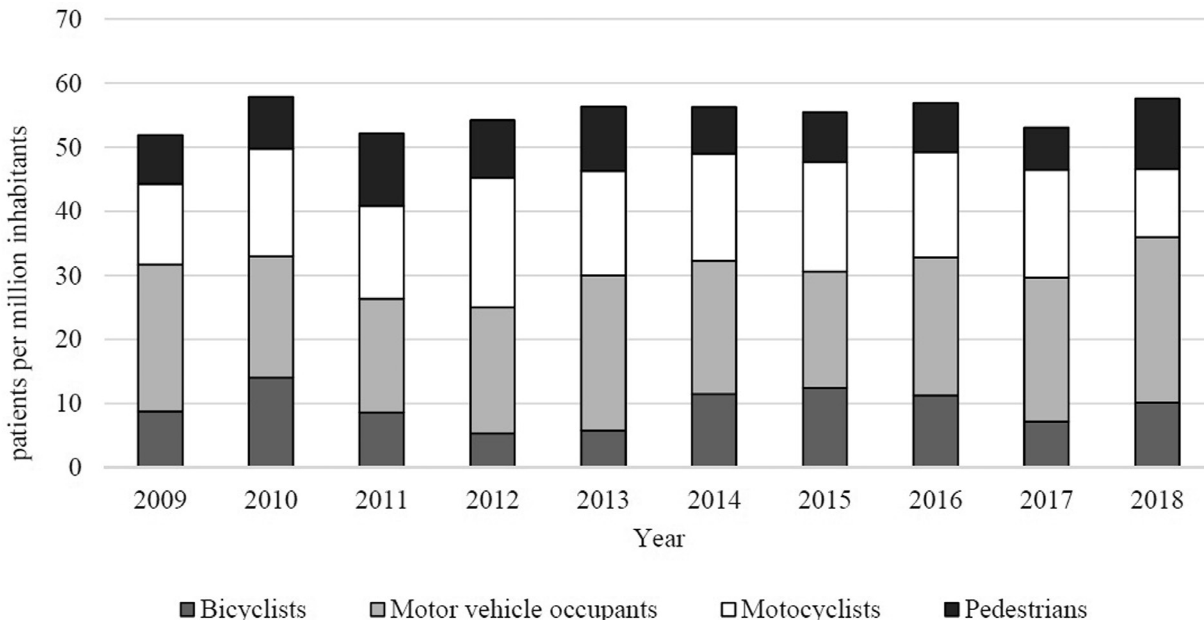

Fig. 1. Incidence of severely injured patients per capita in the HTR during 2009–2018.

Table 1
Characteristics of 1 063 traffic injury patients by injury mechanism in the HTR during 2009–2018.

	Pedestrians	Bicyclists	Motorcyclists	Motor vehicle occupants	Total	Statistic
n (%)	167 (15.7%)	183 (17.2%)	303 (28.5%)	410 (38.6%)	1 063 (100%)	
Age, mean (SD)	54.9 (22.4)	54.5 (16.5)	36.9 (16.6)	41.0 (19.6)	44.3 (20.2)	F-test =55.70, df=3, $p<0.001$
Age group [y]						χ^2=172.36, df=6, $p<0.001$
16-24	25 (15.0%)	7 (3.8%)	97 (32.0%)	118 (28.8%)	247 (23.2%)	
25-64	67 (40.1%)	121 (66.1%)	195 (64.4%)	227 (55.4%)	610 (57.4%)	
65-	75 (44.9%)	55 (30.1%)	11 (3.6%)	65 (15.8%)	206 (19.4%)	
Gender						χ^2 =123.46, df=3, $p<0.001$
male	67 (40.1%)	131 (71.6 %)	269 (88.8%)	283 (69.0%)	750 (70.6%)	
female	100 (59.9%)	52 (28.4%)	34 (11.2%)	127 (31.0%)	313 (29.4%)	
Work-related injury (%)						χ^2=14.81, df=3, p=0.022
yes	6 (3.6%)	10 (5.5%)	8 (2.6%)	34 (8.3%)	58 (5.5 %)	
no	160 (95.8%)	173 (94.5%)	295 (97.4%)	373 (91,4%)	1001 (94.3%)	
unknown	1 (0.6%)	-	-	1 (0.2%)	2 (0.2%)	
Pre-injury ASA						χ^2 =66.38, df=12, $p<0.001$
Normal healthy patient	57 (34.1%)	100 (54.6%)	214 (70.6%)	221 (53.9%)	592 (55.7%)	
Mild systemic disease	80 (47.9%)	70 (38.3%)	70 (23.1%)	142 (34.6%)	362 (34.1%)	
Severe systemic disease	26 (15.6%)	10 (5.5%)	16 (5.3%)	49 (9.8%)	92 (8.7%)	
Severe systemic disease that is constant threat to life	-	-	-	1 (0.2%)	1 (0.1%)	
Unknown	4 (2.4%)	3 (1.6%)	3 (1.0%)	6 (1.5%)	16 (1.5%)	
Trauma bay mortality (%)	6 (3.6%)	3 (1.6%)	1 (0.3%)	6 (1.5%)	16 (1.5%)	n.s.
30-day mortality (%)	29 (17.4%)	18 (9.8%)	17 (5.6%)	25 (6.1%)	89 (8.4%)	χ^2=23.89, df=3, $p<0.001$
Intention of injury						χ^2=38.59, df=12, $p<0.001$
unintentional	149	178	295	361	978	
intentional	12 (7.2%)	1 (0.5%)	4 (1.3%)	20 (4.9%)	37 (3.5%)	
assault	-	-	1	-	1	
unknown	6	4	8	29	47	

Injury outcomes of patients by injury mechanism are presented in Table 2. Pedestrians had higher ISS scores than other groups. However, there were no significant differences between groups. Furthermore, NISS scores were higher among pedestrians and bicyclists than motorcyclists and motor vehicle occupants. Detailed pairwise comparisons showed significant differences in distributions of NISS scores between pedestrians and motor vehicle occupants ($p = 0.029$). Moreover, pedestrians and bicyclists had more often NISS scores ≥25 than other groups.

Almost 76.4% of the patients were treated in the ICU and the total number of ICU days was 6 311. The median ICU LOS varied by injury mechanism from 4 (IQR 2 – 10) days in bicyclists to 6 (IQR 2 – 11) days in pedestrians (Table 2). The total hospital LOS among all patients was 12 517 days with a median of 9 (IQR 5 – 15) days and it also was shortest in bicyclists (7 days, IQR 3.5 – 13) and longest in pedestrians (10 days, IQR 4 – 17) (Table 2).

Half of the patients required surgery (Table 2). The proportion of patients requiring surgery was highest in motorcyclists (56.1%) and lowest in bicyclists (40.4%).

In all patients, the most common AIS 3+ injuries according to ISS body regions were chest injuries (60.0%) and head or neck injuries (43.7%) (Table 2). Chest injuries occurred more frequently in motorcyclists and other motor vehicle occupants, whereas head or neck injuries were most common among bicyclists and pedestri-

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Table 2
Injury outcomes of 1 063 traffic injury patients by injury mechanism in HTR during 2009–2018.

	Pedestrians	Bicyclists	Motorcyclists	Motor vehicle occupants	Total	Statistic
Injuries (per patient)	1 511 (9.0)	1 276 (6.9)	2 596 (8.6)	3 819 (9.3)	9 202 (8.7)	
ISS						n.s.
median (IQR)	24 (17–33)	21 (17–27)	22 (17–29)	22 (17–29)	22 (17–29)	
mean (SD)	25.8 (11.5)	23.6 (9.4)	23.9 (11.4)	24.5 (11.3)	24.4 (11.1)	
NISS						Kruskal-Wallis 9.71, df=3, p=0.021
median (IQR)	29 (23–41)	29 (22–35)	27 (22–35)	27 (22–36)	27 (22–36)	
mean (SD)	32.5 (12.6)	30.9 (11.2)	30.3 (12.4)	29.7 (SD 12.2)	30.5 (12.2)	
NISS groups						χ^2 =13.01, df=3, p= 0.005
severe 16–24	57 (34.1%)	55 (30.1%)	129 (42.6%)	179 (43.7%)	420 (39.5%)	
critical ≥25	110 (65.9%)	128 (69.9%)	174 (57.4%)	231 (56.3%)	643 (60.5%)	
Treated at ICU	128 (76.6%)	131 (71.6%)	219 (72.3%)	334 (81,5%)	812 (76.4%)	χ^2 =11.04, df=3, p=0.012
ICU LOS (days)						n.s.
median (IQR)	6 (2–11)	4 (2–10)	5 (2–9)	5 (3–11)	5 (2–10.75)	
mean (SD)	8.0 (7.2)	7.2 (10.6)	7.5 (8.1)	8.1 (7.8)	7.8 (8.3)	
Hospital LOS (days)						n.s.
median (IQR)	10 (4–17)	7 (3.5–13)	9 (5–15)	9 (5–16)	9 (5–15)	
mean (SD)	12.3 (12.3)	9.9 (10.8)	11.7 (11.0)	12.4 (13.6)	11.8 (12.3)	
Surgery required	88 (52.7%)	74 (40.4%)	170 (56.1%)	200 (48.8%)	532 (50.0%)	χ^2 =11.94, df=3, p=0.008
AIS 3+ by ISS body regions						
Head or neck	93 (55.7%)	123 (67.2%)	79 (26.1%)	169 (41.2%)	464 (43.7%)	χ^2 =90.19, df=3, p<0.001
- surgery required	23 (13.8%)	35 (19.8%)	28 (9.2%)	40 (9.8%)	126 (11.9%)	χ^2 =13.56, df=3, p=0.004
Face	4 (2.4%)	11 (6.0%)	9 (3.0%)	17 (4.1%)	41 (3.9%)	n.s.
Chest	74 (44.3%)	87 (47.5%)	196 (64.7%)	281 (68.5%)	638 (60.0%)	χ^2 =44.19, df=3, p <0.001
Abdominal	21 (12.6%)	12 (6.6%)	65 (21.5%)	102 (24.9%)	200 (18.8%)	χ^2 =33.51, df=3, p <0.001
Extremities	83 (49.7%)	21 (11.5%)	110 (36.3%)	139 (33.9%)	353 (33.2%)	χ^2 =60.85, df=3, p <0.001

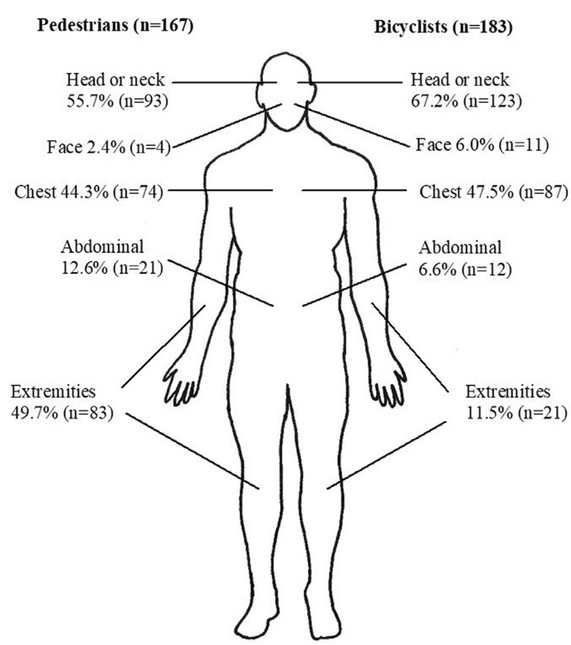

Fig. 2. AIS 3+ injuries of pedestrians and bicyclists according to ISS body regions.

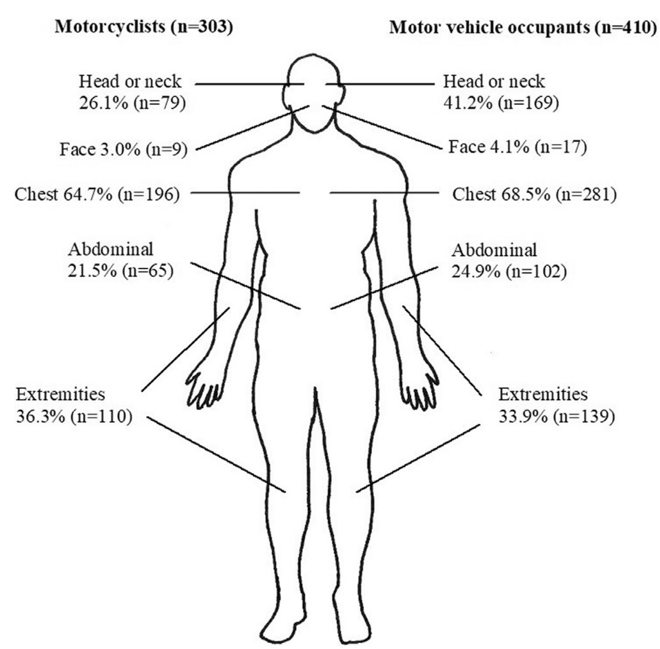

Fig. 3. AIS 3+ injuries of motorcyclists and motor vehicle occupants according to ISS body regions.

ans (Fig. 2, Fig. 3). Except for face injuries, there were significant differences in AIS 3+ injuries according to ISS body regions between injury mechanism groups. Furthermore, the proportion of head or neck injuries that required surgery was 11.9% among all patients and varied from 9.2% in motorcyclists to 19.1% in bicyclists (Table 2).

Over one third (64/183, 35.0%) of all bicyclist injuries were due to single accidents, where the bicyclist fell or collided with a fixed object without crashing into another party. Furthermore, 7 patients (3.9% of all injured bicyclists) were injured in a cycling race by falling alone or colliding with another bicyclist. However, in 2.7% (5/183) of cycling cases, a detailed injury mechanism was unrecorded, or the patient and bike were found at the scene of the accident by a passer-by and there was no clear information on the accident. Among single cycling accidents, 73.4% of the patients sustained head or neck injury whereas the percentage for other cycling crashes was 63.9% (n.s.). Furthermore, there was a significant difference between single cycling crashes (28.1%) and other cycling crashes (14.3%) in the proportions of head or neck injuries that required surgery (p = 0.023).

Discussion

This was the first study on the characteristics of traffic injuries in the HTR. We describe the demographics and the injury outcomes of severe (NISS >15) traffic injuries between the years of

2009–2018 and compared the injury outcomes between the injury mechanisms.

In our data that included all traffic injury mechanisms, the most common serious injury was chest injury followed by head or neck injury. Upon closer examination, the most commonly injured ISS body region varied by injury mechanism. The two most frequently injured body regions were head or neck and extremities among pedestrians, head or neck and chest among bicyclists, chest and extremities among motorcyclists, and chest and head or neck among motor vehicle occupants. Similar results were presented in the Study on Serious Road Traffic Injuries in the EU [16]. In that study, data of MAIS 3+ injuries from several countries, gathered from in-depth sources, hospital discharges, trauma registries, and police records linked to medical registers were used. Furthermore, high proportions of head injuries among bicyclists were also highlighted in many other previous studies [8,17–21].

In the present data, the proportion of single cycling accidents was over one third of all bicycle accidents. In earlier Finnish studies [9,22] using hospital data on less severe injuries, the proportion of single accidents was 81% and alcohol was often involved in these cases. Furthermore, Yilmaz et al. [21] reported single cycling accident proportions of 17.3% and 34.0% among ISS >15 trauma patients in the Netherlands (n = 187) and Australia (n = 194), respectively. Hence, it seems that single bicycle crashes are a significant group of cycling accidents and are poorly reported in official statistics [9,20–23].

Comparison with the publications from the TraumaRegister DGU

The high-quality TraumaRegister DGU® (TR-DGU) of the German Trauma Society (Deutsche Gesellschaft für Unfallchirurgie, DGU) is a German national trauma registry used by several hospitals in Germany with increasing participating from other countries [24]. There are some publications on traffic injuries based on the data from the TR-DGU.

Helfen et al. (2017) [25] analysed data on severely injured (ISS ≥9 and additional intensive or intermediate care unit treatment) bicyclists from the TR-DGU during 2002–2010. Among the total of 2 817 severely injured bicyclists, the median ISS and most frequent injuries (head and chest) were similar to our results. However, even if the mean age of injured bicyclists was lower, the median ICU LOS (4 days) was similar, and the median hospital LOS (15 days) were clearly higher in the TR-DGU data than in the HTR data. A similar observation of longer treatment periods in the German trauma patient population have also been observed previously [26,27].

Brockamp et al. (2017) [24] compared transport-related injury mechanisms and outcomes of young and adult road users using German data from the TR-DGU from years 2002–2012 and patients with ISS ≥9 (n = 24 373). Due to different inclusion criteria (ISS ≥9 vs. NISS >15), they presented mainly lower ISS and NISS values of all injury mechanisms than those in our data. However, the median hospital LOS by injury mechanisms were higher than those of ours (HTR) whereas the median ICU days were slightly lower. It is noteworthy that TR-DGU adult data did not include patients >50 years. Moreover, there were similarities in the body regions of injuries; in both studies head injuries were most common among bicyclists and chest injuries were most common among motorcyclists and motor vehicle occupants. Nonetheless, we used the ISS body regions whereas Brockamp et al. [24] used the AIS body regions.

Reith et al. (2015) [28] assessed TR-DGU data on severely injured (ISS ≥9) pedestrians between 2002 and 2012 (n = 4 435) and compared them to severely injured motor vehicle occupants (n = 16 042). The mean ages in both groups were lower in their TR-DGU data than the corresponding ages in the HTR data, probably because our study inclusion criterion was age >15 years. Reith et al. (2015) did not present the medians of ISS and NISS scores or treatment times. However, they presented means. The mean ISS values in both pedestrians and motor vehicle occupants were slightly higher in the TR-DGU than those in our study, whereas the mean NISS value in pedestrians was slightly lower. The mean NISS value in motor vehicle occupants was almost similar in TR-DGU and in HTR. The proportions of AIS 3+ injuries by body regions among pedestrians and motor vehicle occupants were both very similar to our results. However, the mean ICU LOS and hospital LOS in both groups were again clearly greater in the TR-DGU data than in the HTR data. In TR-DGU data, the mean ICU LOS was 10.4 days among pedestrians and 10.2 days among motor vehicle occupants, whereas the corresponding values in HTR were 8.0 and 8.1 days, respectively. The corresponding figures of mean hospital LOS were 23.4 and 24.0 days, respectively, in the TR-DGU data and 12.3 and 12.4 days, respectively, in the HTR data. Furthermore, mortality in both groups was higher in the TR-DGU data than in the HTR data.

In summary, traffic injury outcomes were similar to our results in studies on the TraumaRegister DGU®. However, the mean ICU LOS and hospital LOS were mainly longer.

Comparison with other studies

Studies on motorcycle crashes in hospital data that also included minor injuries showed high proportions of injuries of extremities [29–32] and were to some extent similar to our study. However, in the present study consisting of only serious and fatal injuries, chest injuries were more common than limb injuries among motorcyclists. In an Australian study, Bambach and Mitchell [33] established a data collection of linked police-reported and hospital data and generated with a weighting procedure an estimation of 19 979 hospitalised motorcyclists and provided detailed information on the nature, incidence, and risk factors for thoracic trauma. They reported that considering only serious injuries, thoracic injuries (24.2%), lower extremity injuries (18.8%), and head injuries (18.2%) were the most frequently sustained injuries, a conclusion that supports our findings. Furthermore, Bambach and Mitchell [33] observed that serious thoracic injuries were the most frequent serious injuries for single motorcycle crashes and collisions with fixed objects. On the other hand, serious lower extremity injuries, followed by serious thoracic injuries, occurred most frequently in collisions with motor vehicles. Another Australian study [34] concluded that thoracic injuries were predominant among fatally injured motorcyclists as a result of collision with roadside barriers.

In our study, injured pedestrians were older than other road users, most frequently had pre-injury comorbidity according to pre-injury ASA classification, and had the highest trauma bay mortality and 30-day mortality. Similar results regarding pedestrian age and mortality and a high proportion of head injuries compared to other road user groups were presented in an Australian study [35] based on data from the Victorian State Trauma Registry (VSTR) and the National Coronial Information System (NCIS) for 2007–2015 (n = 8 066) and in the study of Reith et al. [28] based on the TR-DGU. The pre-injury ASA classification as a background variable appears to be rarely reported in studies on traffic injuries.

The injury was intentional in 3.7% of cases in the HTR data, most frequently among motor vehicle occupants and pedestrians. The 30-day mortality of intentional injuries was 8.1% (3/37). According to Statistics Finland, 807 suicides were committed in 2018 in Finland, and 9% of them were committed by lying on the road or jumping in front of a moving object or by crashing into a motor vehicle [36]. Traffic suicides are a worrying phenomenon as they impair the wellbeing of the drivers involved [37]. From our study population, we could identify traffic injury patients who were injured in suicide attempts. Guidance of these patients to psychiatric care is very important.

The Vision Zero approach to traffic injury prevention and monitoring requires comprehensive data on serious injuries and related factors. The trauma registry provides excellent information on injuries and treatment. However, without information on the accident and related factors, it is difficult to make profound analyses or to specify effective measures. It would be necessary to analyse the effects of safety equipment, traffic environment, type of accident and vehicle and alcohol or drugs involvement on injuries and their severity among different road user groups. As long as we do not have the information on background factors and circumstances of traffic accidents, we cannot draw reliable conclusions. Instead, we can state that traffic accident statistics should be developed either by expanding data collection in hospitals or by linking hospital databases to other detailed accident databases.

Strength and limitations

The strength of this study is the highly reliable data of the HTR. The coverage and accuracy of data and the injury coding have been evaluated as excellent [38,39]. Hence, this study provides reliable and rare information of the most severe traffic injuries and injury outcomes from southern Finland. However, it is possible that some stable patients without any problems in vital signs but still with NISS >15 are treated in regional hospitals located in the catchment area, resulting in incomplete coverage of the HTR regarding NISS >15 cases.

Regarding traffic injury statistics and safety promotion, information on the exact location of the accident, helmet use of bicyclists and motorcyclists, alcohol involvement, and accident type (single or collision) are missing in HTR. These missing variables would be very useful for future analysis.

Conclusions

There was slight growing trend in the incidence of severe traffic injuries during the time period under review. Severely injured pedestrians and bicyclists were older and they had higher mortality than motorcyclists and motor vehicle occupants. According to NISS, pedestrians had the highest overall injury severity, followed by bicyclists. The most common serious injury (AIS 3+) among pedestrians and bicyclists was a head or neck injury whereas motorcyclists and motor vehicle occupants most frequently sustained a chest injury. Both the median length of ICU and hospital LOS were highest pedestrians, and lowest for bicyclists. Half of all patients required surgery and were most frequently motorcyclists and pedestrians. The Helsinki Trauma Registry provides excellent information on injuries and treatment. However, detailed data on the circumstances of traffic accidents are required to gain useful information for accident prevention.

Declaration of Competing Interest

The authors declare that there are no financial or personal relationships with other people or organizations that could cause conflicts of interest.

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