

Injury Patterns of Drivers and Other Vehicle Occupants in the Banja Luka Region (Bosnia and Herzegovina)

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ABSTRACT

Background: Traffic traumatism in Bosnia and Herzegovina has not been given adequate attention and there is a lack of serious research on this problem. Motor vehicle occupants represent a significant number of fatalities on local roads. The aim of this study was to identify particular risk groups of traffic participants and determine the differences in injuring due to the position of the vehicle.

Methods: Study included 400 injured and fatally injured occupants among 2009-2013 in Banja Luka. We analyzed of demographic and injury characteristics, cause of death and alcohol intoxication of drivers. Data are presented numerically and in percentages, statistically analyzed.

Results: Men account for nearly 3/4 of the total number of deaths and over 95% of dead drivers. Nearly two-thirds of victims were aged 15-44 years, and one third of injured were in the third decade of life. Drivers more often had AIS3+ injuries of head, chest, abdomen and AIS2+ injuries of thoracic spine and lower extremities. More often drivers and front passengers had AIS3+ chest injuries, while the back seat occupants had AIS3+ head injuries. There was a positive correlation between age and frequency of AIS3+ chest injuries and AIS2+ spinal injuries. The most common cause of death were head (41%) and chest injuries (33.3%). Nearly 3/4 of injured persons were died at the scene of accident or during transport to the nearest health care facility. Nearly 60% of killed drivers had legally prohibited BAC (> 0.3 g/kg).

Conclusion: Men in motor vehicles more often die in traffic accidents, and a particularly vulnerable category is young male drivers. Seat belts using on domestic routes is dissatisfactory and additional efforts are required.

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► *Implication for health policy/practice/research/medical education:* Injury Patterns of Drivers and Other Vehicle Occupants

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1. Introduction:

The global scale of traffic traumatism with 1.24 million deaths and nearly 50 million injuries annually justify a huge interest and engagement in the study of this problem (1). However, while most of serious studies come from highly developed countries, which are far more advanced in improving of preventive measures, the largest number of casualties occur in less developed and developing countries (2, 3). This problem is also present in Bosnia and Herzegovina, but lack of serious research does not provide conditions for a realistic assessment of its dimensions, greater interest of the state, effective planning and taking appropriate preventive measures. According to official figures, on the roads of Bosnia and Herzegovina in recent years there is a trend of slight decline in the number of casualties, among which the most numerous are drivers (4, 5). Although they do not belong to the group of most vulnerable traffic users, drivers along with the other occupants in the vehicle represent a respectable number of casualties. In this study we analyzed characteristics and differences in injuring of drivers and other motor vehicle occupants at the local level in the Banja Luka region. The aim of this study was to identify particular risk groups of traffic participants and determine the differences in injuring due to the position of the vehicle.

2. Materials and Methods:

In this retrospective study, data on injured traffic participants were collected from the prosecution documents that were the subject of medical expertise at the Department of Forensic Medicine of Republic of Srpska in Banja Luka, in the period from October 2009 by the end of 2013. Data on injuries of survivors were collected from medical records, while data on injuries of the dead were taken from the autopsy reports. Other demographic and crash data were taken from police reports, traffic accident scene records

and records on alcoholemia. We had observed: gender and age of the injured, localization and severity of injuries. In cases of fatalities we analyzed the cause of death and whether the death occurred before admission to a health facility (in prehospital period). We had also analyzed the alcohol intoxication of injured driver. Grouping according to the age was conducted in class intervals of 5 years, while for the analysis of the influence of age on the incidence of serious injuries cases were grouped at three intervals: 0-19, 20-49 and 50 years and over. Registered injuries in patients were classified according to the AIS method of assessment of individual injury, which is oriented towards the level of the individual life-threatening injuries in different body regions (6). In the group of those who died we analyzed localization of injuries that caused death.

Unfortunately, data on the use of seat belts and the age of the vehicle were not available because the current methodology of police investigations of accidents does not include the obligatory recording of the use of seat belts.

We have excluded cases where the exact position of the injured in collision vehicles could not be determined, injured in the train collision, injured in a bus, tractor or working machine, patients in ambulance vehicles and injured who died after more than 30 days after injury.

Obtained data were statistically analyzed using SPSS 16.0 software, chi square test, and results $P < 0.05$ accepted as a significant data.

3. Results:

The study included 400 cases: 151 drivers, 139 front seat passengers and 110 back seat occupants. It is notable that in the group of occupants who died drivers dominate (Table 1).

Gender distribution. In this study, 70.3% of injured were man and 29.7% women. The ratio between male and female was 88.7% and 11.3% respectively in the group of drivers. In the group of co-drivers there were 59.7 % of male and 43.3% female. In the

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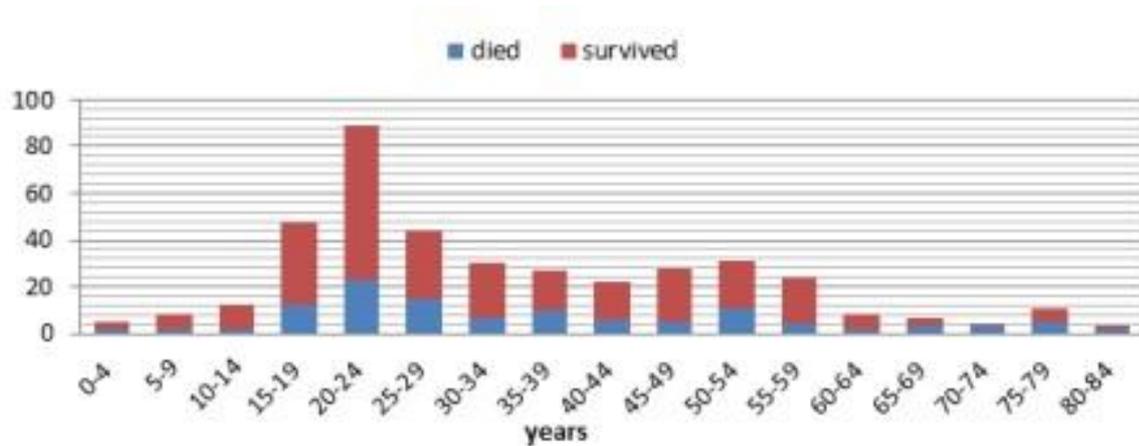


Fig. 1. Age distribution of injured persons.

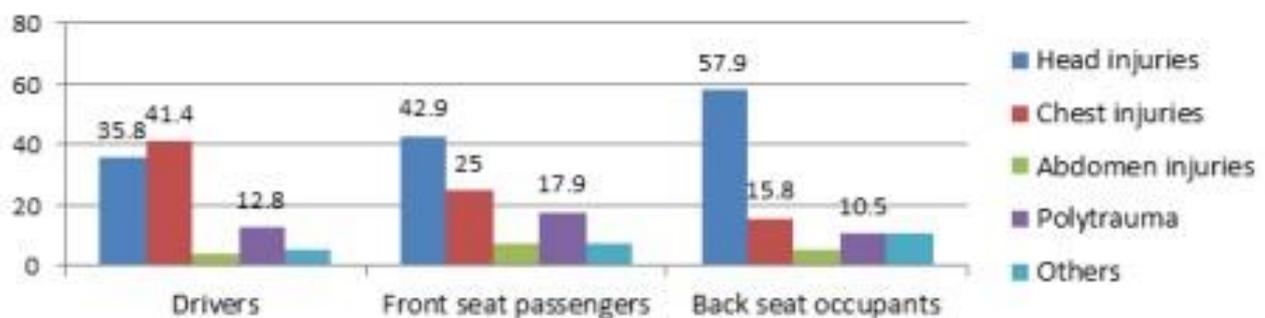


Fig. 2. Causes of death according to the position in the vehicle.

Table 1: Injured according to the position in the vehicle

	Drivers N (%)	Co-drivers N (%)	Back seat occupants N (%)
Survived	81 (28.6)	111 (39.2)	91 (32.1)
Died	70 (59.8)	28 (24)	19 (16.2)
Total	151 (37.8)	139 (34.7)	110 (27.5)

group of back seat occupants male-female ratio was 58.2%- 41.8%. Among dead occupants, 88% were male and 12% female. There were 70 dead drivers, and 67 or 95.7% of them were male.

Age distribution. By far the highest percentage (22.3%) of victims were aged 20-24 years, followed by the adjacent age groups. In total, over 45% of victims were aged 15 - 29 years (Figure 1). 65% of injured were aged between 15 - 44 years, 22.7% of injured were aged between 45 and 64 years, 6% were younger than 15 years and 6.3% had 65 years or more. Exactly one third of

survived and 32.5% of those who died were in the third decade of their life. Among drivers, the highest percentage of those who died (42.8%) were under the age of 30, while every tenth dead driver had 65 years or more.

Injuries. In table 2 the frequency of serious injuries of individual body systems at different positions in the vehicle was shown. Drivers more often had AIS3+ injuries of the head ($P=0.006$), chest ($P=0.000$) and abdomen ($P=0.000$). Also, AIS2+ injuries of thoracic spine ($P=0.019$) and lower extremities ($P=0.000$) were significantly

Table 2: Serious injuries of individual body systems according to the position in the vehicle

Injuries	Drivers (%)	Front seat passengers (%)	Back seat occupants (%)	Total (%)
AIS3+				
<i>Head</i>	30.5	18.0	15.5	22.0
<i>Chest</i>	43.7	25.2	13.6	29.0
<i>Abdomen</i>	27.2	6.5	4.5	13.8
AIS2+				
<i>Face</i>	5.3	8.6	14.5	9.0
Spine	15.9	17.3	9.1	14.5
Cervical	7.3	7.2	4.5	6.5
<i>Thoracic</i>	9.9	2.9	3.6	5.8
Lumbosacral	0.7	2.2	2.7	1.8
Pelvis	7.9	4.3	8.2	6.8
Upper extremity	28.5	22.3	24.5	25.3
<i>Lower extremity</i>	36.4	15.1	14.5	23.0
<i>Lower leg</i>	25.2	7.9	7.3	14.3

Italic – significant differences

Table 3: Frequency of serious injuries of individual body system according to the age

Injuries	Age			Total
	0–19 yrs	20–49 yrs.	≥ 50 yrs	
AIS3+				
Head	23.9	21.2	22.7	22.0
<i>Chest</i>	15.5	28.6	40.9	29.0
Abdomen	8.5	14.5	15.9	13.8
AIS2+				
Face	15.5	7.5	8.0	9.0
<i>Spine</i>	9.9	12.9	22.7	14.5
Pelvis	2.8	8.7	4.5	6.8
Upper extremity	25.4	25.3	25.0	25.3
Lower extremity	16.9	22.8	28.4	23.0

Italic - positive correlation

more common among drivers, while AIS2+ facial injuries ($P=0.035$) were significantly more often among back seat occupants.

Among those who died, the most common injury was AIS3+ chest injury (75.2%), followed by AIS3+ head injury (59.8%) and less significantly in AIS3+ abdominal injury (5.3%).

On the other hand, among those who survived the most common were AIS3+ head injuries (64%), followed by more than

6 times less frequent AIS3+ chest injuries (9.9%) and AIS3+ abdominal injuries (7%).

Concomitant AIS3+ injuries of head and chest were seen in 47 (40.2%) fatalities, of which 33 were seen among drivers (47.1% of dead drivers). Only 1.8% survivors suffered concomitant AIS3+ head and chest injuries.

There were no significant gender differences in serious injuries of any part of the body.

In table 3 we can see a positive correlation between age and the incidence of AIS3+

chest injuries ($P=0.002$) and AIS2+ spinal injuries ($P=0.038$).

Causes of death. The most common cause of death were head injuries (41%), followed by chest injuries (33.3%), polytrauma (13.7%), abdominal injury (5.1%) and other causes of death which were present in 6.8% fatality cases. Differences in causes of death in relation to the position of dead occupants in the vehicles are shown in figure 2.

Out of 117 fatalities, 86 of them (73.5 %) died at the scene of accident or during transport to the nearest medical facility.

Blood alcohol concentration among drivers. Out of 151 drivers analyzed in this study, for 112 of them there were data on blood alcohol concentration. At the time of the accident, 42% of drivers had the concentration of alcohol in blood prohibited by law (more than 0.3 g/kg). In the group of fatally injured drivers, 59.7% of them had the concentration of alcohol in the blood over 0.3 g/kg. The highest measured alcoholemia was 4.87 g/kg (found in the blood of a 23- year old male).

4. Discussion:

There is still an insufficient number of studies on the traffic traumatism in Bosnia and Herzegovina. The material of the Department of Forensic Medicine in Banja Luka, which was used in this study, represents an important source of data on traffic traumatology that can help in better understanding of the problem and finding effective preventive solutions at the local level.

In this study male occupants were majority of injured (70.3%). The predominance of males among fatally injured is particularly pronounced (88% vs 12%). In the group of drivers over 95% of those who died were male. Higher percentage of men among injured is not specific only to our region (7-10). A similar ratio among genders exists in the EU Member States, where the mortality rate of men in road accidents is three (Denmark, Germany, Ireland, the Netherlands) to five times (Greece, Cyprus) higher than women (11). Such a convincing male dominance among the injured can

hardly be explained by their more frequent involvement in traffic. At least, the explanation for this could be the tendency of male to aggressive and risky behavior in traffic (12) although the results of Wickens *et al.* do not confirm a significant difference in the expression of aggression among men and women (13). Certainly, the cultural differences and specificities of the environment in which the research is conducted should not be ignored.

In total number of cases, drivers, front seat and back seat passengers were fairly evenly represented. However, such balanced ratio is disrupted in the group of fatalities, where drivers make a majority (59.8%).

Particular vulnerability of younger people is best illustrated by the fact that, out of the total number of cases in this study, one third belongs to the third decade of life and almost half of them are aged 15-29 years. Taking into account that over 40% of drivers who died were younger than 30 years, it is clear that the problem of traffic traumatism of young people in Bosnia and Herzegovina deserves a more detailed analysis, similar to researches of Constantinou and Weis (14, 15). Vulnerability of labor productive part of the population (15-44 years) is slightly higher than the average of 60% at the global level (1, 16).

Regarding the relationship between the frequency of certain injuries and age, AIS3+ chest injuries and AIS2+ vertebral column injuries in the elderly are, as expected, more often. A positive correlation between AIS3+ chest injuries and age is confirmed by other studies (17-19), while Rao *et al* showed the link between age and fractures of thoracic and lumbar spine (20).

According to the results of our study, drivers more often have AIS3+ injuries of the head, chest and abdomen, compared to co-drivers and back seat occupants. Injuries of the head and chest are, as expected, often among drivers, which is in line with results of Hisham *et al* and Maydan *et al* (21, 22). The highest incidence of concomitant AIS3+ head and chest injuries in this group (almost every second dead driver) points to a special vulnerability of drivers. However, the high

incidence of AIS3+ abdominal injuries among drivers in this study differs from the results of other studies, according to which the highest risk for getting serious abdominal injuries have occupants in the back seat, which is explained by the primary effect of seat belts on abdomen of occupants (23-27). The most acceptable explanation for this distribution and the incidence of serious injuries of the driver and occupants in the back seat could be found at too frequent avoiding of use of seat belts.

Avoidance of this legal obligation is most pronounced among occupants in the back seat, where the use of seat belts is still the exception rather than the rule. Therefore abdomen of occupants in the back seat during traffic accidents is usually not exposed to the pressure by the seat belt, but because of the force of inertia, head and chest region collide with bump and solid obstacles ahead and around. Facts that AIS2+ facial injuries in our study were usually seen among back seat occupants and that head injury is the most common cause of death of back seat occupants support this explanation. Such results confirm the general impression that campaigns aimed at promoting the use of seat belts on our roads among drivers and co-drivers have resulted in a certain, although insufficient success, while among back seat occupants have remained without any response. All this points to the fact that use of the seat belt in our region does not deviate much from the gloomy picture seen in other less developed countries (28).

Regarding to AIS2+ injury of the vertebral column, only injuries of the thoracic spine are significantly more often among drivers. An explanation of these results requires more detailed research.

By observation of AIS2+ injuries of the pelvis and upper extremities we haven't seen any significant difference between drivers, co-drivers and back seat occupants.

Situation is different in case of AIS2+ injuries of lower extremities, which are by far the most frequently registered injury among drivers, even in relation to the co-drivers (36.4% vs 15.1%). Statistical

significance also exists in AIS2+ injuries of lower leg and feet (25.2% of drivers, 7.9% co-drivers and 7.3% of occupants).

The most common cause of death are head injuries, followed by chest injuries. It is surprising that among back seat occupants there is a convincing dominance of head injuries as the cause of death (57.9%). Head injuries are also leading cause of death among co-drivers, but among drivers the most common cause of death are chest injuries, followed by head injuries. These results also require a more detailed study, probably because an important role of seat belts is neglected by all occupants in a motor vehicle, especially among back seat occupants.

Nearly three-quarters of those who died did not arrive in the nearest medical institution. They died at the scene of accident or during transport to the hospital. This is significantly higher than the numbers seen in developed parts of the EU (50%) or Iran (60%), indicating a need to improve the quality of pre-hospital care of victims of traffic accidents (29-32).

Fact that, out of 112 drivers who had records of alcoholemia during traffic accidents, prohibited blood alcohol concentration (over 0.3 g/kg) had 42% of them (among dead drivers the percentage is even higher-nearly 60%). This points that alcohol is very present and an important risk factor in the occurrence of traffic accidents on local roads.

5. Conclusion:

The results of this study indicate that drivers are the most vulnerable categories of occupants in motor vehicles on the roads of the Republic of Srpska and among them especially young male drivers. Also, men in vehicles more often and severely get injured in traffic accidents, which is especially noticeable in accidents with fatalities.

High pre-hospital mortality of injured suggests the need to improve pre-hospital care of injured in traffic accidents.

Alcohol intoxication is a risk factor which is too often present in traffic accidents in our region.

For the explanation of a somewhat unusual results of the study it would be desirable to objectively examine the extent of use of seat belts on our roads, age structure and existence of modern protection systems in motor vehicles in which occupants get injured, as well as the type of collision. Implementation of the use of seat belts on domestic routes is unsatisfactory and further efforts are needed in this direction, by raising awareness of the importance of this preventive measure and decisive applying of legislation that already exists, but only on paper. On the domestic front, traffic traumatology is still under-researched area that deserves greater attention of the public and professional circles.

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