



Epidemiological and clinical characteristics of trauma patients: The first report from a center in Yazd affiliated with the National Trauma Registry of Iran

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Abstract

Background: According to the reports, the road traffic injuries (RTI) mortality rate in Iran as a middle-income country in the Eastern Mediterranean Region (EMR) decreased in past decades but is higher than the global level and remained a health problem.

Objectives: This study aimed to report the characteristics of registered patients injured by different trauma mechanisms in Yazd City, Iran.

Methods: In this study, the patients were registered from September 28, 2016, to December 31, 2022, at Shahid Rahnamoon Hospital, affiliated with the National Trauma Registry of Iran (NTRI) for its first phase. Inclusion criteria were hospital length of stay (LOS) of more than 24 hours, death due to injury in the hospital, or transfer from other hospitals' intensive care units (ICU). Age, gender, Glasgow Coma Scale (GCS), systolic blood pressure (SBP), cause of injury, LOS, injury severity score (ISS), and in-hospital mortality were assessed.

Results: Among 3960 participants, 2307 (58.2%) patients were injured due to RTI as the most common cause of injury. Also, 949 (23.9%) and 359 (9.1%) of the participants experienced fall and stab/cut injuries, respectively. Men were affected more than women in all injury causes ($p < 0.001$). In those with RTI, multiple trauma (55.3%) was the most prevalent event, and then extremities (23.5%) were the most body regions injured ($p < 0.001$). Also, in people who fell, trauma to the extremities (35.4%) was higher than in other regions ($p < 0.001$). According to the adjusted logistic regression model, being ≥ 65 years old has a 1.9 times higher chance of ICU admission compared to being < 18 years old. Also, having $ISS \geq 9$, having $GCS \leq 12$, and having trauma to the head/neck/face, abdomen, spine and multiple trauma had a statistically significant association with the chance of ICU admission with odds ratios (OR) and 95% confidence intervals (CI) of 3.89 (2.49-6.08), 22.26 (10.54-47.02), 2.55 (1.33-4.88), and 4.40 (3.00-6.47), respectively.

Conclusion: Data from the first phase of the only trauma registry center in Yazd province showed that RTI was the most common cause of injury, which was more prevalent among men. People aged 18 to 64 were significantly more affected by all injury causes. After multiple trauma, RTIs and fall injuries were mainly involved in the head and extremities. People must be warned against the potential risks and complications of trauma, especially RTI, more than before.

Keywords: Trauma, Injuries, Epidemiology, Injury Severity Score, Road Traffic Injury.

Introduction

Injuries annually account for approximately 8% of worldwide mortality, and based on a report in 2017, 57,9 deaths per 100,000 were from injuries.^[1] Beyond that,

trauma is a leading cause of disability in adult people and productive ages. According to the global burden of disease, road injuries were the first cause of disability-adjusted life-years (DALY) in the adult population (10-49

years old) from 1990 to 2019.^[2]

In Iran, injuries were the most common cause of mortality (23.6%) in the 15-49 years age group of both sexes in 2010.^[3] According to the reports, the road traffic injuries (RTI) mortality rate in Iran as a middle-income country in the Eastern Mediterranean Region (EMR) decreased in past decades but is higher than the global level^[4,5] and remained a health problem. Another essential aspect of RTI is the economic burden. The total cost of RTI was 6% of Iran's Gross Domestic Product (GDP) in 2013, which was considerably higher than other countries.^[6]

In 2019, fall was the eighth cause of DALY in 75 and older and sixteenth in 50-74 years old.^[2] In 2020, 9.9% of the Iranian population was older than 60 years, which predicts that this age group will increase to 31.2% of the population by 2050.^[7] Therefore, fall injuries and outcomes will be a series of health problems in the future.

A nationwide trauma registry gathers information that is used to understand injury patterns, reduce the burden of injury, improve trauma care, and monitor the performance of the trauma system.^[8,9]

To manage and reduce this high rate of injuries in Iran, we need to detect patterns and amount of damage in our country, in addition to the use of other trauma centers' results. We need valid data; registries are the tool to achieve this data. Also, Iran had successful registry experiences, such as the cancer registry. Therefore, the National Trauma Registry of Iran (NTRI) was established in 2016 at Sina Hospital, a multi-center registry with a hospital basis.

This hospital-based study was performed by data from one of the NTRI-related hospitals in Yazd city. Yazd province is a referral trauma center for several towns. Transportation ways from the south of Iran to the capital across from Yazd city due to its central position on the map. On the other hand, Yazd is one of Iran's industrial and populated cities. There is another study in Yazd city about road injury,^[10] but only some studies on all injury causes.

Objectives

This study aimed to review the first phase of the registry data and report the characteristics of trauma victims through the registry of Shahid Rahnamoon Hospital, the only trauma registry center in Yazd province that joined the NTRI a couple of years ago.

Methods

Study design

This cross-sectional study was done within the framework of the NTRI. We used the NTRI-relating data between September 28, 2016, and December 31, 2022, at Shahid Rahnamoon Hospital, Yazd, Iran.

Study Population

For all patients admitted to Shahid Rahnamoon Hospital with one or more traumatic injuries in a defined diagnostic International Classification of Diseases, 10th Revision (ICD-10) code, the inclusion criteria were considered as one of the following: hospital length of stay (LOS) more than 24 hours, death after injury in hospital, or transfer from intensive care units (ICU) of other hospitals.

Data collection

The following variables were collected from all participants by two registrar's nurses: demographic data including age and gender from the patients' files, Glasgow Coma Scale (GCS) on admission, systolic blood pressure (SBP) on entry, educational level, cause of injury, injured body region, LOS, ICU admission, and in-hospital mortality according to the patient's discharge status.

Registrars filled out checklists and uploaded them to a web-based portal. Then, two trained physicians checked the data quality, including completeness and consistency.

This study categorized causes of injury into four groups: RTI, fall, stab/cut, and others. RTI included pedestrian injury, motorcycle, car, heavy transport vehicle, and bicycle accidents. Fall was defined by the World Health Organization (WHO) as an event where a person comes to rest inadvertently on the ground floor or other lower level.^[11] Others included injuries due to drowning, poisoning, animal attack, explodes, firearm, electrocution, suicide, burn and heat injuries, and unknown reasons.

Injury severity score (ISS) was calculated by summing squares of the three most AIS scores.^[12] This study categorized ISS as 1-8, 9-15, and ≥ 16 . Education levels were divided into five groups: illiterate (no formal education), primary, secondary (lower and higher), and increased education (including post-diploma, BS, MS, MD, PhD) and unclear. SBP<89 at admission; consider hypotension.

Statistical analysis

We expressed continuous variables with normal distribution as means \pm standard deviation (SD) and variables with skewed distribution as medians with interquartile ranges (IQR). Also, we described categorical variables as frequency (%). Analysis of variance (ANOVA) was used to compare the mean of quantitative variables with the normal distribution between the causes of injury. Also, Bonferroni's method was used to determine which

group differences were statistically significant. The Chi-square test assessed the association between nominal (such as gender and body region) or categorical variables and causes of injury. In addition, logistic regression models were used to assess the factors related to ICU admission. Statistical significance was accepted at p values < 0.05. Data analysis used Stata 14.0 (StataCorp LLC, College Station, Texas, USA).

Ethics considerations

The Research Ethics Committee of Tehran University of Medical Sciences approved this study (Approval ID:

IR.TUMS.SINAHOSPITAL.REC.1399.090). During the data collection process, verbal informed consent was obtained from the patients. The study was conducted in accordance with the Declaration of Helsinki.

Results

The registry data of Yazd, Iran, included 3960 (3190 men) participants during this study period. The distribution and baseline characteristics of patients based on the cause of injuries are indicated in Table 1.

Table 1. Baseline characteristics of the study participants based on mechanisms of injuries: Trauma registry of Yazd, N (%)

	RTI (N=2307)	Fall (N=949)	Stab/cut (N=359)	Others (N=345)	Total (N=3960)	P value
Age (year)						<0.001
<18	546 (23.9)	238 (25.6)	54 (15.1)	60 (17.5)	898 (22.9)	
18 to 64	1574 (68.8)	484 (52.0)	296 (82.7)	270 (78.7)	2624 (67.0)	
≥65	167 (7.3)	208 (22.4)	8 (2.2)	13 (3.8)	196 (10.1)	
Gender						<0.001
Male	1893 (82.1)	664 (70.0)	328 (91.4)	305 (88.4)	3190 (80.6)	
Female	414 (17.9)	285 (30.0)	31 (8.6)	40 (11.6)	770 (19.4)	
GCS at admission						<0.001
13 to 15	1968 (86.3)	884 (94.6)	354 (99.2)	322 (94.4)	3528 (90.2)	
9 to 12	122 (5.4)	24 (2.6)	1 (0.3)	4 (1.2)	151 (3.9)	
3 to 8	190 (8.3)	26 (2.8)	2 (0.6)	15 (4.4)	233 (6.0)	
SBP ≤ 89 mmHg at admission	31 (1.4)	22 (2.3)	1 (0.3)	5 (1.5)	59 (1.5)	0.04
ISS categorical (%)						<0.001
1 to 8	1350 (58.5)	569 (60.0)	334 (93.0)	269 (78.0)	2522 (63.7)	
9 to 15	698 (30.3)	305 (32.1)	21 (5.8)	56 (16.2)	1080 (27.3)	
≥16	259 (11.2)	75 (7.9)	4 (1.1)	20 (5.8)	358 (9.0)	
Education level						<0.001
Illiterate	299 (13.0)	310 (32.7)	33 (9.2)	63 (18.2)	705 (17.8)	
Primary	374 (16.2)	209 (22.0)	49 (13.7)	55 (15.9)	687 (17.3)	
Secondary (lower, upper)	598 (25.9)	158 (16.6)	96 (26.7)	88 (25.5)	940 (23.7)	
Diploma	645 (28.0)	147 (15.5)	132 (36.9)	94 (27.2)	1018 (25.7)	
high education	288 (12.5)	98 (10.3)	47 (13.1)	38 (11.0)	471 (11.9)	
Unclear	102 (4.4)	27 (2.8)	1 (0.3)	7 (2.0)	137 (3.5)	
Body region						<0.001
Head/Face/Neck	309 (13.6)	165 (17.6)	3 (0.8)	51 (14.8)	528 (13.6)	
Thorax	17 (0.8)	17 (1.8)	7 (2.0)	4 (1.2)	45 (1.2)	
Abdomen	21 (0.9)	17 (1.8)	8 (2.3)	6 (1.8)	52 (1.3)	
Spine	111 (4.9)	97 (10.3)	2 (0.6)	9 (2.7)	219 (5.6)	
Extremities	533 (23.5)	332 (35.4)	136 (38.3)	113 (33.6)	1114 (28.6)	
Multiple Trauma	1253 (55.3)	310 (33.0)	199 (56.1)	153 (45.5)	1915 (49.2)	
Unknown	20 (0.9)	1 (0.1)	0 (0.0)	0 (0.0)	21 (0.5)	

RTI: Road traffic injury; GCS: Glasgow coma scale; SBP: systolic blood pressure; ISS: injury severity score. Values are shown as Mean (SD) and number (%) for continuous and categorical variables.

The most common cause of injury was RTI, with 2307 victims (58.2%). Also, falling was the second most common cause of injury, with 949 victims (23.9%). Then,

359 participants (9.1%) experienced stabs/cuts, and 345 (8.7%) patients experienced other traumas. Compared to the women, men were affected by all causes of injury more

than four times ($p<0.001$).

People aged <65 experienced RTI more commonly; however, trauma due to falling was more prevalent among people aged ≥ 65 . Moreover, people aged 18 to 64 were affected about three times more than those aged <18 by all injury causes ($p<0.001$). Most of the patients had $13 \leq \text{GCS} \leq 15$ at the admission. Also, 2.3% of patients with fall injuries had $\text{SBP} < 89$ mmHg at admission, which was higher than other injuries. People with no formal education (32.7%) and primary education (22.0%) experienced fall injuries more than other causes of injuries. Whereas people with secondary education (26.7%), diplomas (36.9%), and high education (13.1%) mainly experienced stab/cut ($p<0.001$).

People who experienced RTI, stab/cut, and other traumas mainly caused multiple trauma with frequency of 55.3%, 56.1%, and 45.5%, respectively ($p < 0.001$). However, in people who fell, extremities trauma (35.4%) was higher than in other regions ($p < 0.001$).

In this study, the total frequency of ICU admissions and in-hospital mortalities were 713 cases (18.4%) and 93 cases (2.3%), respectively. Furthermore, the median (IQR) hours of LOS was 68.0 (78.5) (Table 2). Based on the cause of injuries, RTI had the highest LOS compared to other injuries; also, ICU admission was more prevalent among them ($p<0.001$). Moreover, in-hospital mortality was significantly higher among the victims of RTI compared to other trauma mechanisms.

Table 2. Outcomes of the study participants based on mechanisms of injuries: Trauma registry of Yazd

	RTI (N=2307)	Fall (N=949)	Stab/cut (N=359)	Others (N=345)	Total (N=3960)	P value
LOS (hours), Median (IQR)	82.0 (106)	67.0 (72)	42.0 (13)	49.0 (50)	68.0 (78.5)	<0.001
ICU admission (%)	523 (23.1)	136 (14.7)	8 (2.3)	46 (13.6)	713 (18.4)	<0.001
In-hospital mortality (%)	62 (2.7)	28 (3.0)	1 (0.3)	2 (0.6)	93 (2.3)	<0.001

LOS: length of stay; ICU: intensive care unit. Values are shown as median (IQR) and number (%) for continuous and categorical variables.

The univariable logistic regression remodels showed a significant association between $\text{age} \geq 65$ ($\text{age} < 18$ as reference), $\text{ISS} \geq 9$ ($1 \leq \text{ISS} \leq 8$ as reference), and $\text{GCS} \leq 12$ ($13 \leq \text{GCS} \leq 15$ as reference) with ICU admission [Table 3]. Moreover, trauma to the head/neck/face, abdomen, spine, and multiple trauma (trauma to the extremities as reference) are significantly associated with ICU admission. However, fall, stab/cut and other mechanisms of trauma had a negative association with ICU admission compared to RTI with OR (95%CI) of 0.57 (0.46-0.70), 0.07 (0.03-0.15) and 0.52 (0.37-0.72), respectively.

The multivariable model showed that the adjusted chance of ICU admission in patients aged ≥ 65 was significantly higher than in those aged < 18 [OR= 1.91, 95% CI: (1.29 to 2.82), $p < 0.001$]. Moreover, having $9 \leq \text{ISS} \leq 15$ was 3.66 times more adjusted chance of ICU admission than the patients with $\text{ISS} < 9$ [OR= 3.66, 95% CI: (2.83 to 4.73), $p < 0.001$]. Also, patients with $\text{ISS} \geq 16$ had 9.73 times more adjusted chance of ICU admissions than patients with $\text{ISS} < 9$ [OR= 9.73, 95% CI: (9.02 to 17.97), $p < 0.001$].

Additionally, having $9 \leq \text{GCS} \leq 12$ and $3 \leq \text{GCS} \leq 8$ had about 29 and 65 times more chance of ICU admission than the patients with $13 \leq \text{GCS} \leq 15$ [OR= 29.09, 95% CI: (17.72 to 47.75), $p < 0.001$] and [OR= 65.40, 95% CI: (36.18 to 118.20), $p < 0.001$], respectively. Moreover, trauma to the

head/neck/face, abdomen, spine and multiple trauma increased the chance of ICU admission significantly [OR= 3.39, 95% CI: (2.49 to 6.08), $p < 0.001$], [OR= 22.26, 95% CI: (10.54 to 47.02), $p < 0.001$], [OR= 2.55, 95% CI: (1.33 to 4.88), $p < 0.01$], and [OR= 4.40, 95% CI: (3.00 to 6.47), $p < 0.001$], respectively. The chance of ICU admission in patients with stab/cut injuries was 0.22 times compared to the RTI [OR= 0.22, 95% CI: (0.09 to 0.49), $p < 0.001$].

Discussion

This study, as the first report from the data registry of Shahid Rahnamoon Trauma Center, revealed that RTI was the most common cause of injuries (58.2%). In comparison, falling was the second most common cause (23.9%) same as in the Sina Hospital trauma report (another center affiliated with the NTRI in Tehran).^[8] Moreover, the adjusted regression model demonstrated that $\text{ISS} \geq 9$ was associated with higher ICU admission, while stab/cut injuries caused less ICU admission than RTI. Furthermore, we showed that RTI, stab/cut, and other traumas caused significantly higher multiple trauma, whereas trauma to the extremities was more prevalent among victims of falling. Similarly, at Sina Hospital, RTI caused most of the head injuries, and most extremity injuries were related to the fall.^[8]

Table 3. Univariable and multivariable odds ratios (OR) and 95% confidence intervals (CI) of ICU admission among the study population

	Univariable		Multivariable	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Age				
<18	1	-	1	-
18 to 64	1.14 (0.93-1.41)	0.19	1.16 (0.88-1.54)	0.27
≥65	1.99 (1.49-2.65)	<0.01	1.91 (1.29-2.82)	<0.01
Gender (Female)	0.90 (0.73-1.11)	0.36		
ISS				
1≤ISS≤8	1	-	1	-
9 to 15	5.47 (4.45-6.73)	<0.001	3.66 (2.83-4.73)	<0.001
≥16	32.37 (24.48-42.80)	<0.001	9.73 (6.83-13.85)	<0.001
GCS				
13 to 15	1	-	1	-
9 to 12	22.83 (13.73-37.95)	<0.001	29.09 (17.72-47.75)	<0.001
3 to 8	51.59 (28.48-93.44)	<0.001	65.40 (36.18-118.20)	<0.001
Body region				
Extremities	1	-	1	-
Head/face/neck	8.97 (6.15-13.07)	<0.001	3.89 (2.49-6.08)	<0.001
Thorax	2.68 (0.91-7.87)	0.07	3.13 (1.00-9.83)	0.05
Abdomen	9.18 (4.53-18.61)	<0.001	22.26 (10.54-47.02)	<0.001
Spine	2.32 (1.29-4.19)	<0.01	2.55 (1.33-4.88)	<0.01
Multiple Trauma	9.82 (7.02-13.73)	<0.001	4.40 (3.00-6.47)	<0.001
Cause of injury				
RTI	1	-	1	-
Fall	0.57 (0.46-0.70)	<0.001	0.81 (0.60-1.07)	0.14
Stab/cut	0.07 (0.03-0.15)	<0.001	0.22 (0.09-0.49)	<0.001
Other	0.52 (0.37-0.72)	<0.001	0.96 (0.62-1.47)	0.85

RTI; Road traffic injury; GCS: Glasgow coma scale; ISS: injury severity score.

The current study demonstrated that after multiple traumas, RTIs and fall injuries were mainly involved in the head. Previous studies investigated that traumatic brain injury (TBI) was the most frequent cause of mortality in traumatic injuries in the past decades.^[13] Brain injuries in traumatic patients included primary injury because of direct damage from high energy trauma mechanism and secondary injury followed by hypotension and hypoxemia.^[13] TBI causes the release of inflammatory cytokines and pro-inflammatory substances that lead to acute kidney injury (AKI) and acute respiratory distress syndrome (ARDS).^[14] These conditions could increase ICU admission and LOS among RTI victims, as shown in Table 2.

In this study, head injury due to a fall was considered in people with age≥65 years old. Several studies stated that fall-related TBI is considered in older people.^[14-17] Older people have medical problems such as imbalance^[18] and may use some medications that lead to orthostatic hypotension; therefore, the risk of falls could increase in this population. On the other hand, seniors mostly use anticoagulant agents, a risk factor for intracranial

hemorrhage after a fall.^[16-18]

Upper and predominantly lower extremity limbs ranked as first most body region affected by RTI. In comparison, a previous road injury study in Yazd in 2009 showed that the lower extremities (fracture of knee and femur shaft) were the most affected body region.^[10] Also, Xin Ye et al. demonstrated that lower extremity injuries were the leading injury in American crash accidents, with an increasing slope in the past two decades and a decreasing rate of head injury.^[19] These differences may be due to diversities in transporting systems, car technologies, and road facilities. Similarly, fall injuries mainly caused upper and lower extremity injuries. Other studies demonstrated that head, chest, extremity, and pelvic fractures occurred in falls.^[17,18]

The present study showed that RTIs had the most LOS and ICU admissions as well as higher ISS compared to other causes of trauma, in agreement with the Sina trauma report.^[9] ISS was described as an anatomical score for injury severity. Victims with several body part injuries had higher ISS.^[12] Therefore, patients with higher ISS were critical and needed to be admitted to the ICU. According

to our analyses, ISS>9 was associated with ICU admission in line with Böhmer et al.,'s study.^[20]

Another interesting finding of this study was that falling was more prevalent among participants with no formal education than other injury causes. However, among literate people, RTI was significantly higher. Fall injuries occur in older adults more frequently, and older people in Iran are primarily low educated; therefore, it could be a possible explanation for the higher rate of falls among illiterate participants. On the other hand, another study stated that falls from construction sites are considered in low-educated adult people because the construction workers were from low socioeconomic levels.^[15]

Finally, our participants were predominantly men in causes of injury, and the most frequent trauma in both genders was RTI, in agreement with a recent multicenter analysis from the national trauma registry of Iran.^[20] A study revealed that RTI in men was higher than women in EMR because men drove the most time, especially on the highways.^[4] Another study from the Czech Republic demonstrated that trauma injuries in men were higher than in women, and fall was the leading cause of trauma in women.^[21] However, findings showed that crash injuries involved women more than men in the USA.^[19] According to several studies, because men had hazardous jobs, high physical activity, and were drivers, they had a high injury in contrast to women.^[15,21]

This study was the first analysis from the Yazd center of the NTRI. We had about 3200 patients of all ages and genders with different causes of injuries. This study had some limitations. We had no data from follow-up in our registry yet, and we could not consider complications of trauma, such as cognitive problems or disability. NTRI was a hospital-based registry; therefore, we do not include RTI-related deaths in the accident scenes and other trauma deaths before the hospital.

Conclusions

To sum up, we found RTI as the most common cause of injury, which was more common among men. People aged 18 to 64 experienced significantly more all causes of injuries. After multiple trauma, RTIs and fall injuries were mainly involved in the head and extremities. Being 65 years old and older, having ISS≥9, having GCS≤12, and having trauma to the head/neck/face, thorax, abdomen, spine, and multiple trauma had a statistically significant association with the chance of ICU admission. Our analysis has specific implications; policies such as educating people and constructing roads, cars, etc., with higher safety elements should be established for

preventing injuries.

Acknowledgment

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Competing interests

The authors declare that they have no competing interests.

Abbreviations

Road Traffic Injuries: RTI; Eastern Mediterranean Region: EMR; National Trauma Registry of Iran: NTRI; Length of Stay: LOS; Intensive Care Units: ICU; Glasgow Coma Scale: GCS; Systolic Blood Pressure: SBP; Injury Severity Score: ISS; Disability-Adjusted Life-Years: DALY; Gross Domestic Product: GDP; International Classification of Diseases, 10th Revision: ICD-10; World Health Organization: WHO; Traumatic Brain Injury: TBI; Acute Kidney Injury: AKI; Acute Respiratory Distress Syndrome: ARDS; Standard Deviation: SD; Interquartile Ranges: IQR; Analysis of Variance: ANOVA; Odds Ratios: OR; Confidence Intervals: CI.

Authors' contributions

All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

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None.

Availability of data and materials

The data used in this study are available from the corresponding author on request.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. The Research Ethics Committee of Tehran University of Medical Sciences approved this study (Approval ID: IR.TUMS.SINAHOSPITAL.REC.1399.090). During the data collection process, verbal informed consent was obtained from the patients.

Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

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