Original Article DOI: 10.22114/ajem.v0i0.427

Epidemiology of Fatal Injuries among Patients Admitted at Sina Hospital, the National Trauma Registry of Iran, 2016-2019

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Published online: 2020-08-31

Abstract

Introduction: Injuries cause high rates of mortality and harm to millions of people annually.

Objective: The aims of this study were to assess some characteristics of hospitalized trauma patients and determine the variables which were associated with increased rates of mortality.

Methods: Data were extracted from the National Trauma Registry of Iran (NTRI) data bank. Among all trauma patients admitted to Sina Hospital, those who had one of the following were registered in the NTRI: hospitalization for more than 24 hours, death less than 24 hours in the hospital, and transferring from the intensive care unit (ICU) of another hospital. Recorded data relating to the interval between 24 July 2016 and 10 October 2019 were analyzed.

Results: A total number of 3430 patients were studied, of whom 78 (0.02%) did not survive. The mean age of survivors was 38.4 (±18.5) and it was 58.1 (±23.7) for non-survivors ($p<0.001$). The mean Glasgow coma scale (GCS) of survivors was 14.9 (±0.7) and it was 11.7 (±4.4) for non-survivors ($p<0.001$). The most important predictors of death were ICU admission (OR 4.31; 95% CI 1.65-11.26) and not having surgical operation (OR 6.08; 95% CI 2.30-16.03). The injuries with higher injury severity score (ISS) had higher risks of death (OR 1.20; 95% CI 1.06-1.36).

Conclusions: In this study, Road Traffic Crashes (RTCs) were the main cause of injuries. The elder age, lower GCS score, ICU admission, higher ISS and not having surgical operation were the worst factors of death. More studies are needed to reveal other prognostic factors of fatal injuries.

Key words: Fatal Outcome; Registries; Trauma Severity Indices; Wounds and Injuries

Cite this article as: Khaleghi-Nekou M, Moradi A, Zafarghandi M, Fayaz-Bakhsh A, Saeednejad M, Rahimi-Movaghar V, et al. Epidemiology of Fatal Injuries among Patients Admitted at Sina Hospital, the National Trauma Registry of Iran, 2016-2019. Front Emerg Med. 2021;5(1):e9.

INTRODUCTION

Injuries kill more than 5 million people annually and cause harm to millions more (1). The World Health Organization (WHO) declared in 2016 that road traffic crashes (RTCs) were the 8th leading cause of death globally and also in the middle-upper-income countries (2). The number of deaths on the world's roads remains unacceptably high, with an estimated 1.35 million people dying each year (3). The burden of disease related to injuries, particularly RTCs, is expected to rise dramatically by the year 2020 (4).

In recent years, morbidity and mortality caused by traumas have become a major public health issue in Iran. Recent studies have shown that RTCs are the most frequent cause of injuries in Iran, and it is followed by fall and hit (5-7). According to a report from The Institute for Health Metrics and Evaluation, RTCs were ranked third among 10 top causes of death and disability combined in Iran (8). Iran with more than 80 million population, had 15,932 deaths due to RTCs in 2017(3).

Facing similar and alarming facts and figures, most countries have initiated to run trauma registries in order to gather trauma patient information as it can be the first step in trauma monitoring and prevention. Without information, it is impossible to adopt effective strategies in delivering care to trauma patients and to evaluate quality of care and trauma care systems. Also, it can help to close the gaps in accurate data about pre and post-hospital information which are required in any assessment of quality, effectiveness, efficiency and equity (9).

Due to the high burden of injuries in Iran and in order to accumulate comprehensive and integrated data from patients injured due to trauma, the National Trauma Registry of Iran (NTRI) was established and has been operated from 2016 at the Sina Trauma and Surgery Research Center (STSRC), Tehran, Iran. Since then, fourteen trauma centers in different provinces have joined to cooperate in this project, and a few qualitative and quantitative studies have been carried out to assess different aspects of the project, for instance, its minimum dataset and its inclusion criteria, and to describe the results based on data collected for NTRI during the pilot phase at STSRC (10, 11).

The aims of this study were to assess the characteristics of the people registered at NTRI, the variables which are associated with mortality in various types of injuries, and to facilitate planning in reducing the burden of mortalities caused by injuries.

Methods

Study design and setting

For the purpose of this cross-sectional study, the NTRI data which were related to the interval between 24 July 2016 and 10 October 2019, were analyzed. In the NTRI, patients' data are recorded under 109 variables and categorized in ten groups (10). In this study following variables were considered to analyze: gender, age, cause of injury, injury severity score (ISS), intensive care unit (ICU) length of stay (LOS), surgical operation, body mass index (BMI), time duration between event and admission, admission pulse rate, admission respiratory rate, Glasgow coma scale (GCS), hospitalization time.

Case Definition

All trauma patients defined by diagnostic International Classification of Diseases, 10th Revision (ICD-10) code who admitted to Sina Hospital and had one of the followings: hospital length of stay of more than 24 hours, death after injury, and transfer from ICU of other hospitals.

Measurements and data collection

Two nurses were trained for the data registry process at the STSRC. Data collection was performed by the registrars from the patient's profile, physical examination, patient interview, and hospital information system as the administrative database. Registrars filled checklists and uploaded them to a web-based program. Then a trained physician checked the data quality including completeness, accuracy, and consistency (11).

Injury Severity Score (ISS) & Abbreviated Injury Scale (AIS)

An expert coded all diagnoses and external causes of injuries according to ICD-10. To be recorded in the NTRI, ICD-10 patient codes were converted to abbreviated injury scale (AIS) codes, and their severities were calculated as according to ISS. Each AIS code contains 7 digits in which a 6-digit unique numerical identifier before decimal point shows the type of injury (known as the pre-dot code). The digit to the right of the decimal point (known as the post-dot code) is the AIS severity score. There are always cases which suffer from multiple injuries in which damaged organs might be found in different body regions. In these cases, ISS is calculated by summing up the squared values of ISS for the three most severe injuries anywhere in the body of the affected cases (12).

Statistical analysis

Descriptive analyses were performed using mean and standard deviation (SD) for quantitative variables, as well as for categorical data, absolute and relative frequency for categorical data. Independent t-test was used in the analytical section to determine the relationships between quantitative variables. To determine the relationship between qualitative variables, the following statistical tests and techniques were used: Chi-squared test, Fisher Exact test, Odds ratio index with its confidence intervals (OR, 95% CI). Logistic regression by forward method was also used to adjust for confounding and interference effects of variables. Initially, all variables with less than 0.2 p-value in the single-variable analysis were entered into the model. In the next steps, by comparing different models, the most suitable model was selected in terms of fit. To estimate the coefficients, the maximum correlation method was used. Analyzes were performed using SPSS software version 22 and Stata version 12.

Results

Registry data of a total number of 3430 patients were analyzed, of whom, 2923 (85.2%) were male, and the remaining were female (507, 14.8%). Mean age of the included cases was 38.8±18.9 years, out of whom, 24% were in the 25-34 years' age group. Out of the entire records belonging to 3430

Table 1: Frequency distribution of factors associated with mortality in trauma

Variables	Discharge status		P	ICU admission		P	Total
	Survived (n=3352)	Died (n=78)		Yes (n=549)	No (n=2881)		
Gender, n (%)							
Male	2923 (85.2)	59 (75.6)	0.016	419 (76.3)	2504 (86.9)	<0.001	2923 (85.2)
Female	507 (14.8)	19 (24.4)		130 (23.7)	377 (13.1)		507 (14.8)
Age, n (%)							
<15	161 (4.7)	1 (1.3)	<0.001	20 (3.6)	141 (4.9)	<0.001	161 (4.7)
15-24	715 (20.8)	8 (10.3)		92 (16.8)	623 (21.6)		715 (20.8)
25-34	823 (24.0)	8 (10.3)		99 (18.0)	724 (25.1)		823 (24.0)
35-44	605 (17.6)	5 (6.4)		70 (12.8)	535 (18.6)		605 (17.6)
45-54	420 (12.2)	10 (12.8)		63 (11.5)	357 (12.4)		420 (12.2)
55-64	300 (8.7)	10 (12.8)		64 (11.7)	236 (8.2)		300 (8.7)
>65	406 (11.8)	36 (46.2)		141 (25.7)	265 (9.2)		406 (11.8)
Age, mean (SD)	38.4 (18.5)	58.1 (23.7)	<0.001	46.6 (22.9)	37.3 (17.7)	<0.001	3430
External causes of injury, n (%)							
Road traffic crashes	1778 (51.8)	34 (43.6)	<0.001	288 (52.5)	1490 (51.7)	<0.001	1778 (51.8)
Non-road traffic crashes	9 (0.3)	0 (0.0)		2 (0.4)	7 (0.7)		9 (0.3)
Blunt force	619 (18.0)	4 (5.1)		45 (8.2)	574 (19.9)		619 (18.0)
Fall	791 (23.1)	36 (46.2)		185 (33.7)	606 (21.0)		791 (23.1)
Stab/Cut injuries	151 (4.4)	3 (3.8)		15 (2.7)	136 (4.7)		151 (4.4)
Firearms	43 (1.3)	0 (0.0)		9 (1.6)	34 (1.2)		43 (1.3)
Other	39 (1.1)	1 (1.3)		5 (0.9)	34 (1.2)		39 (1.1)
ISS, n (%)							
1-3	783 (29.1)	6 (10.9)	<0.001	47 (11.0)	736 (32.6)	<0.001	783 (29.1)
4-8	1404 (52.3)	9 (16.4)		165 (38.6)	1239 (54.8)		1404 (52.3)
9-15	457 (17.0)	32 (58.2)		188 (44.0)	269 (11.9)		457 (17.0)
16-24	18 (0.7)	3 (5.5)		13 (3.0)	5 (0.2)		18 (0.7)
>=25	25 (0.9)	5 (9.1)		14 (3.3)	11 (0.5)		25 (0.9)
ISS, mean (SD)	4.2 (3.3)	9.3 (6.1)	<0.001	7.1 (4.8)	3.8 (2.9)	<0.001	2687
ICU admission, n (%)							
Yes	549 (16.0)	29 (37.2)	<0.001	-	-	-	549 (16.0)
No	2881 (84.0)	49 (62.8)					2881 (84.0)
ICU days, mean (SD)	1.0 (4.5)	10.7 (16.6)	<0.001	7.9 (11.1)	0	<0.001	3430
Surgical operation, n (%)							
Yes	2744 (87.0)	33 (51.6)	<0.001	395 (80.6)	2349 (88.2)	<0.001	2744 (87.0)
No	409 (13.0)	31 (48.4)		95 (19.4)	314 (11.8)		409 (13.0)
BMI, n (%)							
Underweight (<18.5)	177 (5.5)	2 (4)	0.562	24 (5.1)	153 (5.6)	0.361	177 (5.5)
Normal (18.5-24.9)	1641 (51.2)	22 (44)		225 (47.9)	1416 (51.8)		1641 (51.2)
Overweight (25-29.9)	1032 (32.2)	18 (36)		166 (35.3)	866 (31.7)		1032 (32.2)
Obese (>30)	356 (11.1)	8 (16)		55 (11.7)	301 (11.0)		356 (11.1)
AIS, mean (SD)	2.2 (1.3)	3.5 (1.6)	<0.001	2.8 (1.3)	2.1 (1.2)	<0.001	3430
Hospitalization days, mean (SD)	8.1 (17.4)	14.0 (17.2)	0.004	16.3 (17.9)	6.7 (16.9)	<0.001	3419
GCS, mean (SD)	14.9 (0.7)	11.7 (4.4)	<0.001	14.3 (2.1)	14.9 (0.6)	<0.001	3357
Admission pulse rate, mean (SD)	82.5 (15.2)	90.0 (23.0)	0.006	85.1 (13.8)	82.2 (15.7)	<0.001	3384
Admission respiratory rate, mean (SD)	18.3 (4.4)	18.7 (5.1)	0.552	18.7 (6.8)	18.2 (15.7)	0.099	3330
Duration between event and admission in minutes*, median (interquartile range)	104.0 (376)	85 (933)	0.901	109 (385)	103 (360)	0.694	2689

ISS: injury severity score; ICU: intensive care unit; BMI: body mass index; AIS: abbreviated injury scale; GCS: Glasgow coma scale
*Since Kolmogorov-Smirnov test showed that this variable does not have a normal distribution, Mann–Whitney test was used.

patients, missing data existed in terms of unknown ISS for 743 patients. So, ISS statistics were calculated for the remaining 2687 patients, of whom, 98.4% had severity scores less than 16. There were 549 (16.0%) patients who were admitted to ICU. From 3153 patients, 2744 (87.0%) had surgical operation. Most of the patients (1641,51.2%) had a BMI within a normal range, and this type of data was missing for 224 patients. Seventy-eight records (2.3%) of the studied registry data were related to those who died due to trauma. Among them, 59 cases (75.6%) were male and 36 cases (46.2%) aged more than 65 years old. ISS statistics were missing for 23 patients. Mean of the recorded ISS scores for those who died was 9.32±6.11, and ISS of 32 (58.2%) were between 9

Table 2: Estimated risk of death due to trauma through univariate and multivariate logistic regression

Variable	Reference category	Univariate			Multivariate		
		OR	**95% CI**	**P**	**OR**	**95% CI**	**P**
Age		1.04	1.03 to 1.05	<0.001	1.07	1.03 to 1.10	<0.001
Gender							
Female	Male	1.88	1.11 to 3.19	0.018	0.90	0.33 to 2.45	0.838
AIS		1.50	1.35 to 1.67	<0.001	1.02	0.54 to 1.92	0.941
Transport to hospital							
Other	Ambulance	0.65	0.39 to 1.11	0.118	1.09	0.43 to 2.76	0.854
Admission respiratory rate		1.01	0.97 to 1.05	0.498	1.01	0.95 to 1.07	0.723
Admission GCS		0.60	0.55 to 0.65	<0.001	0.62	0.49 to 0.78	<0.001
BMI		1.00	0.98 to 1.01	0.933	0.99	0.92 to 1.07	0.981
ISS		1.19	1.14 to 1.23	<0.001	1.20	1.06 to 1.36	0.003
Surgical operation							
No	Yes	6.73	4.07 to 11.12	<0.001	6.08	2.30 to 16.03	<0.001
ICU admission							
Yes	No	9.63	6.03 to 15.40	<0.001	4.31	1.65 to 11.26	0.003
Body region							
Head and neck	Upper extremity and lower extremity	0.22	0.06 to 0.74	0.014	2.45	0.71 to 8.39	0.153
Thorax		0.44	0.17 to 1.14	0.094	3.60	0.65 to 19.96	0.142
Abdomen		0.35	0.12 to 1.01	0.053	2.03	0.17 to 23.73	0.571
Spine		0.09	0.05 to 0.15	<0.001	5.32	0.51 to 55.19	0.161
External causes of injuries							
RTCs	Stab/cut and burn injuries	2.44	1.51 to 3.93	<0.001	1.89	0.56 to 6.42	0.304
Fall		0.33	0.11 to 0.94	0.039	6.95	1.002 to 48.30	0.050
Blunt force		0.88	0.30 to 2.45	0.781	1.57	0.15 to 16.50	0.704

CI: confidence interval; OR: odds ratio; AIS: abbreviated injury scale; GCS: Glasgow coma scale; BMI: body mass index; ISS: injury severity score; ICU: intensive care unit; RTCs: road traffic crashes

and 15. Demographic characteristics data was presented in table 1.

Comparison of the demographic characteristics of survived cases with those who did not survive shows that there was no statistically significant difference between the two groups in terms of two variables: admission respiratory rate (RR), and the interval between event and admission (p>0.05). In contrast, there were statistically significant differences between two groups with respect to age, ISS, length of hospitalization, ICU days, GCS, admission pulse rate (PR), and AIS values (p<0.05). Compared to those who survived, in the dead group, values for GCS variables were significantly less, and for the rest of variables, the values were significantly higher (p<0.001).

Of those being admitted to ICU, 419 (76.3) were male, 141 (25.7) were more than 65 years old, 188 (44.0) were in 9-15 ISS group, 395 (80.6) had surgical operation, and about 225 (47.9) had normal BMI. RTCs and fall increase the chance of admission to ICU by 288 (52.5) and 185 (33.7) respectively. The followings were also observed in comparison with those who were not admitted: GCS variables were significantly less among those being admitted, and for the rest of variables, the values were significantly higher in this group (p<0.001).

Table 2 shows estimated risk of death in study population due to trauma through univariate and multivariate logistic regression. In single-variable analysis, risk of mortality due to trauma was shown to be related with the following: age, AIS, gender, GCS, ISS, not having surgical operation, ICU admission, head and neck injury, abdomen injury and injuries to the spine, fall and RTCs. The variables of transport to hospital, admission respiratory rate, BMI and injury to the thorax also had no significant effect on risk of death. Each unit increase in AIS was associated with 15% increase in risk of death (OR=1.50, 95% [CI: 1.35-1.67], p<0.05). Vice versa, each unit increase in GCS reduced risk of death by about 40% (OR=0.60, 95% [CI: 0.55-0.65] p <0.001). Estimating the risk of death in a person who injured by road traffic crashes and fall are 2.44 times and 0.33 times higher in person who injured by stab/cut and burn injuries respectively (OR 2.44, 95% CI [1.51-3.93]) (OR 0.33, 95% [CI 0.11-0.94]).

Table 2 also shows the final logistic regression coefficient model evaluating the relationship between death and some underlying variables in studied trauma cases. The variables such as gender, AIS, transport to hospital, admission RR, BMI, body region, and external causes of injuries had no significant impact on risk of death. For every

Table 3: Univariate and multivariate logistic regression for estimation of ICU admission due to trauma

Variable	Reference category	Univariate		P	Multivariate		P
		OR	95% CI		OR	95% CI	
Age		1.02	1.01 to 1.02	<0.001	1.02	1.01 to 1.02	<0.001
Gender							
Female	Male	2.06	1.64 to 2.57	<0.001	1.36	0.94 to 1.97	0.092
AIS		1.35	1.28 to 1.43	<0.001	1.17	0.98 to 1.38	0.066
Transport to hospital							
Other	Ambulance	0.74	0.61 to 0.91	0.005	0.78	0.56 to 1.08	0.137
Admission respiratory rate		1.02	1.002 to 1.03	0.021	1.03	1.00 to 1.06	0.011
Admission GCS		0.69	0.63 to 0.75	<0.001	0.72	0.58 to 0.90	0.004
BMI		1.00	0.99 to 1.01	0.199	0.99	0.97 to 1.01	0.903
ISS		1.26	1.22 to 1.31	<0.001	1.22	1.16 to 1.29	<0.001
Surgical operation							
No	Yes	1.79	1.39 to 2.31	<0.001	0.78	0.53 to 1.14	0.210
Body region							
Head and neck	Upper extremity and lower extremity	0.49	0.31 to 0.78	0.003	0.77	0.37 to 1.58	0.485
Thorax		1.05	0.69 to 1.60	0.794	4.98	2.48 to 10.00	<0.001
Abdomen		0.95	0.62 to 1.46	0.844	1.03	0.51 to 2.10	0.915
Spine		0.21	0.17 to 0.27	<0.001	0.25	0.16 to 0.38	<0.001
External causes of injuries							
RTCs	Stab/cut and burn injuries	1.57	1.28 to 1.94	<0.001	1.19	0.82 to 1.73	0.344
Fall		0.40	0.29 to 0.56	<0.001	0.63	0.37 to 1.08	0.095
Blunt force		0.76	0.51 to 1.13	0.176	0.76	0.38 to 1.50	0.436

CI: confidence interval; OR: odds ratio; AIS: abbreviated injury scale; GCS: Glasgow coma scale; BMI: body mass index; ISS: injury severity score; ICU: intensive care unit; RTCs: road traffic crashes

additional year of life, risk of mortality increased by 1.07 (OR 1.07, 95% [CI 1.03-1.10]). While for every added unit in GCS variable, risk of death decreased by about 38% (OR 0.62, 95% [CI 0.49-0.78]), $p<0.05$). ISS increases 1.2 times the risk of death in victims (OR 1.2, 95% [CI 1.06-1.36]). Patients who did not have surgical operation, were at a 6 times higher risk of death compared to those who had (P-value<0.001, OR 6.08, and 95% [CI 2.30-16.03]). Also, there was a significant association between ICU admission and risk of death (P-value=0.003). There is a boundary relation between the fall and the risk of death (P-value=0.050). Based on the fitting model, the final model can predict 42% of risk of mortality (R^2 =0.42).

Univariable evaluations of estimated ICU admission in study population due to trauma in table 3 showed that, the variables of BMI, thorax injury, abdomen injury and blunt force did not have a significant impact on ICU admission. ICU admission due to trauma was shown to be related with the following: Age gender, AIS, transport to the hospital, Admission respiratory rate, GCS, ISS, not having surgical operation, injury to the head and neck and injury to the spine. Risk of ICU admission increased by 26% for each unit increase in ISS (OR=1.26, 95% [CI 1.22-1.31]), a statistically finding. Eventually, RTCs and fall had statistically significant impact on ICU admission compared with stab/cut and burn injuries.

In the end, all variables with a significant effect on ICU admission were entered simultaneously into the regression model, presented in Table 3. Risk of ICU admission increases by 2% for each year increase in age (OR=1.02, 95% [CI: 1.01-1.02]). Each unit increase in respiratory rate at the time of admission would increase the risk of ICU admission by 3%; (OR=1.03, 95% [CI: 1.00-1.06]). Each unit increase in GCS, risk of ICU admission decreased by about 28% (OR=0.72, 95% [CI: 0.58-0.90]). It also appeared that each unit increase in ISS would cause a 22% increase in risk of ICU admission; (OR=1.22, 95% [CI: 1.16-1.29]). Finally, patients with injuries to the thorax and spine were more at risk of ICU admission. Based on the fitting model, the final model can predict 32% of risk of ICU admission (R^2 =0.32).

Discussion

In this study, the NTRI data which were related to the interval between 24 July 2016 and 10 October 2019, were analyzed to reveal the factors associated with higher mortality. In line with the results in earlier studies, this study also showed that injuries and deaths were more common in men (11, 13-16). Findings can be explained with the fact that men are more likely to have outdoor activities and thus are more vulnerable compared with women who are more likely, in Iranian socioeconomic and cultural situation, to be safe as housewives from causes of injuries in the society (17). Besides, men are more likely to work with heavy industrial equipment making them more exposed to work-related injuries.

The findings in this study are in line with the findings about risk-factors of mortality such as sex, age, GCS, ICU admission, and histories of surgical operations. Results here show that most injured patients were in active age group (mean age 38.86±18.94), and this finding was endorsed elsewhere (11, 16, 18). Moreover, results here revealed that as age increases, risk of death grows, and this is in line with the finding in two Iranian and French studies showing respectively that patients more than 65 and more than 75 years in age are more likely to die due to falls (19, 20). These results indicated that more attention should be paid to the elderly, and to their physiological conditions and underlying diseases which contribute to their post-injury death. These findings become even more important as two recent studies have shown respectively, that as age grows elderlies may become even more prone to fall-related traumas (21), and that the injured elderly are more likely to request nursing services due to their health conditions (22).

With regard to GCS, our results showed that the risk of death decreased by 12% for each unit increase in this variable among trauma patients. Shao-Chun Wu and colleagues in their study showed that the patient who died, presented significantly lower GCS (23). Yadollahi et al. showed the same results and expressed that this index used along with other triage indices could become a useful tool to estimate risk of death in trauma patients (17).

According to the findings, increase in ISS score is associated with a higher risk of death. Several other studies revealed that ISS had significant effects on the mortality of trauma patients (17, 24). A study also claimed that ISS score would increase by aging (17). As reported by Yadollahi et al., ISS was one of the most important risk factors for elderly mortality (25). Considering the adverse outcomes of trauma in elderly patients and the risk factors of mortality in this vulnerable age group, we can reduce the risk of mortality and morbidity by creating safer environments to avoid accidents by constant monitoring and special treatments following trauma.

In this study, about 85 percent of survived patients did not need ICU admission. On the other hand, among ICU admitted patients, the chance of death was 4.31 times more compared to other patients. This implies that many of the trauma-related mortalities could have been caused rather than cured by inappropriate use of the facilities and hence the risky conditions in intensive care units (ICU) (26). It is notable that the management of severely injured patients requires all of the skills and resources of modern-day intensive care medicine and can be challenging and expensive (27). Moreover, the majority of trauma patients requiring intensive care, have a serious head injury (27). As revealed in this study, injury to the head and neck is associated with increased risk of mortality. So, more attention should be taken to them.

The results here correspond with the findings elsewhere which indicated that the most common external causes of injuries were RTC, fall and stab/cut injuries in injured patients similar to the pilot phase of this study (11). Similarly, the findings here are in line with some other studies which reported that unintentional injuries like RTC were the leading cause of death and that the intentional injuries are the next cause in both developed and developing countries (28-30). Also, it has been shown that RTC increases by industrialization and urbanization (5). Furthermore, the findings here are endorsed by another study revealing that RTC injuries have the highest frequency and mortality rate in Iran, compared with other causes of injury (6). This study emphasizes the decreasing economic and social burden of injuries and mortality resulting from RTC by taking the following steps: 1. improvement in road standards and structures, 2. decreasing both time and distance in access to medical centers, 3. improving road traffic education and culture, 4. improving safety measures and standards of the products by car manufacturing and related industries, 5. More serious discipline and more effective road traffic rules and laws (6). Gomez and his colleagues showed that fall was more common than RTC which is in contrast with the findings here (17) and with those found by Sharif-Alhoseini et al (11). Domestic fall was more common in the elderly, and despite the fact that they cause less severe injuries, mortality is higher in this age group because of their otherwise poor physical status (5, 15).

According to the results here, traumas usually cause injury to the head and neck, and this fact was similarly found elsewhere (15, 31, 32), and found that this types of injuries decreased survival (20, 32).Another study showed an increasing trend in the incidence of head injuries, historically. Nevertheless, rapid motorization along with inadequate traffic education and slow implementation of safety regulations might be the causes of this observation (18). Improvements in manufacturing quality and application of airbags, seat belts, and helmets are among the most important and effective safety measures (33). Further research has to be conducted to clarify the relation between head injury and increased risk of in-hospital mortality rate.

Surgical operations may become necessary in the course of injury treatment which decreased the risk of mortality in traumas. This indicates that surgery will save the life of the patient. A cohort study showed that the patients exposed to traumas and acute care surgeries had lower mortality than those who did not (34). Obviously, shortening the time from trauma to surgery, greatly improves the quality of trauma care (35). For deceased patients with traumatic brain injury who failed to undergo necessary surgery, the reasons included limitations in theatre space, delayed procurement of supplies, and diagnostic logistics. The dramatic increase in mortality for patients not receiving necessary surgical care stressed the importance of increasing access to neurosurgery for future interventions (36).

Limitations

Despite of hard working, there are still considerable missing data that can affect the results, and improving data gathering would be so helpful. The present study can be considered as a baseline for future assessments of the injury mortality in Tehran Province and sheds light on priorities to prevent mortalities after trauma. Data for a larger number of people could have been collected and registered to be analyzed in this study if: surviving patients had been followed after the discharge from the hospital.

Conclusions

Injury is an important cause of morbidity and mortality worldwide. In this study, attempts were made to reveal variables that affect mortality in injuries. The fatal trauma injuries were related to a set of variables such as old age, decreasing GCS scores, higher ISS code, not having surgical operation, and ICU admission. More studies are needed find other factors that cause mortality and reduce survival in traumas.

Acknowledgements

None.

Authors' contribution

Conceptualization: PS, MS, MZ. Data curation: MKN, AM. Formal Analysis: AM, PS. Funding acquisition: MZ, PS. Investigation: KN, MO, SB, MKN. Methodology: AM. Project administration: MZ, PS. Resources: PS, MZ, VRM, MSA, EF, MM, HSB, HPH, HP. Supervision: PS, MZ, VRM, MSA, EF, MM, HSB, HPH, HP. Validation: MK, SS, AR. Visualization: MKN, PS. Writing – original draft: MKN, AM, AFB, MS. Writing – review & editing: PS, MZ, AFB, MS, VRM, MSA, EF, MK, MM, HSB, HBH, HP, MKN.

Conflict of interest

None declared.

Funding

This study was funded by Sina Trauma and Surgery Research center under the project of National Trauma Registry of Iran [NTRI]. The contract number was 97-03-38-40539.

References

1. World Health Organization. WHO Health topics, Injuries, [n.d.]. Available from: http://www.emro.who.int/health-topics/injuries/index.html, .
2. World Health Organization. The top 10 causes of death, 2018, [cited 2018, 24 May,]. Available from: https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death,.
3. World Health Organization. Global status report on road safety 2018, 2018, [cited 2018, n.d.]. Available from: https://www.who.int/violence_injury_prevention/road_safety_status/2018/en/,.
4. Peden M, McGee K, Sharma G. The injury chart book: a graphical overview of the global burden of injuries. Geneva: World Health Organization. 2002 Apr 3;5.
5. Haji Aghajani M, Haddadi M, Saadat S. Epidemiological Pattern of Injuries in Iran; a Nationwide Review of Seven Million Emergency Department Admissions. Emergency. 2017;5(1):e10.
6. Azami-Aghdash S, Abolghasem Gorji H, Sadeghi-Bazargani H, Shabaninejad H. Road Traffic Injuries Epidemiology in Iran: Based on the Data from Disaster Management Information System (DMIS) Of the Iranian Red Crescent. Iran Red Crescent Med J. 2017;19(1):e38743.
7. Saadat S, Yousefifard M, Asady H, Moghadas Jafari A, Fayaz M, Hosseini M. The Most Important Causes of Death in Iranian Population; a Retrospective Cohort Study. Emergency. 2015;3(1):16-21.

8. Institute for Health Metrics and Evaluation(IHME). What causes the most death and disability combined? 2017. [Available from: http://www.healthdata.org/iran].
9. Ehteram H, Sharif-Alhoseini M. Designing trauma registry system using a logical framework approach. Chinese J Traumatol. 2013;16(5):316-8.
10. Ghodsi Z, Rahimi-Movaghar V, Zafarghandi M, Saadat S, Mohammadzadeh M, Fazel M, et al. The Minimum Dataset and Inclusion Criteria for the National Trauma Registry of Iran: A Qualitative Study. Arch Trauma Res. 2017;6(2):1-7.
11. Sharif-Alhoseini M, Zafarghandi M, Rahimi-Movaghar V, Heidari Z, Naghdi K, Bahrami S, et al. National Trauma Registry of Iran: A Pilot Phase at a Major Trauma Center in Tehran. Arch Iran Med. 2019;22(6):286-92.
12. The Abbrevated Injury Scale, 2015 Revision, Chicago, ll USA: Association for Advancement of Automotive Medicine. page: 228.
13. Gomez D, Sarrami P, Singh H, Balogh ZJ, Dinh M, Hsu J. External benchmarking of trauma services in New South Wales: Risk-adjusted mortality after moderate to severe injury from 2012 to 2016. Injury. 2019;50(1):178-85.
14. Curtis K, Caldwell E, Delprado A, Munroe B. Traumatic injury in Australia and New Zealand. Australas Emerg Nurs J. 2012;15(1):45-54.
15. Zhang M, Guo M, Guo X, Gao L, Zhou J, Bai X, et al. Unintentional injuries: A profile of hospitalization and risk factors for in-hospital mortality in Beijing, China. Injury. 2019;50(3):663-70.
16. Kunitake RC, Kornblith LZ, Cohen MJ, Callcut RA. Trauma early mortality prediction tool (TEMPT) for assessing 28-day mortality. Trauma Surg Acute Care Open. 2018;3(1):e000131.
17. Yadollahi M. A study of mortality risk factors among trauma referrals to trauma center, Shiraz, Iran, 2017. Chinese J Traumatol. 2019;22(4):212-8.
18. Yadollahi M, Ghiassee A, Anvar M, Ghaem H, Farahmand M. Analysis of Shahid Rajaee hospital administrative data on injuries resulting from car accidents in Shiraz, Iran: 2011-2014 data. Chinese J Traumatol. 2017;20(1):27-33.
19. Abbasi H, Bolandparvaz S, Yadollahi M, Anvar M, Farahgol Z. Time distribution of injury-related in-hospital mortality in a trauma referral center in South of Iran (2010-2015). Medicine (Baltimore). 2017;96(21):e6871.
20. Bege T, Pauly V, Orleans V, Boyer L, Leone M. Epidemiology of trauma in France: mortality and risk factors based on a national medico-administrative database. Anaesth Crit Care Pain Med. 2019;38(5):461-8.
21. Na'emani F, Fayaz-Bakhsh A, Sohrabi Z, Zali ME. Service required for elderly receiving home care: a situational analysis.Payes. 2019;18(6):513-25.
22. Na'emani F, Esmaiil Zali M, Sohrabi Z, Fayaz-Bakhsh A. Prevalence of Risk Factors for Falls Among the Elderly Receiving Care at Home. Salmand. 2019;13(5):638-51.
23. Wu SC, Rau CS, Kuo SCH, Chien PC, Hsieh HY, Hsieh CH. The Reverse Shock Index Multiplied by Glasgow Coma Scale Score (rSIG) and Prediction of Mortality Outcome in Adult Trauma Patients: A Cross-Sectional Analysis Based on Registered Trauma Data. Int J Environ Res Public Health. 2018;15(11):2346.
24. Sarani B, Temple-Lykens B, Kim P, Sonnad S, Bergey M, Pascual JL, et al. Factors associated with mortality and brain injury after falls from the standing position. J Trauma. 2009;67(5):954-8.
25. Yadollahi M, Mahmoudi A, Niakan M, Fadaei Dashti M. Evaluating Risk Factors of Geriatric Trauma Mortality by Logistic Regression; A Cross-Sectional Study in 2011 - 2016. Iran Red Crescent Med J. 2018;20(5):e56049.
26. Abbasi HR, Mousavi SM, Taheri Akerdi A, Niakan MH, Bolandparvaz S, Paydar S. Pattern of Traumatic Injuries and Injury Severity Score in a Major Trauma Center in Shiraz, Southern Iran. Bull Emerg Trauma. 2013;1(2):81-5.

27. Oakley PA, Coleman NA, Morrison PJ. Intensive care of the trauma patient. Resuscitation. 2001;48(1):37-46.
28. Stewart KA, Groen RS, Kamara TB, Farahzad MM, Samai M, Cassidy LD, et al. Traumatic injuries in developing countries: report from a nationwide cross-sectional survey of Sierra Leone. JAMA Surg. 2013;148(5):463-9.
29. Khushboo Sheth. The Leading Causes Of Death In India, 2017 [cited 2017, April 25.]. Available from: https://www.worldatlas.com/articles/the-leading-causes-of-death-in-india.html,.
30. Xu J, Murphy SL, Kochanek KD, Arias E. Mortality in the United States, 2015. NCHS Data Brief. 2016(267):1-8.
31. Valderrama-Molina CO, Giraldo N, Constain A, Puerta A, Restrepo C, Leon A, et al. Validation of trauma scales: ISS, NISS, RTS and TRISS for predicting mortality in a Colombian population. Eur J Orthop Surg Traumatol. 2017;27(2):213-20.
32. Zargar M, Modaghegh MH, Rezaishiraz H. Urban injuries in Tehran: demography of trauma patients and evaluation of trauma care. Injury. 2001;32(8):613-7.
33. Azami-Aghdash S, Sadeghi-Bazargani H, Shabaninejad H, Abolghasem Gorji H. Injury epidemiology in Iran: a systematic review. J Inj Violence Res. 2017;9(1):27-40.
34. Sarmiento Altamirano D, Himmler A, Chango Sigüenza O, Pino Andrade R, Flores Lazo N, Reinoso Naranjo J, et al. The Successful Implementation of a Trauma and Acute Care Surgery Model in Ecuador. World J Surg. 2020;44(6):1736-44.
35. Hu PY, Chen XY, Chen XH, Chen YM. Trauma care construction under the guidance of county-level trauma centers. Chinese J Traumatol. 2018;21(5):256-60.
36. Kuo BJ, Vaca SD, Vissoci JRN, Staton CA, Xu L, Muhumuza M, et al. A prospective neurosurgical registry evaluating the clinical care of traumatic brain injury patients presenting to Mulago National Referral Hospital in Uganda. PLoS One. 2017;12(10):e0182285.