



Survival and Quality of Hospital Care for Victims of Car Crashes in Western Azerbaijan, Iran

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Abstract

Background: Car crashes are among the prevalent incidents seriously threatening public health.

Objectives: This study aimed to assess the survival and quality of hospital care for patients of car accidents in Western Azerbaijan, Iran.

Methods: This cross-sectional study was conducted on 1,697 trauma victims admitted to Imam Khomeini hospital in Urmia, Iran, during 2016. The data, including systolic pressure, Glasgow Coma Scale, respiratory rate prior to admittance, severity of injuries based on surgery description, limbs and brain computed tomography scan, and diagnostic ultrasound by a specialist, were collected from medical records. The survival chance of patients was estimated using Trauma and Injury Severity Score (TRISS). To evaluate the quality of hospital service, Z and W statistics were utilized.

Results: Out of 1,697 admitted victims, 1,226 (72.3%) and 471 (27.7%) subjects were male and female, respectively. The patients were within the age range of 15-54 years, including 901 (75%) male and 296 (25%) female subjects. The predominant educational levels were under diploma and illiterate in male and female patients, respectively. The mean values of the Revised Trauma Score for the recovered and deceased patients were 7.75 ± 0.38 and 6.19 ± 1.59 , respectively; however, the mean values of the Injury Severity Score for the recovered and deceased patients were 14.57 ± 13.72 and 52.03 ± 27.02 , respectively, indicating a statistically significant difference between the two groups. The number of observed mortalities was 69; nevertheless, the expected mortalities were 60 cases. Furthermore, the quantified W and Z statistics were -9 and 0.02, respectively.

Conclusion: The results showed that the observed mortality exceeded the expected mortality indicating the low quality of hospital care.

Keywords: Car crashes, Iran, TRISS

1. Background

Human health has been threatened by many hazardous events. Vehicle collision or car crash is one of the pervasive events putting human health at risk. Mortality due to traffic-related injuries is a public health concern in many countries, particularly in low-income countries (1-3). According to the World Health Organization's annual report, 1.24 million people (18 in every 100,000 individuals) lose their lives due to roadway crashes, and over 50 million individuals are reported with injury or disability. In Asia, car crashes annually cause 400,000 mortalities and over 4 million injuries. The casualties could reach 1.9 million if neglected. Additionally, over 90% of the mortalities happen in the low-income countries of Africa and Eastern Mediterranean region (4-6).

In Iran, traffic-related injuries are the most prevalent injuries and second cause of mortality (7, 8). In the last decade, the national mortality rate was 30 in every 100,000 vehicles; however, the average rates of the world and Eastern Mediterranean region were 22.6 and 13.9 in 100,000 vehicles, respectively (9, 10). In comparison to other countries, the highest

mortality rate and burden of disease are accounted for in Iran. The average number of mortalities is 3 per 10,000 vehicles worldwide, which is estimated at 7.3 in Iran (11).

Traffic-related injuries are regarded as predictable events and global major public health challenges. Every day, 30,000 traffic-related injuries and 3,000 mortalities occur around the world. In a study carried out by Soori et al., it was reported that traffic accidents are responsible for 37.5% of unintentional injuries and the first cause of mortality in the rural areas of Iran (10). As a longstanding key part of pre-hospital triage, the scoring method of traumatic patients has been used to predict early mortality and assist physicians in the patient examination for the provision of proper care. Using the scoring method in pre-admittance proceedings can play an important role in injury mitigation. Improper classification of trauma victims due to the lack of suitable trauma assessment systems could bring irreversible outcomes for patients and might increase the mortality rate (12, 13).

The application of survival predictors, such as Trauma and Injury Severity Score (TRISS), Injury Severity Score (ISS), and Revised Trauma Score

(RTS), for traffic injury victims has currently become a common practice. Using a standard and appropriate treatment, which plays the primary role in the mortality reduction of trauma patients, has become a matter of interest in recent years. Studies have demonstrated that the lack of appropriate treatment is responsible for 50% of patient mortalities. The presence of well-equipped centers could lead to a 30% decline in the mortality of trauma patients. The results of a study showed that the presence of equipped centers and their proper measures could reduce the mortality rate from 30% to 9%. The third phase of mortality in trauma patients occurs within 1-30 days after trauma and approximately 10-20% of mortalities take place in this period (14, 15).

The scoring for the prediction of results can be categorized into three groups of anatomy scores, physiological scores, and combination of the two (16). Survival is the primary purpose of treating severe trauma patients. The secondary purposes include quick recovery, avoiding organ failure, and finally attaining optimal quality of life (15). The Major Trauma Outcome Study (MTOS) was a retrospective study conducted by the American College of Surgeons in 1982 to predict the outcomes of large traumas in several trauma centers (17). To evaluate injury severity and quality of hospital care provided to car accident patients, different systems, such as A Severity Characterization of Trauma, ISS, RTS, and Abbreviated Injury Scale (AIS), are available. The TRISS uses a combination of other systems; therefore, it is more applicable and preferred in developing countries (18, 19). The TRISS is one of the credible systems for the assessment of hospital service quality and determination of the expected survival. The TRISS is comprised of three items, namely physiologic score or RTS, anatomic score or ISS, and age (17, 20).

In a study carried out by Deshmukh et al. (21) in India, it was observed that the number of mortalities is five cases greater than the results of the MTOS. The studies conducted by Esmaili et al. (22) and Khosravi et al. (23) showed seven and four mortalities higher than the MTOS findings, respectively. All of the aforementioned studies associated the low quality of hospital services with a high number of mortalities (24-26). Although multiple studies investigated traffic-related injuries in Iran, fewer studies were associated with hospital service quality and survival of car accident victims (15, 23).

2. Objectives

The current study aimed to assess the survival and quality of hospital care in patients with traffic injuries in Eastern Azerbaijan, Iran.

3. Methods

This cross-sectional study, with descriptive-analytical objectives, was conducted using the data of car victims admitted to Imam Khomeini hospital in Urmia, Iran, within January 1 to December 30, 2016. The data were obtained from the patient files in the Medical Records Department of the hospital. The data inclusion criteria were traffic-related injury, at least 3-month of residency in the affiliated cities of Eastern Azerbaijan province before the accident, survival until admittance, registration of the patient data in the hospital trauma system, and diagnosis of at least one injury in the patient. A total of 2,015 individuals were selected based on the inclusion criteria, 1,750 of whom had a history of intensive care unit (ICU) referral, transfer from other cities, and traumas of head, abdomen, and face. Ultimately, out of 1,750 cases, 1,697 patients were available for survival analysis.

The data collection form was comprised of demographic variables (i.e., age, gender, educational level, occupation, and location), traffic accident variables (i.e., location of the accident, patient condition, accident location, transfer to the surgery room, ICU referral, mechanism of injury, and bump on the head), and TRISS indices. Survival prediction systems include TRISS, RTS, and ISS. The ISS is an anatomy score used for the prediction of non-fatal outcomes in patients with several injuries. The RTS physiologic score is utilized for the prediction of post-incident mortality. The TRISS is a combination of the RTS, ISS, and age, as a predictor, to assess survival rate after the bump. The TRISS evaluation method is carried out based on the physiologic criteria outlined in Table 1.

The ISS system underwent some modifications since the development. To evaluate the severity of injury using the ISS, the body is divided into six regions, including head and neck, face, chest, abdomen, extremities (e.g., pelvis), and externals (27-31). Injuries, based on severity, are ranked on a six-point scale (minor, moderate, serious, severe, critical, and maximal). For the calculation of the ISS, the injured organ is initially scored by the AIS. Then,

Table 1. Classification of Revised Trauma Score based on variables

Glasgow Coma Scale	Systolic blood pressure	Respiratory rate	Class
3	0	0	0
4-5	1-49	1-5	1
6-8	50-75	6-9	2
9-12	76-89	10-29	3
13-15	>89	>29	4

three injuries with the highest AIS scores are selected. Subsequently, the chosen injuries are squared and summed ($ISS=x^2 + y^2 + z^2$). The minimum and maximum ISS scores are 3 ($1^2 + 1^2 + 1^2$) and 75 ($5^2 + 5^2 + 5^2$), respectively. The ISS score ranges from 0 to 75 and increases with the severity of the injury.

The RTS is a physiologic assessment index designed to predict mortality caused by trauma with five independent variables of the Glasgow Coma Scale (GCS), respiratory rate (RR), systolic blood pressure (SBP), chest dilation, and capillary refill. The RTS score is within the range of 0-12. A low RTS value accounts for higher severity of injury to patients. The RTS scoring system has the highest validity and influence on the prognosis of patients with a concussion (15, 32, 33). The RTS is also used in triage. Therefore, a logistic regression analysis model was presented to predict the outcome of the injury in patients based on the RTS. In this model, the RTS value is calculated as follows:

$$(1) \text{RTS} = 0.2908 (\text{RR}) + 0.7326 (\text{SBP}) + 0.9368 (\text{GCS})$$

The RTS ranges from 0 to 7.84. Moreover, the RTS value is determined by the inclusion of the three measured indices in the model. Using the RTS, the survival chance of the patients can be measured according to the following formula:

$$(2) P = 1 / (1 + e^{-\text{RTS} \times 3 / 5718})$$

To assess the probability of survival in patients younger than 15 years, equation 3 is used as follows:

$$(3) \text{Logit} = -0.4499 + 0.8085 (\text{RTS}) + 0.0835 (\text{ISS}) + 1.7430 (\text{age point})$$

Equation 4 is employed for other age groups. In any condition, the survival percentage is determined based on equation 5.

$$(4) \text{Logit} = -2.5355 + 0.9934 (\text{RTS}) + 0.0651 (\text{ISS}) + 1.1360 (\text{age point})$$

$$(5) P(S) = 1 / (1 + e^{\text{logit}})$$

The number of expected mortalities in TRISS is determined by the number of patients with an estimated survival chance of < 50%.

To evaluate the quality of hospital services, Z and W statistics were measured using the following formulas:

$$(6) \text{Z-statistic} = \frac{\text{observed death} - \text{Expected death}}{\sqrt{\text{Expected death} - \text{Expected alive}}}$$

$$(7) \text{W-statistic} = \frac{\text{Observed alive} - \text{Expected alive} \times 1000}{\text{rate patients}}$$

Then, the obtained findings were compared to the results of the MTOS. A Z-statistic value within the range of -1.96/+1.96 indicated that no significant difference can be observed between the results of the current study and those of the MTOS (34). The TRISS was assessed using an online calculation tool at the trauma website (<http://www.trauma.org>). The Kolmogorov-Smirnov test was conducted to check the normal distribution of the data. The SPSS software (version 16) was used to analyze the data.

4. Results

The results of the present study showed that out of 1,697 hospitalized victims, 1,226 (72.3%) and 471 (27.7%) subjects were male and female, respectively. Both genders were within the age range of 15-54 years, including 901 (75%) male and 296 (25%) female patients. The educational levels of the patients were under diploma and illiterate in male and female subjects, respectively. The patients were mostly self-employed and housewives. Urban areas and streets in particular (Table 2) were the most frequent accident locations among the patients (male: 1,208 [79%]; female: 314 [21%]). The majority of the male (n=366; 71%) and female (n=286, 49%) victims were pedestrians and passengers, respectively. The most frequent accident locations for males (n=542; 73%) and females (n=212; 31%) were in the city and roads between cities, respectively. Most of the patients in both genders were not transferred to the ICU and had blunt trauma and head injury. The majority of male victims underwent surgeries but not the female subjects (Table 3).

Table 2. Absolute and relative frequency of demographic characteristics in car crash victims

Variable	Male frequency n (%)	Female frequency n (%)
Age (year)	0-14	147 (61)
	15-54	901 (75)
	54<	178 (67)
Educational level	Illiterate	213 (53)
	Under diploma	608 (77)
	Diploma	294 (82)
	Associate's degree	31 (79)
	Bachelor's degree	80 (69)
Occupation	Unemployed and farmer	69 (97)
	Self-employed and housewife	592 (61)
	Retired and student	61 (82)
	Employee and others	319 (93)
	Student and child	185 (66)
Living location	City	850 (71)
	Village	376 (72)
Gender	1,226 (72.3)	471 (27.7)

The observed mortalities were 69, which were 9 cases higher than the expected deaths (n=60). The W and Z statistics were reported as 9 and 0.02, respectively (Figure 1).

The GCS level was within the range of 0-3 in 4

recovered and 20 deceased patients. The maximum RR values in both recovered and deceased groups were within the range of 10-29. The SBP in the recovered and deceased groups was reported as higher than 89 mmHg (Table 4). The mean values of

Table 3. Absolute and relative frequency distribution of car crash victims

Variable		Male frequency n (%)	Female frequency n (%)
Accident location	Highway	18 (77)	4 (23)
	Freeway	281 (66)	139 (34)
	Alley	21 (63)	12 (37)
	Street	1,208 (79)	314 (21)
Position of the injured	Pedestrian	366 (71)	146 (29)
	Cyclist	26 (92)	2 (8)
	Motorcyclist	198 (96)	8 (4)
	Driver	327 (91)	30 (9)
Accident location	Passenger	307 (51)	286 (49)
	In the city	542 (73)	196 (27)
	Between two cities	479 (69)	212 (31)
Intensive care unit referral	Village	205 (77)	61 (33)
	Yes	230 (85)	37 (15)
Surgery room	No	1,013 (71)	412 (29)
	Yes	748 (78)	208 (22)
Mechanism of accident	No	478 (64)	262 (36)
	Penetrating	113 (77)	33 (23)
Concussion	Blunt	1,113 (71)	438 (29)
	Yes	716 (72)	289 (28)
	No	457 (71)	182 (29)

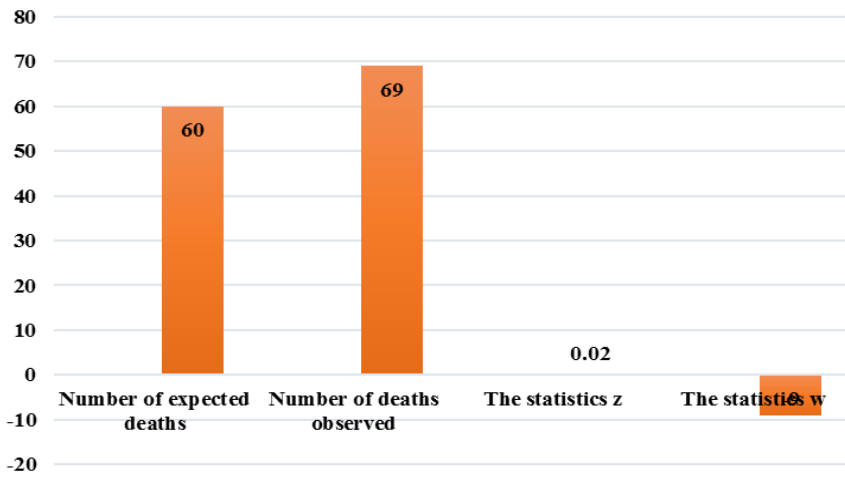


Figure 1. Number of observed and expected mortalities in car crash victims admitted to Imam Khomeini hospital of Urmia, Iran

Table 4. Absolute and relative frequency distribution of Trauma and Injury Severity Score qualitative indices in car crash patients

Variable		Recovered n (%)	Deceased n (%)
Glasgow Coma Scale	0-3	4 (0.2)	20 (29.0)
	5-4	7 (0.4)	7 (10.1)
	8-6	24 (1.5)	13 (18.8)
	12-9	36 (2.2)	4 (5.8)
	15-13	1,554 (95.5)	25 (36.3)
Respiratory rate	1-5	1 (0.1)	0
	9-6	2 (0.1)	2 (2.9)
	10-29	1,619 (99.6)	65 (94.2)
	29<	4 (0.2)	2 (2.9)
Systolic blood pressure	1-49	7 (0.4)	0
	50-75	2 (0.1)	2 (2.9)
	89-76	21 (1.3)	6 (8.7)
	89<	1,598 (98.2)	61 (88.4)

Table 5. Mean comparison of Trauma and Injury Severity Score quantitative indices in car crash patients

Variable	Recovered Mean±standard deviation	Deceased Mean±standard deviation	P-value
Revised Trauma Score	7.75±0.38	6.19±1.59	0.001
Injury Severity Score	14.57±13.72	52.03±27.02	0.001

the RTS in the survived and deceased patients were 7.75 ± 0.38 and 6.19 ± 1.59 , respectively. The mean scores of the ISS in the survived and deceased patients were 14.57 ± 13.72 and 52.03 ± 27.02 , respectively, indicating a statistically significant difference between the recovered and deceased groups (Table 5).

5. Discussion

In developed countries, TRISS is used as a qualitative measure to assess the injury and survival chances of trauma patients. The developing countries are no exception in this regard, as some studies were also conducted in such countries (23, 35-37). The findings of the aforementioned studies showed that the observed mortalities were higher than the expected mortalities. Deshmukh et al. (21) estimated expected mortalities at 15%; however, they reported observed mortalities as 33%. The W-statistic value showed nine mortalities higher than that of the MTOS. Compared to the MTOS value, the Z-statistic value in the present study demonstrated no statistically significant difference between the deceased and recovered patients. It has been noticed that the rate of mortalities caused by accidents was associated with the quality of hospital services. In this regard, the results of the current study are consistent with other investigations (15, 22, 23). The measured indices explain the role of immediate service provision for the victims and hospital service quality in the survival and recovery of traffic accident patients.

Esmaili et al. (22) quantified the respective Z and W statistics of +0.02 and -7, respectively. In their study, more patients died in comparison to the MTOS, which was explained by poor hospital service quality. In this study, 72.3% of the patients were male, with the female to male ratio of 1:4, which is consistent with the results of studies by Sing et al. (12) and Akbari et al. (38). This might be due to the cultural circumstances constraining women from driving.

Most of the patients in the present survey were within the age range of 15-54 years. It is highlighted that the mortality rate in the elderly, regardless of injury severity, is 2 to 3 times higher than those reported for other age groups. Only 15.4% of the total patients of this study were older than 55 years (39). This might be due to the population structure of the region, which is predominantly young, and greater involvement of young age groups in traffic-related activities. This finding also demonstrated that young and middle-aged individuals are at high risk of injury

or death, thereby indicating the necessity of interventional plans. The educational levels of most male and female patients were under diploma and illiterate, respectively. The patients were mostly included in the category of self-employed and housewife, which is in line with the results of studies conducted by Khorami et al. (40), Khatibi et al. (41), and Ahadi et al. (42).

Esmaili et al. (22) have reported the mean values of ISS as 12.4 ± 4.3 and 36.9 ± 8.9 in the recovered and deceased patients, respectively. In addition, they calculated the mean values of the RTS at 7.19 ± 0.93 and 4.35 ± 0.74 in the recovered and deceased subjects, respectively. In the current study, the RTS mean score of the deceased patients was lower than that of the recovered subjects; however, the ISS mean value of the deceased patients was higher than that of the recovered subjects. These results are confirmed by the findings of studies by Chan et al. (43) and Chaudhry et al. (44). Out of 69 deceased patients, 61 individuals had an ISS value of higher than 20. The patients with high ISS scores are at a higher probability of mortality. Moreover, a high ISS score combined with several body injuries, provided that RTS is lower than 5, increases the chance of death in patients. These findings are in line with the findings of studies by Saidi et al. (45), Akhavan Akbari et al. (38), and Pafarther et al. (46).

In the MTOS, to determine the severity of the injury, especially in deceased patients, necroscopic methods were applied as accurate techniques for ISS determination. However, the necroscopic data are not available in Iran due to cultural issues generating diagnostic bias, particularly in patients undergoing fewer diagnostic measures as the result of sudden death. To reduce the bias, the patient group was selected from the ICU, Surgery, Neurosurgery, and Orthopedic wards, and those who died in the Emergency Ward were excluded from the study.

In developed countries, most victims with severe and deadly lesions were hospitalized alive due to on-site medical care; nevertheless, in developing countries, most of such patients do not survive to reach the hospital. Therefore, in studies of developing countries, the cases that died in the emergency department were omitted from trauma outcome assessment (47). However, in this regard, the results of a study showed that the implementation of Advanced Trauma Life Support can be significantly effective in the determination of fate and outcome of trauma patients. The emphasis of the aforementioned study was on the immediate on-site treatment of the victims and given the necessity transfer to a trauma

center. Following this plan, the mortality rate has dropped from 63.3% to 29.4% (48).

The majority of the victims were pedestrians in males and passengers in females. This is acknowledged by the findings of studies conducted by Asura et al. (49), Ahadi et al. (42), and Saidi et al. (45). The accidents mostly occurred within the city. Furthermore, 16% and 56% of the victims were transferred to specialty wards and surgery rooms, respectively (45, 49, 50). A large number of patients were injured with blunt trauma and bump on the head (15, 51).

One of the strengths of this study was a large sample size in the comprehensive trauma center. Misregistration and incomplete data entry in some records and lack of proper cooperation of some patients were considered the restricting factors in following the survival status. A TRISS study also reflects the quality of hospital services provided for car crash victims. Therefore, it is recommended to carry out periodic surveys to gain knowledge about the quality status of hospital services. If the results of TRISS would be lower than those of the MTOS, the quality of hospital services might require promotion programs, such as educational plans and organization of cardiopulmonary resuscitation and trauma surgery teams.

6. Conclusion

In this study, the survival reducing factors included male gender, educational level of under diploma, self-employment and being housewife, urban areas and city streets, being a passenger, blunt trauma, bump on the head, surgery, and low GCS value. Given the TRISS estimate, the hospital care quality in the present study was lower than that reported for the MTOS.

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Footnotes

Authors' Contribution: Omid Garkaz (first author): senior researcher (20%); Sahar Paryab (second author): discussion of the manuscript (20%); Hamid Reza Mehryar, (third author): assistant researcher (15%); Hamid Reza Khalkhali (fourth author): statistical analysis (20%); Shaker Salari Lak (fifth author): writer of methodology and discussion of the manuscript (25%)

Conflict of Interests: The authors declare that

there is no conflict of interest.

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