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Assessment of Survival and Hospital Care Quality in Patients with Traffic Injury in East Azerbaijan

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Abstract

Background: Traffic events are the second most common cause of mortality and the first cause of years of life lost (YLL) in Iran.
Objectives: The aim of this study was to determine the survival of patients with traffic injury and evaluate hospital care quality using the trauma and injury severity score (TRISS) method.
Methods: This cross-sectional study was conducted on 1000 patients aged 1 to 89 years old who were hospitalized in two university hospitals in East Azerbaijan, Iran. Patients were selected by using stratified sampling. Data were extracted from medical records and analyzed by STATA11 software. Injury severity score (ISS), revised trauma score (RTS), and expected survival were calculated using the TRISS software package. W-scores and Z-scores were calculated to evaluate the performance of hospitals. Finally, results were compared to those of the major trauma outcome study (MTOS).
Results: Among 1000 patients, 246 (24.6%) were female. The mean age was 32.6 years (SD, 18.6). Mean ISS for living patients was 12.4 (SD, 4.3) while it was 36.9 (SD, 8.9) for fatal cases. The average RTS was reported to be 7.1 and 4.35 for alive and fatal cases, respectively ($P < 0.001$). Based on TRISS, 58 cases were expected to result in death; however, 65 fatalities were observed (65/1000). The W-score was -7 per 1000 and Z-score was + 0.02. The TRISS misclassification rate for survival status of patients with traffic injury was reported as 2.6%.
Conclusions: Our findings indicate that the quality of care at the hospitals under study using the TRISS method was lower than the quality of care in the MTOS study. Further, survival of traffic injury patients was clearly influenced by the quality of hospital services provided.

Keywords: TRISS, Care Quality of Hospital, Traffic Injuries, Eastern Azerbaijan, Iran

1. Background

Throughout history, accidents have been considered a threat to human health. Traffic injury and trauma are the third most common cause of mortality and the second leading cause of disability in all age groups (1, 2). The world health organization (WHO) has predicted that by 2020 deaths due to traffic injury will increase to 2.34 million per year (3). Currently, traffic injuries kill 1.24 million people in the world annually and an additional 20 - 50 million people receive disabling injuries; 60% of them are in the age group of 14 - 45 years (4). In Iran compared to developed countries, traffic injury is the second leading cause of mortality and the leading cause of years of life lost (YLL) (5). It is estimated that 0.8 million people need emergency and medical care every year in Iran due to traffic injury (6). Traffic injury alone reduces annual GDP by 1% to 15% in developing countries (7). In Iran, the average cost of traffic fatalities is US$67,000 and the average cost of one permanent disability is US$100,000 (8). According to the Iran ministry of health, 320,000 cases were referred to hospitals in 2014 due to traffic injury, of which 5.7% died (9). In East Azerbaijan, 2000 total injury deaths were recorded in 2010, of which 60% were due to traffic injury (10).

One important factor affecting survival of patients with traffic injury is type and quality of hospital services. Accident and injury records provide informative data to monitor and evaluate the performance of health care systems. Using a reliable and valid system to assess the severity of injury and analyze survival rates plays an important role in determining survival and prognosis of traffic injury and health status (11). Different systems exist to evaluate severity of injury, including the abbreviated injury scale (AIS), injury severity score (ISS), revised trauma score (RTS), and trauma and injury severity score (TRISS) (12-14). De-

veloped countries use TRISS more than other methods because it is a combination of all methods and it also resolves the limitations of previous methods. In addition to determining the severity of the injury, this method can evaluate hospital care quality (15, 16) TRISS uses three criteria including anatomic (ISS), physiologic (RTS), and age criteria (17-19).

Deshmukh et al. (20) studied traffic injuries in India and the number of surviving patients was 5 fewer than in the MTOS study, showing the low quality of health care provided for injured people In Iran, Khosravi and Ebrahimi (21) conducted a study on traffic injury in Shahroods' Imam Hussein hospital; results showed that the number of surviving patients was 4 fewer than in the MTOS study. This also indicates that hospital care quality is lower Although several studies are available on the mortality rate of traffic injuries in Iran (22-25), very few studies have investigated survival of traffic injury and quality of hospital services using the TRISS method (11, 21).

2. Objectives

The aim of this study was to determine the survival rate of hospitalized patients with traffic injury and evaluate hospital care quality through TRISS method in East Azerbaijan university hospitals.

3. Methods

3.1. Study Design and Sampling

A cross-sectional study was conducted with 1000 patients with traffic injuries admitted during 2012 to two university governmental and referral hospitals in Tabriz, Iran. These two hospitals receive almost all crash and traffic injuries. Of a total of 7000 V-code records from the two referral hospitals, 1820 records were selected based on the inclusion criteria (described below) and 820 records were withdrawn based on the exclusion criteria. Finally, 1000 records were included in the study, 600 patients from Imam Reza hospital and 400 cases from Shohada hospital, using stratified sampling. In each hospital, records were selected randomly. Considering a confidence level of 95%, P = 0.1, d = 0.02, and design effect (DF) was 1.15 for the sample size (1000 subjects).

Inclusion criteria were as follows: patients with any codes of international classification of diseases including V01 - V04, V10 - V14, V20 - V24, V30 - V34, V40 - V44, V50 - V54, V60 - V64, and V70 - V74, age group 1 - 89 years, injury of more than one part of the body, residency in one of the districts of the province of East Azerbaijan for at least a month, traffic injuries with any vehicle, including cars, trucks, public transport, bicycle, and motorcycle, as well as pedestrian, in street, roads, vehicle collisions with any objects, overturning the vehicle, and alive patient at admission. Exclusion criteria were non-traffic accidents, patients of airplane crash, patients who died in the emergency room, outpatient cases, and incomplete records.

3.2. Evaluation of TRISS

TRISS is a quantity scale for estimating survival of patients with injury; it includes three scores for ISS, RTS, and patients' age characteristics. RTS using the Glasgow coma scale (GCS), respiratory rate (RR), and blood pressure (BP) and ISS using anatomic criteria are calculated depending on the location and severity of damage (18) (Table 1). To calculate the ISS, the body is divided into six regions (head, face, chest, abdomen, pelvis, and extremities). Each region is allocated a score from 1 to 6 depending on the severity of injuries. Score 1 represents minor injury and score 6 represents lethal injury. Finally, the three injuries with the highest scores are selected and the sum of the squares is calculated as the ISS. If a body part has a score of 6, ISS will automatically be 75. The ISS ranges from 0 to 75 and increases with increasing severity of injury. RR is qualitatively divided into five categories in which the score 0 represents the worst state and score 4 represents the best case. RTS ranges from 0 to 7.84 and has an inverse relationship to the severity of injury (12).

Table 1. Revised Trauma Elements Score

Class[a]	GCS	SBP	RR
0	3	0	0
1	4 - 5	1 - 49	1 - 5
2	6 - 8	50 - 75	6 - 9
3	9 - 12	76 - 89	> 29
4	13 - 15	> 89	10 - 29

Abbreviations: GCS, Glasgow coma scale; RR, respiratory rate; SBP, systolic blood pressure.
[a]The scoring for each group is selected from the fourth column separately.

3.3 Data Collection and Estimation of Survival

Data were collected using a checklist designed by clinical professors. The checklist included three parts: 1) demographic data, 2) traffic accident characteristic data, and 3) TRISS data. These data were extracted from medical records. To estimate survival, patients were categorized into three age groups, under 15, 15 to 54 years, and 55 years and older. The TRISS formula used to calculate survival in the under-15 group was (log it = - 0.4499 + RTS $\times$ 0.8085 + ISS $\times$ 0.0835 + (age point) $\times$ 1.7430). The formula [(age

point) × 1.1360 + log it = - 2 .5355 + RTS × 0.9934 + ISS × 0.0651] was used for the other age groups. In all items, the patient survival rate is equal to P(S) = 1.1 + e log it. Expected mortality in the TRISS model includes those who have less than a 50% chance of survival. To evaluate the performance of hospitals, W- and Z-scores were calculated, as follows:

$$Z = \frac{Observed \quad death - Expected \quad death}{\sqrt{Expected \quad death - Expected \quad alive}} \quad (1)$$

$$W = \frac{Observed \quad alive - Expected \quad alive}{Total \quad patients} \times 1000 \quad (2)$$

Finally, the results from the present study were compared with those from the MTOS study. The negative W-score indicates that health care is undesirable and reflects a low quality of hospital services. The estimated Z-score was between -1.96 to +1.96, which shows no significant difference between this study and MTOS (21).

3.4. Data Analysis

Data were analyzed using STATA11 and online TRISS (http://www.trianalytics.com; http://www.trauma.org) statistical software packages. Data normality was checked using the Kolmogorov-Smirnov test. Mean and standard deviation were used for data with a normal distribution; otherwise, inter-quartile range (IQR), median, and relative frequencies were used for nominal variables. Chi-square and Mann-Whitney tests were used to investigate the relationship between nominal and classified variables. In all tests, a P value < 0.05 was considered significant.

3.5. Ethical Considerations

This study protocol was approved by the ethics committee of Tabriz University of medical sciences with license No. 5.53.4639. Verbal informed consent was obtained from all participants. In order to protect the privacy of individuals, data were entered into the computer showing only a code rather than the user's profile. We avoided imposing any cost on the participants.

4. Results

Among all 1000 studied patients with traffic injury, 246 (24.6%) were female and 754 (75.4%) were male. Mean age was 32.6 years (SD, 18.6). Of the patients, 70% were in the age group 15 - 54 years, 15% were under 15 years, and 14.9% were over 54 years. The proportion of hospital case fatalities was 65/1000 and 935 patients were discharged alive from the hospital. Most deaths occurred in the age group 15 - 54 years (56.9%). Of the accidents, 52.4% occurred in urban areas. Median (IQR) length of stay was 8 days (9). Car passengers made up 54.7% of the total patients (Table 2).

Table 2. Frequency Distribution of Demographic and Injury Related Characteristics

Variable	Male, No. (%)	Female, No. (%)	Total, No. (%)
Age			
Under 15	89 (11.8)	62 (25.2)	151 (15.1)
15 to 54 years	565 (74.9)	135 (54.9)	700 (70)
55 years and more	100 (13.3)	49 (19.9)	149 (14.9)
Hospital			
Imam Reza	456 (60.5)	144 (58.5)	600 (60)
Shohada	298 (39.5)	102 (41.5)	400 (40)
Discharge			
Alive	708 (93.9)	227 (92.3)	935 (93.5)
Death	46 (6.1)	19 (7.7)	65 (6.5)
Scene of traffic injury			
Highway	27 (3.6)	8 (3.3)	35 (3.5)
Freeway	59 (7.8)	25 (10.2)	84 (8.4)
Main road	167 (22.1)	59 (24)	226 (22.6)
Rural roads	51 (6.8)	15 (6.1)	66 (6.6)
Avenue	395 (52.4)	129 (52.4)	524 (52.4)
Alley	55 (7.3)	10 (4.1)	65 (6.5)
Location of traffic injury			
Pedestrian	97 (12.9)	41 (16.7)	138 (13.8)
Cyclist	27 (3.6)	5 (2)	32 (3.2)
Motorcycles	137 (18.2)	25 (10)	162 (16.2)
Car driver	120 (15.9)	1 (0.4)	121 (12.1)
Car passenger	373 (49.5)	174 (70.7)	547 (54.7)
Mechanism of trauma			
Blunt	707 (93.8)	235 (95.5)	942 (94.2)
Penetrative	47 (6.2)	11 (4.5)	58 (5.8)

Of the patients, 84.2% were categorized in the 13 - 15 GCS range group. Of the deceased patients, 30.8% were in the 5 - 4 GCS range group, while 88.2% of alive patients were in the 13 - 15 GCS range group ($P < 0.001$). For RR, 91.3% of patients were reported in 10 - 29 RR range group: 92.94% of alive patients were in the 10 - 29 RR range group and 32.30% of the deceased patients were in the 10 - 29 RR range group. SBP over 89 was reported for 96.14% of alive patients and 60% of deceased patients. ISS mean for alive patients was 12.6 (SD, 4.8) while it was 36.4 (SD, 8.9) for deceased patients. The average RTS for alive and deceased patients was 7.1 (SD, 0.93) and 4.3 (SD, 0.74), respectively, and this difference was significant ($P < 0.001$) (Tables 3 and 4).

Table 3. TRISS Qualitative Index Distribution

Variable	Death, No. (%)	Live, No. (%)	P Value
GCS			0.001
3	4 (6.15)	8 (0.85)	
4 - 5	20 (30.76)	18 (1.92)	
6 - 8	8 (12.30)	32 (3.42)	
9 - 12	16 (24.61)	52 (5.56)	
13 - 15	17 (26.15)	825 (88.23)	
RR			0.001
1 - 5	15 (23.07)	15 (1.60)	
6 - 9	20 (30.76)	18 (1.92)	
> 29	9 (13.10)	40 (4.27)	
10 - 29	21 (32.30)	862 (92.19)	
SBP			0.001
1 - 49	2 (3.07)	3 (0.32)	
50 - 75	19 (29.23)	16 (1.71)	
76 - 89	5 (7.69)	17 (1.81)	
> 89	39 (60)	899 (96.14)	

Abbreviations: GCS, Glasgow coma scale; RR, respiratory rate; SBP, systolic blood pressure.

Table 4. TRISS Quantitative Index Distribution

Variable	Death, Mean (SD)	Alive, Mean (SD)	P Value
RTS	4.35 (0.74)	7.19 (0.93)	0.001
ISS	36.4 (8.9)	12.6 (4.8)	0.001

Abbreviations: ISS, injury severity score; RTS, revised trauma score.

The calculated survival using TRISS for alive patients was 97.07 (SD, 6.3) while it was 52.04 (SD, 16.5) for deceased patients. The number of expected deaths estimated by TRISS was 58 while the number of observed deaths was 65. The W-score was calculated to be -7 per 1000 and the Z-score was +0.02. The expected and observed deaths for Imam Reza Hospital were 43 and 48, respectively. The Z-score was 0.032 and W-score was -8.3 and the expected deaths were calculated to be 15 and observed deaths were 17 for Shohada hospital. The W-score was -5 and Z-score was reported as +0.02 (Table 5). The TRISS misclassification rate for survival status of patients with traffic injury was reported as 2.6%.

5. Discussion

The results of the present study showed that observed deaths have a slightly higher frequency than expected deaths. Deshmukh et al. (20) reported expected deaths to be 15% while observed death was 33% The W-score indicated that for every 1000 hospitalized patients with traffic injury in East Azerbaijan province, there were 7 fewer survivals than shown by MTOS. Z-scores showed no significant difference between the patients in this study patients and those in MTOS. In Imam Reza hospital, for every 1000 patients with traffic injury an average of 8 fewer patients survived than in MTOS, and in Shohada hospital, for every 1000 patients with traffic injury, 5 fewer patients survived than MTOS. Z-statistic showed no significant difference among deceased and recovered patients compared to MTOS. According to the results of this study, traffic injury mortality is clearly affected by the quality of hospital services provided, which is in line with similar results reported in various studies (11, 26-30)

Singh et al. (30) studied traffic injury patients and reported Z-scores and W-scores of -3.95 and -5.34, respectively. In this study patients died more frequently than in MTOS, which was due to the low quality of provided hospital services.

In this study, RTS mean reported for deceased patients was 4.35 (SD, 0.73) while it was 7.19 (SD, 0.93) for recovered patients. ISS mean was 36.4 (SD, 8.9) for deceased patients and 12.6 (SD, 4.8) for recovered patients. Comparing ISS and RTS means in deceased and recovered patients showed a statistically significant difference between the two groups, with RTS mean significantly lower in deceased patients than in recovered patients and ISS mean higher in deceased patients than in recovered patients. The results of all studies in this field showed a direct relationship between ISS and injury severity and an inverse relationship between RTS and injury severity (31-33)

Norouzi et al. (11) conducted a study on traffic-injured patients in Ardebil in which RTS mean for deceased patients was 5.29 and 7.62 for recovered patients. Also, ISS mean was 29.65 in deceased patients and 13.98 in recovered patients.

In this study, the means age of patients was 18.66 years (SD, 3.62). Of the patients, 70% were in the 15 - 54 age range, representing the most productive age groups in society. Other study results support our study results (34-36). Of the patients, 24.6% were female and the male to female ratio was 3.06:1 (37, 38). This result is reasonable based on the cultural conditions of women and their limited activities in transportation. Akhavan Akbari reported a male to female ratio of 4.3 (38).

The order of frequency of injury mechanisms leading to hospitalization in the present study was car occupants, motorcyclists, and then pedestrians. In a study by Fannyan et al., 35.4% of traffic injuries were to car occupants and 12.3% were to motorcyclists.

Table 5. Observed and Expected Death Frequency

Variables	Observed Death, No. (%)	Expected Death, No. (%)	W-Score	Z-Score
Hospitals				
Imam Reza	48 (8)	43 (5.7)	- 8.3	+ 0.03
Shohada	17 (4.3)	15 (3.8)	- 5	+ 0.02
Total	65 (6.5)	58 (5.8)	- 7	+ 0.02

5.1. Conclusion

Based on the findings of this study, quality of care at the hospitals under study as determined using the TRISS method was lower than the quality of care in the MTOS study and survival of traffic injury patients was clearly influenced by the quality of hospital services provided.

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