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Risk Factors of Mortality following Road Accident in Southern Iran

Vahid Rahmanian [1], Narges Rahmanian [1], Razieh Zahedi [2 *], Elham Mansoorian [1], Hekmatollah Khoubfekr [3]

[1] Research Center for Social Determinants of Health, Jahrom University of Medical Sciences, Jahrom, Iran
[2] Research Center for Noncommunicable Diseases, Jahrom University of Medical Sciences, Jahrom, Iran
[3] Iranshahr Health Services, Iranshahr University of Medical Sciences, Iranshahr, Iran

*** Corresponding Author:** Razihe Zahedi, Research Center for Noncommunicable Diseases, Jahrom University of Medical Sciences, Jahrom, Iran. **Email:** zahedi_razieh@yahoo.com

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Abstract

Background: Traffic accidents are among the main causes of death and disability in the world.
Objectives: This study aimed to determine the predictors of mortality in patients injured due to traffic accidents, in southern Iran.
Methods: This cross-sectional study was conducted on 1793 road accident patients referred to Imam Hassan Trauma Hospital. Data were retrospectively collected from medical records over a period of 12 months from March 2018 to February 2019. The data were analyzed using STATA software (version 16.0).
Results: A total 1745 patients (97.4%) survived and 47 (2.6%) patients died. The average age of those who survived and those who died were 27.2±0.4 and 25.6± 2.2 years, respectively (p value=0.7). There was no significant relationship between gender and hospital mortality (p=0.19). According to the results, 38.8% of cases died from motorcycle accidents (p value=0.003). Suburban road accidents 2.6 (95%CI: 1.4, 4.8), Alcohol use 2.4 (95%CI:1.3, 4.3), pedestrian injuries 3.2 (95%CI:1.5, 6.8), head and neck injury 45.8 (6.3, 333.1) as well as thoracic injuries 22.6 (95%CI:6.9, 72.9), Abdominal injuries 6.2 (95%CI 3.2, 11.9), Vertebral injuries 9.3 (95%CI: 4.3, 19.9), extremity injuries 4.3 (95%CI:1.9, 9.7), abnormal of creatinine 4.1 (95%CI: 1.01, 16.4) respectively. ISS 20.32(95%CI: 4.85, 96.26), and GCS 1871.5 (95%CI: 250.6, 13975.8), were associated with hospital mortality in road accident patients. The Multivariate analysis shows that ISS≥16 and GCS score≤8, could predict the probability of death in road accident patients.
Conclusion: In summary, suburban roads, alcohol use, ISS≥16, GCS≤8, head and neck injury, thoracic injury, abdominal injury, vertebral injury, extremity injury and abnormal creatinine were independently associated with hospital mortality in injured patients.

Keywords: Hospital mortality, Injury severity score, Accidents; Iran.

Introduction

Injuries, as predictable and preventable events, are considered as the most important public health challenges and impose a heavy economic burden on the society, especially in developing countries.[1,2]

Road accidents are the leading cause of death in injuries, and annually about 1.2 million people are killed in the world and 20 to 50 million people are injured and disabled.[3] In the United States, more than 50 million patients receive medical care for injuries annually, and injury accounts for approximately 30 percent of all intensive care unit admissions.[4]

According to statistics of the World Health Organization (WHO), road traffic mortalities decreased by 30% between 2000 and 2020 in high-income countries, but increased significantly in low-income or middle-income countries.[5]

Low- and middle-income countries account for 84% of the world's population and 53% of vehicles[4,6] Also, 90% of deaths due to traffic accidents occur in these countries, which is twice as much compared to high-income countries.[7]

The death from traffic accidents in worldwide, the European Region, and the Eastern Mediterranean region of the WHO are 19, 17.4, and 26.4 per 100 000, respectively,[8]

Iran is among the top five countries with the highest road traffic death rates (39 per 100,000 population) in the world.[9,10] After coronary heart disease, traffic accidents are cosidered the third cause of mortality in Iran.[11] On the other hand, the amount of damage caused by traffic accidents in Iran is more than 600 billion dollars, which accounts for 6.4% of gross national income.[12]

Patients with traumatic injuries have a significantly lower likelihood of mortality or morbidity (10.4%versus 13.8%; relative risk (RR) 0.75, 95% CI 0.60-0.95) when treated at a designated trauma center. Older age, obesity, and major

comorbidities are associated with worse outcomes following trauma. In trauma patients with significant hemorrhage, a lower Glasgow coma score and older age are both independently associated with increased mortality.[5]

Other study showed that male drivers (OR (odds ratio), 5.48) not wearing seat belts (OR, 5.07), pedestrian error (OR, 2.66), weekend events (OR, 3.62), and driving between 8:00 AM and 23:59 PM (OR, 11.68) were risk factors for mortality in traffic accidents.[13] In a review study, head trauma was reported as the most common cause of death or hospitalization.[14] There are a variety of challenges in the management of patients with traumatic injuries. These patients have usually undergone multidisciplinary evaluation, resuscitation and stabilization in the emergency department and possible operative intervention prior to inpatient admission. These patients remain at risk for complications due to unrecognized injuries or related to initial or ongoing management.[15]

Recognizing the risk factors for injuries and deaths in traffic accidents can help improve safety policies and programs.[16] Most of the previous studies have focused on the traffic-related mortality casued by behavioral and environmental factors, while less attention has been paid to the individual and clinical factors.

Objectives

The aim of this study was to determine the predictors of mortality in patients injured in traffic accidents at the Imam Hassan Mojtaba Darab Trauma hospital, with emphasis on individual and clinical factors in southern Iran.

Materials and Methods

Study Design

This cross-sectional study was conducted on 1793 road accident patients based on census method in the Emam Hassan Trauma hospital during 12 months, from March 2018 to February 2019. This referral trauma hospital is a 196-bed governmental teaching hospitals for adult trauma in Darab County. Darab is a county in Fars province, south of Iran, with an estimated population of 210 000, according to the recent national census. The inclusion criteria the present study were all road accident patients who were injured by motor vehicles (including cars, buses and motorcycles) during the study period that were referred to the hospital and had a hospital documentation. Trauma patients with other mechanisms of injury, patients with a hospital stay of less than 24 hours and patients with incomplete documents were excluded.

Data were collected from patients' medical records based on a checklist designed in accordance with the studied variables including age, gender, marital status, type of road, vehicle type, alcohol use, drug use, transportation type, injury profiles, site of injury, Injury Severity Score (ISS), Glasgow Coma Scale (GCS) at the time of entering the emergency department, laboratory data within 24 hours of admission (CBC (complete blood count), BUN (blood urea nitrogen), creatinine, and electrolytes), and patients' outcomes.

Statistical Analysis

The data were analyzed using STATA software (StataCorp, version 16.0). All continuous variables are expressed as mean±standard deviations (SD), and categorical data are presented by frequency and percentage as needed. Pearson chi-square or Fisher exact tests were used to compare the difference in the proportions. Univariate and multivariate logistic regression analyses were performed to identify risk factors of mortality on vehicle accident injuries using the backward method. The results are expressed by odds ratios and 95% confidence interval.

Ethical Consideration

The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Jahrom University of Medical Sciences (Project identification code IR.JUMS.REC.).

Results

This study showed that 1745 patients (97.4%) survived and 47 (2.6%) died from road accident injuries. The mean age (SD) of the survived patients and those who died was 27.2 (0.4) and 25.6 (2.2) years, respectively (P=.7). Of them, 1301 (72.6%) and 492 (27.4%) were male and female, respectively (P=.19). The most death cases belonged to the motorcycle drivers (38.8%; P=.003). The mean length time (SD) of transferring accident cases to the hospital in the survived patients and those who died were 10.3 (0.4) and 15.2 (4.5) minutes, respectively (P=0.10) (Table-1).

The results of univariate analysis showed that suburban roads (2.6 (95% CI, 1.4, 4.8)), alcohol use (2.4 (95% CI,1.3, 4.3)), pedestrians (3.2; 95% CI, 1.5, 6.8)), and head and neck injury (45.8; (CI 95%, 6.3, 333.1)); and thoracic (22.6; (95% CI, 6.9, 72.9)), abdominal (6.2; (95% CI, 3.2, 11.9)), vertebral (9.3; (95% CI, 4.3, 19.9)), and extremities injuries (4.3; (95% CI, 1.9, 9.7)), abnormal creatinine level (4.1; (95% CI, 1.01,

16.4)), ISS(20.32; (95% CI, 4.85, 96.26)), and GCS (1871.5 (95% CI, 250.6, 13975.8)) were associated with hospital mortality in road accident patients (*P*<.05) (Table-2).

A multivariate logistic regression was run by 10 variables that had significant associations with mortality in univariate analysis. The multivariate analysis results demonstrated that by controlling the effect of confounding, mortality in hospital 20.32 times more likely to be associated with ISS≥16 (OR: 20.32, 95% CI: 4.85-96.26) and 1871.5 times in patients with GCS≤8 (OR: 1871.5 , 95%CI: 250.6, 13975.8) (Table-3). The goodness of fit of model was 328.49 (p-value=0.001), which indicated that the model was fitted well with the data.

Table-1. Predictors of hospital mortality in road accident patients.

Variable		Surviving group=1745 (97.4%) N (%)	Non-surviving group=47 (2.6%) N (%)	P-value
Age	16-40	1055(76.2)	30(81.1)	0.71
	40-60	261(18.8)	5(13.5)	
	>60	69(5)	2(5.40)	
Gender	Male	1269(72.7)	31(66)	0.19
	Female	476(27.3)	16(34)	
Marital status	Single	1005(57.6)	33(70.2)	0.06
	Married	739(42.4)	14(29.8)	
Type road	urban	999(57.3)	16(34)	0.001
	suburban	744(42.7)	31(66)	
Vehicle type	pedestrian	205(11.7)	13(27.7)	0.003
	bicycle	165(9.5)	0	
	motorcar	749(42.9)	15(31.9)	
	heavy machinery	68(3.9)	1(2.1)	
	motorcycle	558(32)	18(38.8)	
Alcohol use	Yes	440(25.2)	21(44.7)	0.003
	No	1304(74.8)	26(55.3)	
Drug use	Yes	148 (8.5)	7 (14.9)	0.10
	No	1596 (91.5)	40 (85.1)	
Fasten Seat belt	Yes	266 (15.4)	0 (0)	0.001
	No	1461 (84.6)	45 (100)	
Type of transfer to hospital	EMS	1015 (58.3)	30 (63.8)	0.30
	Personal	726 (41.7)	17 (36.2)	
GCS	≤8	34 (2)	45 (97.8)	<0.0001
	9-12	283 (16.3)	0 (0)	
	13-15	1414 (81.7)	1 (2.2)	
Head and neck injury	Yes	871 (50.1)	46 (97.9)	<0.0001
	No	868 (49.9)	1 (2.1)	
Thoracic injury	Yes	685 (39.4)	44 (93.6)	<0.0001
	No	1054 (60.6)	3 (6.4)	
Abdominal injury	Yes	561 (32.3)	35 (74.5)	<0.0001
	No	1178 (67.7)	12 (25.5)	
Vertebral injury	Yes	599 (34.4)	39 (83)	<0.0001
	No	1140 (65.6)	8 (17)	
Extremities injury	Yes	988 (56.8)	40 (85.1)	<0.0001
	No	751 (43.2)	7 (14.9)	
Hb level	>12	8 (0.5)	0 (0)	0.20
	9-12	118 (6.8)	2 (22.2)	
	<9	1605 (92.7)	7 (77.8)	

Platelet count	<150,000	8 (0.5)	0 (0)	0.90
	150,000-450,000	3 (0.2)	0 (0)	
	>450,000	1720 (99.4)	8 (100)	
BUN	≤24	1721 (99.4)	8 (100)	0.90
	>24	10 (0.6)	0 (0)	
Creatinine	Normal (≤1.5)	1542 (89.1)	6 (66.7)	0.05
	Abnormal (>1.5)	189 (10.9)	3 (33.3)	
Serum Na	Normal (136-145)	267 (15.4)	2 (25)	0.70
	Hyponatremia (Na<136)	1238 (71.5)	5 (62.5)	
	Hypernatremia (Na>145)	226 (13.1)	1 (12.5)	
Serum K	Normal (3.5-5)	583 (33.7)	3 (33.3)	0.90
	Hypokalemia (K<3.5)	1138 (65.7)	6 (66.7)	
	Hyperkalemia (K>5)	10 (0.6)	0	

Table-2. The risk factors could predict the mortality of road accident patients by Univariate logistic regression

Variables		**B Coefficent**	**OR* (95% CI)**	**P-value**
Age		0.007	0.9 (0.9, 1.01)	0.50
Gender(male/female)		0.3	1.4 (0.7, 2.5)	0.30
Marital status (married /single)		0.2	0.8 (0.5, 1.3)	0.40
Type road (Suburban road/interurban road)		-0.9	2.6 (1.4, 4.8)	0.002
Vehicle type	pedestrian	1.2	3.2 (1.5, 6.8)	0.003
	bicycle	-17.3	_____	____
	motorcar	ref	ref	____
	heavy machinery	-0.3	0.7 (0.1, 5.6)	0.80
	motorcycle	0.5	1.6 (0.8, 3.2)	0.20
Alcohol use (No /yes)		-0.9	0.4 (0.2,0.7)	0.003
Drug use (yes /No)		-0.6	0.5 (0.2, 1.2)	0.10
Type of transfer to hospital (EMS /personal)		-0.2	0.8 (0.4, 1.4)	0.40
GCS	≤8	-7.5	1871.5 (250.6, 13975.8)	<0.001
	9-12	-21.5	_____	____
	13-15	ref	ref	____
ISS	0-8	ref	ref	
	9-15	0.42	1.39(0.48-4.47)	0.38
	≥ 16	4.58	20.32(4.85-96.26)	0.002
Head and neck injury (yes /No)		-3.8	45.8 (6.3, 333.1)	<0.001
Thoracic injury (yes /No)		-3.1	22.6 (6.9, 72.9)	<0.001
Abdominal injury (yes /No)		-2.2	6.2 (3.2, 11.9)	<0.001
Vertebral injury (yes /No)		-1.8	9.3 (4.3, 19.9)	<0.001
Extremities injury (yes /No)		-1.5	4.3 (1.9, 9.7)	<0.001
Hb level	>12	ref	ref	0.10
	9-12	15.8	3.9 (0.8, 18.9)	0.09
	<9	17.1	____	
Platelet count		0.005	1.005 (0.9, 1.01)	0.30
BUN		-15.8	____	
Creatinine		1.4	4.1 (1.01, 16.4)	0.04
Serum Na	Normal (136-145)	ref	ref	0.60

	Hyponatremia (Na<136)	-0.6	0.5 (0.1, 2.8)	0.50
	Hypernatremia (Na>145)	-0.5	0.6 (0.01, 6.6)	0.70
Serum K	Normal (3.5-5)	ref	ref	0.60
	Hypokalemia (K<3.5)	0.2	1.02 (0.3, 4.1)	0.90
	Hyperkalemia (K>5)	-15.9	_____	

*: Odds Ratio

Table-3. The risk factors could predict the mortality of road accident patients by multivariable logistic regression

Variables		B Coefficent	OR*(95% CI)	p-value
GCS	≤8	-7.5	1871.5 (250.6, 13975.8)	<0.001
	9-12	-21.5	-	-
	13-15	ref	-	-
ISS	0-8	ref		
	9-15	0.42	-	-
	≥ 16	4.58	20.32(4.85-96.26)	0.002

*: Odds Ratio

Discussion

This study showed that the mortality of the motorcycle drivers was higher than other road accident patients.[1,17] The structure of motorcycles is such that it provides the least amount of protection for its riders, which makes them more exposed to severe injuries. According to a study conducted in Iran, in 8000 cases of trauma in a period of one year in six university-affiliated medical centers, the most injuries of young people were related to injuries caused by motorcycles.[18]

Other results of the present study showed that 27.7% of the patients died and 11.7% of surviving trauma patients were pedestrians. Soori and Ebrahimi in a study in Iran reported that Qom province with 108.81, Gialn 98.98, Zanjan 91.21, Golestan 89.09 and Khorasan Razavi 87.49 per 100,000 people have the highest incidence and Chaharmahal Bakhtiari province with 3.97 per 100,000 people had the lowest rate of pedestrian traffic accidents.[1]

Key risk factors for traffic injuries in pedestrians can be vehicle speed, alcohol consumption by the driver and pedestrian, lack of traffic safety infrastructure for pedestrians, poor road design and inadequate visibility of pedestrians on the road, pedestrians, working, standing on the side of the road, crossing the street and hitting. According to the Global status report on road safety (2018) in Iran, the death rate of pedestrians accounted for more than 28% of the total deaths due to traffic accidents.[2] Other results of this present study showed that 44.7% of the dead and 25.2% of the surviving trauma patients had consumed alcohol. In this study, the results implied that alcohol use increased the risk of death in patients by 2.4 times.

Moreover, the findings showed that most of the victims of road traffic injury were male, which is consistent with studies conducted in cities of Isfahan and Urmia, Nigeria, and Brazil.[19-22] This result is expected considering the risky behaviors of men while riding a motorcycle.

Moreover, our findings showed that about 76.2% and 81.1% of the survivors and non-survivors were 16 to 40 years old. Some studies have also shown that injuries due to motorcycle accidents are more common in younger age group.[23,24] This can be due to noncompliance with the rules, poor driving experience, and risky behaviors, such as speeding, drug and alcohol use.

Moreover, this study showed that the risk factors influencing in-hospital mortality included suburban roads, alcohol use, ISS≥16, GCS≤8, head and neck injuries, thoracic injury, abdominal injury, vertebral injury, extremity injury, and abnormal creatinine. The multivariate logistic regression model showed that ISS≥16 and GCS score ≤ 8 increases the odds of mortality in the hospital by 20.32 and 1871.5 times.

Other studies that examined mortality risks of injured patients confirmed the results of this study.[3,25,26] In terms of GCS ssurviving patients had significantly higher GCS compared to dead patients. This finding consistent with the results of the previous studies on patients with multiple trauma patients.[19-21]

ISS was significantly higher in patients died compared to surviving patients. ISS has estimated the combined effects of the multiply-injured body regions of admitted patients and is based on the Abbreviated Injury Scale (AIS). Other studies

have shown that ISS is one of the predictors of mortality in trauma patients.[3,10,27]

As new findings, our study demonstrated that abnormal level of creatinine (>1.5) is a great risk of in-hospital mortality. However, most trauma studies focused on coagulation laboratory tests and did not consider other laboratory tests, such as renal function or electrolyte imbalance, as death risk factors in patients with trauma.[28,29] Furthermore, the laboratory scale within 24 hours of admission (CBC, BUN, and electrolytes) was not associated with increased mortality in in-hospital patients. However, in a study on the risk of mortality in injured pedestrians in Shahid Rajaee trauma hospital, Shiraz, Iran, it was reported that low hemoglobin level, abnormal BUN level, thrombocytopenia, and hypokalemia were associated with in-hospital mortality.[2]

According to the previous studies, head and extremity injuries occur most commonly in motor vehicle accidents.[2,10] In addition, our results showed that 97.9% of the dead patients in our study had head injury. Furthermore, our results implied a strong association between head injuries and in-hospital mortality (OR, 45.8; CI95%, 6.3, 333.1). On the other hand, 100% of patients who died in this study did not wear seat belts. Ghaem et al, in a study of outcome determinants of injuries in a level 1 trauma center in Southern Iran showed that the odds of mortality were more in patients with head and neck injuries (OR, 7.92; (95% CI, 4.18- 14.99)) than other injuries.[30]

Seat belts restrain the occupant to the seat and prevent the driver's head from hitting the car body. Seat belts reduces the risk of death in front-seat drivers and occupants by 40-50% and in rear-seat occupants by 25%.[5,15] Despite the importance and efficiency of seat belts, its use is low in Iran and most of the developing countries that leads to more head injury. Recent studies have reported the use of seat belts in Iranian cities from 14% to 63%.[4,15,31]

Furthermore, extremities and vertebral injuries were associated with an increased mortality, and there was a linear relationship between these injuries and mortality. This finding is consistent with the results of Joosse et al. study.[32] In the mentioned study, it was reported that hip fractures, minor pelvic fractures, femur fractures, and minor thoracic wall injuries are associated with increased mortality. However, it should be noted that Joosse et al. considered all patients with trauma and only focused on injury profiles.

The limitation of this study was that the variables were selected according to the clinical characteristics and laboratory records of injured road accident patients, and prehospital factors were not included because some of these data were not recorded with sufficient detail. In addition, this was a retrospective study based on the secondary data analysis of hospital resources that have inherent limitations in the use of such information sources due to incomplete registration of files and bad handwriting.

Conclusions

In summary, suburban roads, pedestrians, alcohol use, GCS≤8, head and neck injury, thoracic injury, abdominal injury, vertebral injury, extremity injury, and abnormal creatinine level were independently associated with hospital mortality in injured patients. This finding can help develop successful health policies and supervision in trauma centers to decrease hospital mortality in road accident patients.

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Authors' Contribution

All authors pass the four criteria for authorship contribution based on the International Committee of Medical Journal Editors (ICMJE) recommendations.

Conflict of Interests

The authors declare that there is no conflict of interest.

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