Trauma Mon. 2017 March; 22(2):e26019. doi: 10.5812/traumamon.26019.

Published online 2016 May 10. **Research Article**

Predictors of Survival in Motor Vehicle Accidents Among Motorcyclists, Bicyclists and Pedestrians

Homayoun Sadeghi Bazargani,[1] Reza Gholi Vahidi,[2] and Ali Akbar Abhari[3,*]

[1]Department of Statistics and Epidemiology, Tabriz University of Medical Sciences, Tabriz, IR Iran
[2]Faculty of Management and Medical Information, Tabriz University of Medical Sciences, Tabriz, IR Iran
[3]Tabriz Health Services Management Research Center, Tabriz University of Medical Sciences, Tabriz, IR Iran

[*]*Corresponding author*: Ali Akbar Abhari, Tabriz Health Services Management Research Center, Tabriz University of Medical Sciences, Tabriz, IR Iran. Tel: +98-4133356165, Fax: +98-4133357284, E-mail: abhariaa@gmail.com

Received 2015 January 10; **Revised** 2015 May 04; **Accepted** 2015 August 05.

Abstract

Background: Motor vehicle accidents are the leading cause of death in adolescents and young adults worldwide. Road traffic fatality is high in Iran; about 28,000 individuals die from road traffic accidents annually. Previous studies on trauma care in Iran have mainly focused on pre-hospital trauma care. This paper deals with the rate and the related factors of traffic injury deaths in hospitals.

Objectives: The objectives of the present study were to investigate the predictors of survival rates of 2-wheel vehicle and pedestrian traffic injuries in hospitals of Tabriz, Iran.

Patients and Methods: This longitudinal study reviewed 15,331 injuries in 21 hospitals in the city of Tabriz from March 2012 to March 2013. The required data on motorcycle, bicycle and pedestrian (MBP) traffic injuries were collected from hospital information systems (HISs). Operation codes were extracted according to the 2010 California Billing Code and the data were analyzed using the STATA 13 statistical software package.

Results: The total number of deaths due to traffic injuries was 266. Of these deaths, 184 were among inpatient traffic injuries 166 were MBP inpatients and 82 were outpatients. Young MBP patients (20 to 40 years of age) experienced a higher injury rate than older ones (48.4%, $P < 0.05$). Of all traffic injuries, 26% were pedestrian, 32% were motorcyclist, 4.6% were bicyclist, and 37.1% were non-MBPs. Most of the 266 deaths (251 deaths; 94.3) happened in public teaching hospitals. Fourteen deaths (5.3%) happened in other public hospitals and 1 death (0.4%) occurred in a private hospital. The difference, using the Fisher's exact test, was significant ($P < 0.01$). The hazard ratio for the death of victims referred to public teaching hospitals was 5.8 times more than other hospitals (RR = 5.7, 95% CI: 3.4 - 9.6). The likelihood of admission for victims transported by emergency medical services (EMS) was 1.13 times more than for victims not transported by EMS (RR = 1.13 - 1.22, 95% CI: 1.05 - 1.2). Of the 266 deaths, 265 (99.62%) occurred in grade 1 hospitals and 1 (0.38%) occurred in a grade 2 hospital.

Conclusions: Close attention to these predictors may aid officials in planning effective training programs and prevention measures. These predictors can also be used in the legislation of traffic laws and regulations and managerial plans of hospitals.

Keywords: Traffic Injuries, Motorcycle, Bicycle, Pedestrian, Mortality

1. Background

Traffic injuries are a major public health challenge and are expected to be the fifth significant cause of global health issues by 2030 (1). Traffic injuries are recognized as a main health problem in many high-income countries and are also a major cause of mortality and disability in many low-and-middle income countries. This is especially true in recently developing countries. In less wealthy countries, such as South Asia and Africa, traffic injuries are a major factor of mortality and disability for adults in many age groups (2) and especially for children (3). Among the causes of trauma, motor vehicle accidents involving pedestrians are common, and are one of the main causes of mortality and morbidity in adolescents and young adults around the world. Approximately 856,000 road deaths occur in developing countries annually (4). Traffic accidents have killed more than 30 million people in the past century and traffic injuries have exceeded 10 million yearly (5). The world health organization (WHO) declared that traffic accidents killed 1.29 million people yearly and is the ninth factor of mortality (2.2% of total mortality) (6).

Medical care for traffic injuries has resulted in costs for health systems in recent years (7). WHO suggested that governments should "invest in information systems on traffic injuries that are appropriate, simple, cost-effective and consistent with national and international standards" (8).

Road traffic mortality in Iran is high, and leads to the deaths of about 28,000 people yearly (9). As reported by WHO, Iran is ranked 8th for road fatalities per 100,000 inhabitants per year (32.1/100,000) which equals 24896

deaths in the year 1392 of national Shamsi calendar (21 March 2013- 20 March 2014) (10).

According to the world assessment in 2000, traffic-related mortality in Iran was higher than the average (31.3 per 100,000 versus 19.5 per 100,000) and also higher than the rate estimated for the eastern mediterranean (EMRO) countries (27.7 per 100,000). Finally, traffic collisions were also the main cause of death among children aged 5-14 in rural areas of Iran (37%) (11). Globally, road traffic injuries are the second leading cause of death for young people aged 5 - 25 years (12, 13).

Previous studies on traffic injuries in Iran have mostly been conducted on pre-hospital care, such as prevention, belt use, etc. In addition, some studies conducted on traffic injury care at hospitals in various low and middle-income countries (LMICs) have mainly focused on the access to resources and interventions for better outcomes, and the quality of traffic injury care at hospitals (1). The purpose of this paper was to investigate the predictors of survival rates for 2-wheel vehicle and pedestrian traffic injuries in hospitals of Tabriz, Iran.

2. Objectives

The objective of the present study was to investigate the predictors of survival rates for 2-wheel vehicle and pedestrian traffic injuries in hospitals of Tabriz, Iran. We investigated the objective with a focus on the differences of outcomes and delivery methods for injuries in variously owned hospitals.

3. Materials and Methods

This longitudinal study was conducted at 21 hospitals in Tabriz city from March 2011 to March 2012. The required data were acquisitioned from hospital information systems (HISs). All patients with pedestrian, motorcycle or bicycle traffic injuries referred to both the outpatient and inpatient units of the studied hospitals were considered eligible for the study. Victims of relevant traffic injuries were identified according to the codes of the international classification of diseases version 10 (ICD-10 Version: 2010) as part of an obligatory registration in Iran. All codes in a range of V01 to V29 were selected. Data from 21 hospitals were initially screened.

3.1. Inclusion and Exclusion Criteria

Traffic injuries admission; accurate record of External Causes of Injury (ICD10, 9) and other needed data. Failure to meet one of these criteria led to exclusion from the study.

Of the 21 hospitals of the city, 4 hospitals did not admit any traffic accident injuries during the study period. They were: one single-specialty psychiatric hospital, one single-specialty heart hospital, and two general hospitals. Furthermore, five minor hospitals were excluded to avoid the risk of potential bias. This was done because detection of the MBP and non-MBP traffic injury victims was impossible due to the data mining limitations. However, these five hospitals admitted 325 victims altogether (compared to total 15331 admissions) and there were no deaths due to road traffic injuries among them. Among the twelve hospitals included in the study six were public teaching hospitals, two public hospitals and four private hospitals. In terms of hospital type, there was one trauma hospital, seven general hospitals, two hospitals of eye specialty and two maternity hospitals. Data from a total of 15,331 injuries were analyzed in this study. The hospitals were divided into 3 quality ranks (accreditation degree): 1, 2 and 3, with the quality descending respectively.

Patient information extracted from the hospital files was transferred into a predefined checklist. The main variables of interest at this stage included: hospital's accreditation degree, hospital ownership, referral level of hospital, sex, age, ward type, final diagnosis, operation code (14), external causes of injuries (ICD-10), length of stay, outcome and type of referral/transfer to hospital. Data were analyzed using the STATA 13 statistical software package (15). Descriptive statistical methods and appropriate graphs were used to summarize the data. Chi-square and Cox rank tests were used for bivariate analysis. Relative risk was used to investigate the association between variables; relative risks along with 95% confidence intervals were also reported. The confidence intervals for relative risks were evaluated using exact estimation.

Annual survival rate were used to assess or compare the survival rates after injuries. The Kaplan Meier estimator survival curve of traffic injuries by hospital type was used to plot the survival proportion hazards multivariate Cox regression, which was used to compare the survival rates while controlling for potential confounding variables.

Proportion hazard assumption was checked based on graphical methods of assessment. The adjusted hazard ratio along with a 95% confidence interval was reported.

3.2. Ethical Approval

Ethical approval of this study was obtained from the ethics committee of Tabriz University of Medical Sciences.

4. Results

Of the 15,331 traffic injuries referred to the studied hospitals in Tabriz, 11800 subjects (77%) were outpatients and

3,400 (22.1%) were inpatients. For (0.9%) of those injured the type of service was not recorded.

Inpatients were divided into wards of Orthopedic surgery (1,879 [12.4%]), Emergency Department (11,931 [78.5%]), Surgery (621 [4.1%]), Maxillofacial surgery (87 [0.6%]), Trauma (330 [2.2%]), ICU (91 [0.6%]), Eye surgery (107 [0.7%]), Burns (29 [0.2%]), Operative and plastic surgery (55 [0.4%]) and other injuries (70 [0.5%]). MBPs comprised 71.6% of the inpatient traffic injuries while only 19.3% of outpatient traffic injuries were MBPs.

Distribution of traffic injuries among age groups were 1 to 20 years (23.1%), 21 to 40 years (48.4%), and 41 and above (28.5%). The mean age of all victims was 32.8 years with a standard deviation of 17.5 years, and the mean age of inpatient victims was 33.5 years and the mean age of outpatient victims was 32.6 years.

Distribution of all traffic injuries during the months from March 2011 to March 2012 were 10.0, 8.2, 8.6, 12.4, 9.9, 11.0, 9.0, 7.6, 6.1, 5.9, 5.3 and 6.0 percent respectively.

Distribution of all traffic injuries according to the referral type (delivery method) were: 17.9% bystanders, 20.7% referred from other hospitals, 0.4% private ambulance, 45.7% emergency medical services (EMS), 12.2% state ambulance and 3.1% police. About 22.6% of traffic injury victims transferred by EMS were MBP victims, while 34.5% of the victims referred by non-EMS were MBP. Distribution of MBP traffic injuries among referral types were: 21.2% bystanders, 27.2% referred from other hospitals, 0.9% private ambulance, 30.0% EMS, 12.2% state ambulance and 8.4% police. Characteristics of the injuries are summarized in Table 1. Distribution of the death and length of stay among the admitted injuries are presented in Table 2.

Of the 584 inpatient injuries transferred by EMS, 28 (4.8%) died, and of the 2,632 injuries not transferred by EMS, 156 (5.9%) died. Distribution of referrals for fatal cases of outpatient traffic injuries were bystanders (0.9%), referred from other hospitals (2.4%), private ambulance (0.0%), EMS (2.2%), state ambulance (2.1%) and police (2.2%). Of the 266 total deaths, 184 (69.2%) were inpatient and 82 (30.8%) outpatient.

Forty-five (16.9%) of the fatalities were female victims. The proportions of death were 4.5% for inpatients, 0.7% for outpatients and 1.7% as overall. The number of deaths for all traffic injuries was 266; there were 184 inpatient deaths including 166 MBP inpatients, and 82 outpatient deaths.

Forty deaths occurred in the first month; these were distributed as 32 (80%) deaths at public teaching hospitals, 7 (17.5%) deaths at other public hospitals and 1 (2.5%) death at private hospitals. We used the Kaplan Meier estimator to compare survival trends between variously owned hospitals. The survival likelihood trend of traffic injuries in the first month of admission is shown in Figure 1. The slope for public teaching hospitals was steep compared to hospitals under different ownership.

Table 1. Characteristics of the injured people admitted to the hospitals of Tabriz, Iran: 2011-2012

	Frequency	Relative Frequency
Admitted Traffic Injuries	15331	100%
Inpatient	3,400	22.1
Outpatient	11,800	77
Not recorded	131	0.9
Referral Type	**All Traffic Injuries Frequency (%)**	**MBPsa Frequency (%)**
EMS	7,006 (45.7%)	1,023 (30.0%)
Referred From Other Hospitals	3,174 (20.7%)	925 (27.2%)
Private Ambulance	61 (0.4%)	31 (0.9%)
State Ambulance	1,870 (12.2%)	415 (12.2%)
Bystanders	2,744 (17.9%)	721 (21.2%)
Police	475 (3.1%)	286 (8.4%)
MBPs Admitted	**Inpatient Frequency (%)**	**Outpatient Frequency (%)**
Motorcyclist	1,030 (49.2%)	1,493 (65.4%)
Bicyclist	167 (8.0%)	18 (0.8%)
Pedestrian	896 (42.8%)	772 (33.8%)
Total	2,093 (100%)	2,283 (100%)

[a] Motorcyclists, Bicyclists, Pedestrians.

Of all traffic injuries, 26% were pedestrian, 32% motorcyclist, 4.6% bicyclist and 37.1% non-MBP.

The hazard ratio for MBP victims versus other traffic injuries, after correcting for possible confounding effects of age and sex, was 3.7 in the Cox regression model's multivariate analysis (hazard ratio = 3.7, 95% CI: 2.24 - 6.03). The adjusted hazard ratio for age and sex in pedestrian versus non-MBP injuries was 4 (hazard ratio = 4, 95% CI: 2.34 - 6.84). The hazard ratio in motorcyclists was 3.1 (hazard ratio = 3.1, 95% CI: 1.82 - 5.48), and in bicyclists the hazard ratio was 2.78 (hazard ratio = 2.78, 95% CI: 0.98 - 7.8). The mortality risk for men was higher than for women in overall traffic injuries.

Of those victims who were referred to hospitals by the EMS, 24.6% were hospitalized while 21.7% of those who were not referred by EMS, hospitalized ($P < 0.01$). The likelihood of admission for victims transported by EMS was 1.13 times more than that of victims not transported by EMS (RR = 1.13 - 1.22, 95% CI: 1.05 - 1.2).

Of the 266 deaths, 251 deaths (1.6% of all traffic victims) occurred in public teaching hospitals.

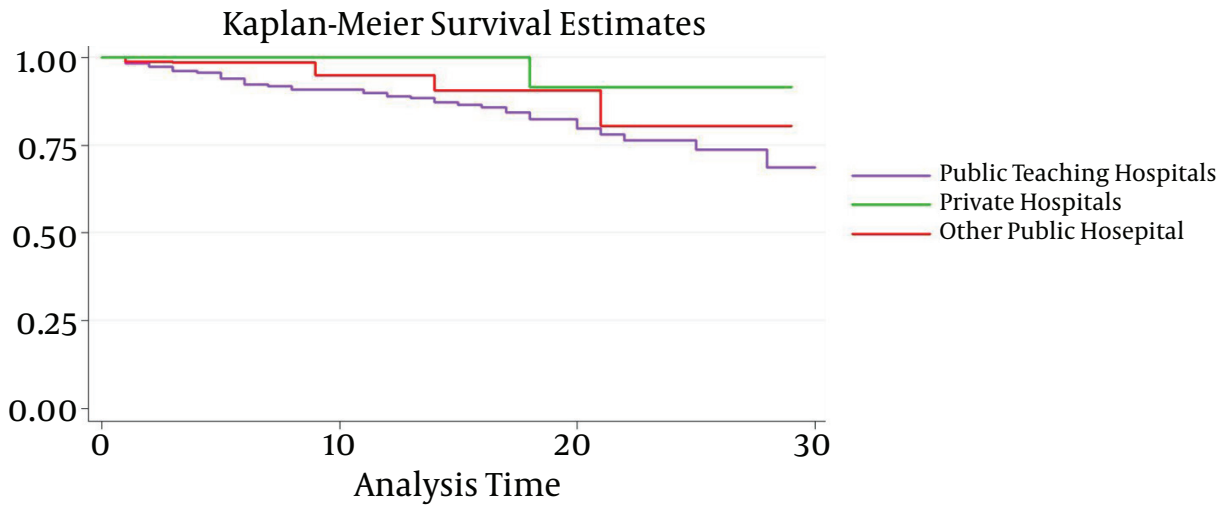

Figure 1. The Kaplan Meier Estimator Survival Curves of Traffic Injuries by Hospital Type in First 30 Days

Table 2. Death and length of stay of the injured people admitted to the hospitals of Tabriz, Iran: 2011-2012

Deaths	Inpatient Frequency (%)	Outpatient Frequency (%)	Total Frequency (%)
All Deaths	184 (69.2%)	82 (30.8%)	266 (100%)
MBPs' Death	166 (76.1)	52 (23.9)	218 (100%)
Sex			
Mal	221 (83%)		
Female	45 (17%)		
First Month Deaths by Hospital Type	**Frequency**	**Relative Frequency**	
Public Teaching Hospitals	32	80%	
Public Hospitals	7	17.5%	
Length Of Stay (LOS)	**Frequency**	**Relative Frequency**	
2 Days or less	1,221	35.9%	
More than 1 month	55	1.6%	

Of the 3,400 inpatients, 3,162 (93%) had a registered length of stay and 238 (226 (6.6%) at university hospitals, 7 (0.2%) at public hospitals and 5 (0.1%) at private hospitals) did not have a registered length of stay. The mean length of stay for all inpatients with traffic injuries with a recorded length of stay was 5.5 days with a standard deviation of 8.4 days. 52.6% of the victims stayed at private hospitals for more than 30 days, compared to 0.4% for public teaching hospitals; 48.4% of victims stayed at public teaching hospitals for two or fewer days, while this rate for private hospitals was 15.8.

Fourteen deaths (5.3%) occurred in other public hospitals and 1 death (0.4%) occurred at a private hospital. The average length of stay for victims referred by EMS was 6.18 days and for victims who were not referred by EMS was 5.88 days.

Among the 15,181 traffic injuries (99.02%) referred to rank 1 hospitals and 150 (0.98%) referred to rank 2 hospitals, 266 deaths occurred. 265 deaths (99.6%) occurred in rank 1 hospitals and 1 death (0.4%) occurred in a rank 2 hospital. Of the 3,400 inpatients, 3,310 (97.4%) were referred to rank 1 hospitals and 90 (2.6%) were referred to rank 2 hospitals. Of the 11,931 outpatients, 11,871 (99.5%) were referred to rank 1 hospitals and 60 (0.5%) were referred to rank 2 hospitals.

5. Discussion

In the five excluded hospitals there were no records for deaths related to traffic injuries (335 injuries, 2.1% total of traffic injuries in study period). Of all the traffic injuries referred to hospitals in the city of Tabriz, three quarters of the victims were outpatients and one quarter was inpatients. It is possible that many of the victims were not severely injured and did not require hospitalization. These results

emphasize the need for outpatient services at hospitals, although hospital managers must also consider the needs of victims who require inpatient services such as surgery. The rate of admission of traffic injuries in hospitals of Tabriz was equal to that of England (22%) (16), but less than that of Kenya (trauma centers only) (49.5%) (17), Sweden (26%) (7, 18), Iran (37.9%) (19) and Singapore (23%) (20). The rate of admission in intensive care units (ICUs) in other studies were 35% for Kenya (17), 7.2% for Saudi Arabia (21) and 5% for Singapore (20). MBP victims were 5.2 times more likely to be hospitalized compared to other types of traffic injury victims referred to hospitals in Tabriz (RR = 5.2, 95% CI: 4.9 - 5.7). With respect to the inpatients in hospitals, the type of incident was one of the main causes of death in this group. Being a pedestrian, motorcycle rider or bike rider increased the risk of death compared to other types of traffic victims. In this study, 7% of MBP victims were bicyclists, although in Iran people use bikes less than some other countries, such as southeast Asian countries.

The six public teaching hospitals had a high proportion of clinical services delivery with 8,910 outpatients and 2,529 inpatients (overall 11439 victims comprising 74.6% of all injuries), while one hospital owned by social security organization admitted 0.4% of victims with traffic injuries and five private hospitals had 1.89% of the traffic victims. One of these six hospitals is a trauma center and has a big share of the traffic injuries. However, this reflects the low weights of private hospitals in the treatment of traffic victims. Of this small portion, 79.2% of victims were admitted for inpatient services. This demonstrates the interest of these hospitals to attract those who need inpatient services. On the other hand, there is a possibility that public teaching hospitals and other public hospitals refer victims to private hospitals so that the victims can obtain inpatient services; this possibility must be analyzed. This is happening despite the fact that all of the traffic casualties referred to charity hospitals receive either outpatient services or referrals to public teaching and other public hospitals for inpatient services, and the fact that private hospitals do not have any problem with the cost of traffic injuries. Because the Ministry of Health has undertaken all costs of traffic accident victims. Furthermore, private hospitals have 42 beds of the total 175 Intensive Care Unit (ICU) beds available in the city (24%), and 40 operation rooms (ORs) of the 146 available in the city (27%). Also the occupancy rate of private hospitals is lower than those of other hospitals, and if they took a greater share of traffic injuries, this rate will increase. In addition, traffic accidents can occur anywhere in the city and province and it is necessary for traffic victims to receive medical care as quickly as possible. Thus referring these patients to specific hospitals from all parts of the city or province can result in delay in receiving medical care. The option to refer these patients to private hospitals should be reviewed. However, private hospital emergency departments are weaker than those of other hospitals despite the commitment of the Health Ministry to equip the emergency departments with proper equipment and enough staffing (based on specific standards). Further preparation of private hospital emergency departments could increase their effectiveness for admitting traffic victims.

Public teaching hospitals admitted most of the victims with traffic accident injuries (74.6%) and had 251 deaths (2.2% of total traffic injuries). The hazard ratio for mortality of the victims referred to public teaching hospitals was 5.8 times more than that of other hospitals.

The survival likelihood trend of traffic injuries in the first month of admission is shown in Figure 1. The slope for the public teaching hospitals was steep compared to those for the other types of hospitals.

The hazard ratio for MBP victims compared to other traffic injuries was 3.7 in the Cox regression model's multivariate analysis. The hazard ratio for age and sex in pedestrian versus non-MBP injuries was 4; in motorcyclists was 3.1; in bicyclists was 2.78; and for men was higher than for women in overall traffic injuries.

The likelihood of admission for victims transported by EMS was 1.13 times more than that for victims not transported by EMS (RR = 1.13 - 1.22, 95% CI: 1.05 - 1.2). This means that the chance of a MBP victim's admission via EMS is 60% compared to other traffic injury victims. Also, the proportion of EMS transfers for victims of road traffic accidents was small, and within this small portion, pedestrian injuries had the lowest proportion of transfer. Since pedestrians had the highest need for EMS services, it needs to be considered how to increase the rate of pedestrian transfer by EMS.

Although the rates of death of inpatients referred by other vehicles were higher, the difference between the numbers of those fatally injured who were admitted to the hospitals by EMS and those admitted to hospitals by other vehicles is not statistically significant. The mortality rate is higher for outpatient victims who referred to hospitals via other vehicles than victims referred by EMS ($P < 0.05$). It is possible this was related to other factors such as severity of injury, treatment and management in the hospitals. If there is a significant difference for the outpatient victims, perhaps it is related to treatment given in the ambulance during transport. The role of EMS might be discovered when these data are analyzed in terms of injury severity. The mortality rate of traffic injuries in hospitals in other studies were: 11.5 per 100,000 in Peru, 42.2 per 100,000 in El Salvador, 24 per 100,000 in Brazil and 22.7 per 100,000 in Venezuela (8), 4.8% in Greece (22), 3.3% in Turkey (23), 5.4%

in Kenya (17), 0.2% in England (children's centers only) (24), 8.6% in Canada (21), 1.9% in Singapore (bicyclist only) (25), 8.4% in Iran (20), 4.8% in England (26), 1.9% in Singapore (EDs only) (27), 6.9 per 100,000 in the USA (19), 3.9% in Iran (28), 8.29% in England (bicyclist and motorcyclist only) (29) and 1.1% in Saudi Arabia (30).

The mortality rate of traffic injuries in Tabriz hospitals per 100,000 of the population is 15.6; this rate is less than that from El Salvador, Brazil and Venezuela, and more than that from the USA and Peru. However, this result is not related to our objectives.

As Figure 2 shows, there was a relationship between the number of deaths and the number of inpatients. The death ratio rises during holidays (especially in the early days of vacation), because there is an increase in the amount of travel, which thus increases the number of accidents and the number of injuries and inpatients. One of the limitations of this study was that due to the large sample size, the injury severity score (ISS) was not used.

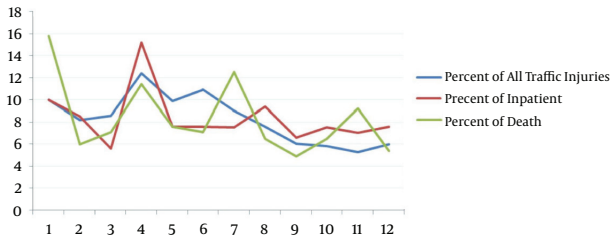

Figure 2. Distribution of Death Percentage, Hospitalization Percentage and Injuries Percentage in 12 Months Period

Although the number of victims of road traffic deaths is rising around the world, this rate is higher in Iran. There was a significant relationship between mortality and type of accident (MBP). Motorcyclists were at the greatest risk of injury, the greatest risk of death and the greatest risk of compare to non-MBPs. The number of accidents, number of hospitalizations and number of deaths had direct correlations with the month of the year. Victims aged 20 to 40 were most at risk of injury. Public teaching hospitals contributed the most in outpatient and inpatient treatment (three quarters).

Private hospitals have mostly offered their services to inpatients. They admitted only 1.9% of victims with traffic injuries and keep their patients with traffic injuries for longer than other hospitals. This provision of medical services to a small number of patients over a long period of time contrasts with public teaching hospitals, which have offered their services to a large number of injured victims whom they hold for only a short time. This results in a lower occupancy rate for private hospitals compared to public teaching hospitals. Unfortunately, it cannot be concluded that EMS response reduced the death rate for victims.

Acknowledgments

We would like to express our sincere thanks to the members of treatment affairs of Tabriz University of Medical Sciences for their approval and support of this research.

Footnotes

Authors' Contribution: Study concept, design and supervision: Ali Akbar Abhari and Reza Gholi Vahidi; acquisition of data: Ali Akbar Abhari; analysis and interpretation of data: Homayoun Sadeghi Bazargani; drafting of the manuscript, technical and material support: Ali Akbar Abhari.

Funding/Support: This study was sponsored by Tabriz University of Medical Sciences.

References

1. Haghparast-Bidgoli H, Khankeh H, Johansson E, Yarmohammadian MH, Hasselberg M. Exploring the provision of hospital trauma care for road traffic injury victims in Iran: a qualitative approach. *J Inj Violence Res.* 2013;**5**(1):28–37. doi: 10.5249/jivr.v5i1.195. [PubMed: 22095003].
2. Mock CN, Abantanga F, Cummings P, Koepsell TD. Incidence and outcome of injury in Ghana: a community-based survey. *Bull World Health Organ.* 1999;**77**(12):955–64. [PubMed: 10680242].
3. Shanon A, Bashaw B, Lewis J, Feldman W. Nonfatal childhood injuries: a survey at the Children's Hospital of eastern Ontario. *CMAJ.* 1992;**146**(3):361–5. [PubMed: 1530689].
4. Odero W, Garner P, Zwi A. Road traffic injuries in developing countries: a comprehensive review of epidemiological studies. *Trop Med Int Health.* 1997;**2**(5):445–60. doi: 10.1111/j.1365-3156.1997.tb00167.x.
5. Alinia S, Rezaei S, Hadadi M, Sari AA. Extent, nature and hospital costs of fireworks-related injuries during the Wednesday Eve Festival in Iran. *Journal of injury and violence research.* 2013 Jan 1;**5**(1):11.
6. Chandran A, Sousa TR, Guo Y, Bishai D, Pechansky F, Vida No Transito Evaluation T. Road traffic deaths in Brazil: rising trends in pedestrian and motorcycle occupant deaths. *Traffic Inj Prev.* 2012;**13 Suppl 1**:11–6. doi: 10.1080/15389588.2011.633289. [PubMed: 22414123].
7. Wang Z, Jiang J. An overview of research advances in road traffic trauma in China. *Traffic Inj Prev.* 2003;**4**(1):9–16. doi: 10.1080/15389580309860. [PubMed: 14522656].
8. Medina Y, Espitia-Hardeman V, Dellinger AM, Loayza M, Leiva RGC. A Road Traffic Injury Surveillance System Using Combined Data Sources In Peru. *Rev Panam Salud Publica.* 2011;**29**(3):191–7.
9. Kadkhodaie MH. Three-year review of facial fractures at a teaching hospital in northern Iran. *Br J Oral Maxillofac Surg.* 2006;**44**(3):229–31. doi: 10.1016/j.bjoms.2005.06.016. [PubMed: 16099558].
10. Toroyan T. Global status report on road safety 2015. Geneva: World Health Organization, Department of Violence and Injury Prevention and Disability; 2015.
11. Soori H, Naghavi M. Childhood deaths from unintentional injuries in rural areas of Iran. *Injury prevention.* 1998 Sep 1;**4**(3):222–4.

12. Available from: http://www.unicef.org/iran/media_4783.html.
13. Ballesteros MF, Schieber RA, Gilchrist J, Holmgreen P, Annest JL. Differential ranking of causes of fatal versus non-fatal injuries among US children. *Inj Prev.* 2003;**9**(2):173–6. [PubMed: 12810747].
14. The California Division of Workers' Compensation Medical Billing and Payment Guide . 2011.
15. StataCorp LP. Stata data analysis and statistical Software. *Special Edition Release.* 2007:10.
16. Moore RS, Summers CL, Jackson M, Tesfayohannes B. Paediatric road accidents in two health districts. *J Accid Emerg Med.* 1994;**11**(2):109–11. [PubMed: 7921564].
17. Jok OAJ. Causes of Injuries Resulting in A Visit to The Emergency Department of A Provincial General Hospital, Nyanza, western Kenya. *Afr Health Sci.* 2011;**11**(2):255–61.
18. Safiri S, Sadeghi-Bazargani H, Amiri S, Khanjani N, Safarpour H, Karamzad N, et al. Association between Adult Attention Deficit-Hyperactivity Disorder and motorcycle traffic injuries in Kerman, Iran: a case-control study. *2013.* 2013;**2**(1):5. doi: 10.13183/jcrg.v2i1.24.
19. Salari A AA. Demographic study of trauma caused by traffic Accident in Yazd. *Yazd Univ Med Sci.* 2002;**10**(3):27.
20. Nazari R, Bijani A. Mortality rate and severity of road traffic injuries in patients presenting to Amol 17 SHahrivar hospital. *Babol Univ Med Sci.* 2010;**13**(1):76–81.
21. Dueck A, Poenaru D, Pichora DR. Cost factors in Canadian pediatric trauma. *Can J Surg.* 2001;**44**(2):117–21. [PubMed: 11308233].
22. Markogiannakis H, Sanidas E, Messaris E, Koutentakis D, Alpantaki K, Kafetzakis A, et al. Motor vehicle trauma: analysis of injury profiles by road-user category. *Emerg Med J.* 2006;**23**(1):27–31. doi: 10.1136/emj.2004.022392. [PubMed: 16373799].
23. Gürses D, Sarioglu-Buke A, Baskan M, Kilic I. Cost factors in pediatric trauma. *Can J Surg.* 2003;**46**(6):441.
24. Ogendi JO, Ayisi JG. Causes of injuries resulting in a visit to the emergency department of a Provincial General Hospital, Nyanza, western Kenya. *Afr Health Sci.* 2011;**11**(2):255–61. [PubMed: 21857858].
25. Heng KW, Lee AH, Zhu S, Tham KY, Seow E. Helmet use and bicycle-related trauma in patients presenting to an acute hospital in Singapore. *Singapore Med J.* 2006;**47**(5):367–72. [PubMed: 16645684].
26. Waters EA. Should pedal cyclists wear helmets? A comparison of head injuries sustained by pedal cyclists and motorcyclists in road traffic accidents. *Injury.* 1986;**17**:372–5.
27. Jean LM, Swee-Han L, Anantharaman VYA. Patterns of Injuries Sustained by Pedestrians in Road Traffic Accidents at the Singapore General Hospital. *Ann Emerg Med.* 2004;**44**(4).
28. Mobalegi J, Molanaee N. Evaluation of mortality and injuries from motor vehicle crashes in admitted patients to Sanandaj Besat hospital. *Kordestan Univof Med Sci.* 2002;**6**(24):28–32.
29. Waters EA. Should pedal cyclists wear helmets? A comparison of head injuries sustained by pedal cyclists and motorcyclists in road traffic accidents. *Injury.* 1986;**17**(6):372–5. [PubMed: 3818068].
30. Shanks NJ, Ansari M, Ai-Kalai D. Road traffic accidents in Saudi Arabia. *Public Health.* ;**108**(1):27–34. doi: 10.1016/S0033-3506(05)80032-0.