

## Original Article

DOI: 10.22114/ajem.v0i0.108

# The Cost Analysis of Patients with Traffic Traumatic Injuries Presenting to Emergency Department; a Cross-sectional Study

Farhad Rahmati<sup>1</sup>, Mohammad Doosti<sup>1</sup>, Maryam Bahreini<sup>2,3\*</sup>

1. Department of Emergency Medicine, Shohaday-e-Tajrish Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

2. Department of Emergency Medicine, Sina Hospital, Tehran University of Medical Sciences, Tehran, Iran.

3. Pre-Hospital Research Center, Tehran University of Medical Sciences, Tehran, Iran.

\*Corresponding author: Maryam Bahreini; Email: m-bahreini@tums.ac.ir / bahreiniMaryam@gmail.com

Published online: 2018-11-17

## Abstract

**Introduction:** Road traffic traumatic injuries are the leading cause of death especially among young men who are mostly vulnerable victims. This catastrophe is more complicated in low to middle-income countries.

**Objective:** This study assessed the financial costs of traffic casualties in a level-1 trauma university hospital.

**Method:** One thousand trauma patients presenting to the emergency department of Shohaday-e-Tajrish Hospital were included in the study. The prehospital and hospital costs as well as the expenses of physiotherapy, rehabilitation, outpatient visits and further surgical interventions were considered as direct expenses. The costs of productivity loss were estimated as indirect expenses.

**Results:** The direct and indirect costs were assessed 27.4% and 72.6% of total, respectively. The mean age of permanent disability was 43 years old. The average expenses of temporary and permanent disabilities were 2934.4 million rials, equal to 106 thousand \$ (nearly 4.2 million rials or 153 \$ per patient) and 23.9 billion rials, equal to 866.3 thousand \$ (1.1 billion rials or 39.2 thousand \$ per person), respectively.

**Conclusion:** The national burden of traffic injuries in Iran is significantly destructive as it consists of 2.19 % of Gross Domestic Product annually. Besides, young men are involved in most of the traffic accidents representing the need to establish rigorous preventive instructions and reduce human, and financial costs.

**Key words:** Emergency department; Gross domestic product; Hospital costs; Length of stay; Traffic accident

**Cite this article as:** Rahmati F, Doosti M, Bahreini M. The Cost Analysis of Patients with Traffic Traumatic Injuries Presenting to Emergency Department; a Cross-sectional Study. Adv J Emerg Med. 2019;3(1): e2.

## INTRODUCTION

Traffic casualties are one of the major leading causes of mortality which impose sociocultural, and economic consequences. According to the World Health Organization (WHO) traffic accidents result in a mortality of over 1.2 million people and a morbidity of 20-50 million victims each year mainly in low, and middle-income countries (1). Moreover, nearly half of the traumatic deaths aged 15-43 years which clearly demonstrates the economic burden on families and nations due to the need for long-term healthcare or the economic impact on family income resulting from a disabled, or a lost member (2). The national healthcare is directly influenced by road accidents regarding the interacting factors of the injury, and post-injury consequences. 6 main categories are discussed analyzing the traffic costs: the property damage, temporary traumatic injuries, time out of work, psychological costs and grief, permanent disabilities or death cost, and administrative expenses (3). The global costs of road accident are estimated to be 518 million \$ annually (1).

Unfortunately, road accidents are considered the second leading cause of death after cardiovascular disease in Iran. The mortality and morbidity rate of motor-vehicle crashes are estimated to be over 25 thousand and 100 thousand individuals each year, respectively (4). It is crucial to ascertain the traumatic traffic costs in order to plan for more influential preventive measures. We analyzed the costs of therapeutic interventions on traffic trauma patients presenting to our hospital and tracked patients over time to ascertain their work status after hospital discharge.

## METHODS

### Study design

This prospective cross-sectional study was conducted at one of the main educational trauma centers of Tehran, Iran. The protocol of study has been reviewed and approved by Shahid Beheshti University of Medical Sciences Institutional Review Board, and ethical committee. Informed consent was obtained from the participants.

### Participants

All traffic traumatic patients presenting to the emergency department of Shohadaye Tajrish Hospital, Tehran, Iran were included in the study through convenience sampling. It is a level I trauma center, with nearly an annual 40000 ED patient visits, the great number of which were trauma patients. Patients were excluded if they had become lost to follow-up for any reason or there was significant missing data.

### Data Collection

Data was collected by an emergency medicine PGY-2 resident by means of a questionnaire including demographic characteristics (Patient's age, sex, educational degree, time and mechanism of injury, the way of patient transfer to the emergency room, length of hospital stay, time to return to work), as well as analysis of costs in 2 more steps: First, direct prehospital and hospital costs were obtained from hospital's records; second the information including outpatient visits, surgery follow-ups, physiotherapy, rehabilitation and also indirect costs such as time out of work, financial loss due to temporary or permanent disabilities or death were asked in the follow-up stage via phone calls from the patients or their families 6 months later and filled out in the questionnaire. Patients were excluded if phone calls were unsuccessful or hospital data was unavailable.

### Cost Analysis

**Prehospital costs:** Patients are transported to hospitals in Iran either by emergency medical service (EMS) or by their own on public transport or private taxi. EMS transport missions are free in Iran; however, each transportation cost for Ministry of Health was estimated to be about 1 million rials (the currency in Iran), equal to 36.3 \$ and the mean cost of private transport was 150 thousand rials or 5.4 \$ according to the mean fare of each taxi transfer in 2015. At the time of this study, one dollar was equal to 27,577 rials in 2015.

**Hospital Costs:** In this study hospital expenses included inpatient and outpatient costs as well as medications, patient visits, diagnostic and therapeutic interventions, hospital food, etc. These costs were subjected to the Government approved costs of the Ministry of Health and Medical Education in Iran.

**Costs of disabilities:** Patients were asked about income when they received the follow-up phone calls. The costs of temporary disabilities were estimated by the days off from work multiplied by the age-related patient's wage each month. Additionally, the Central Bank Annual Inflation rate was considered in patient income and was also

added. Costs of permanent disabilities were seemingly calculated based on patient income multiplied by days off from work regarding life expectancy in those years and the added sum of the Central Bank Annual Inflation rate.

**Costs of death:** Generally, dead patients are not transferred to the hospital and declare dead by prehospital emergency medical technicians in the field. The costs of deceased patients in the hospital were estimated for cardiopulmonary resuscitation and other resuscitative measures as well as the costs of financial loss regarding life expectancy for the rest of life. Life expectancy was derived from the World Health Organization report of health statistics in 2015 to be 75.5 years (5). Finally, the deceased patients revealed in the follow-up phone calls, whom the leading cause of death was related to the trauma disability, were considered and the costs were assessed according to their life-expectancy, time off from work and Bank Annual Inflation rate.

The formula below was used for cost calculation of permanent disability and death:

$$\sum_{t=1}^n \frac{\text{capita}}{(1+r)^t}$$

t: "Mean age of dead victims" subtracted from the "Mean age of life expectancy in 2015 in Iran" (75.5 years)

r: Bank rate in 2015 (18%)

capita: The per capita income for the Iranian population according to the International Monetary Fund in 2015 (166.7 million rials or 6044.9 \$).

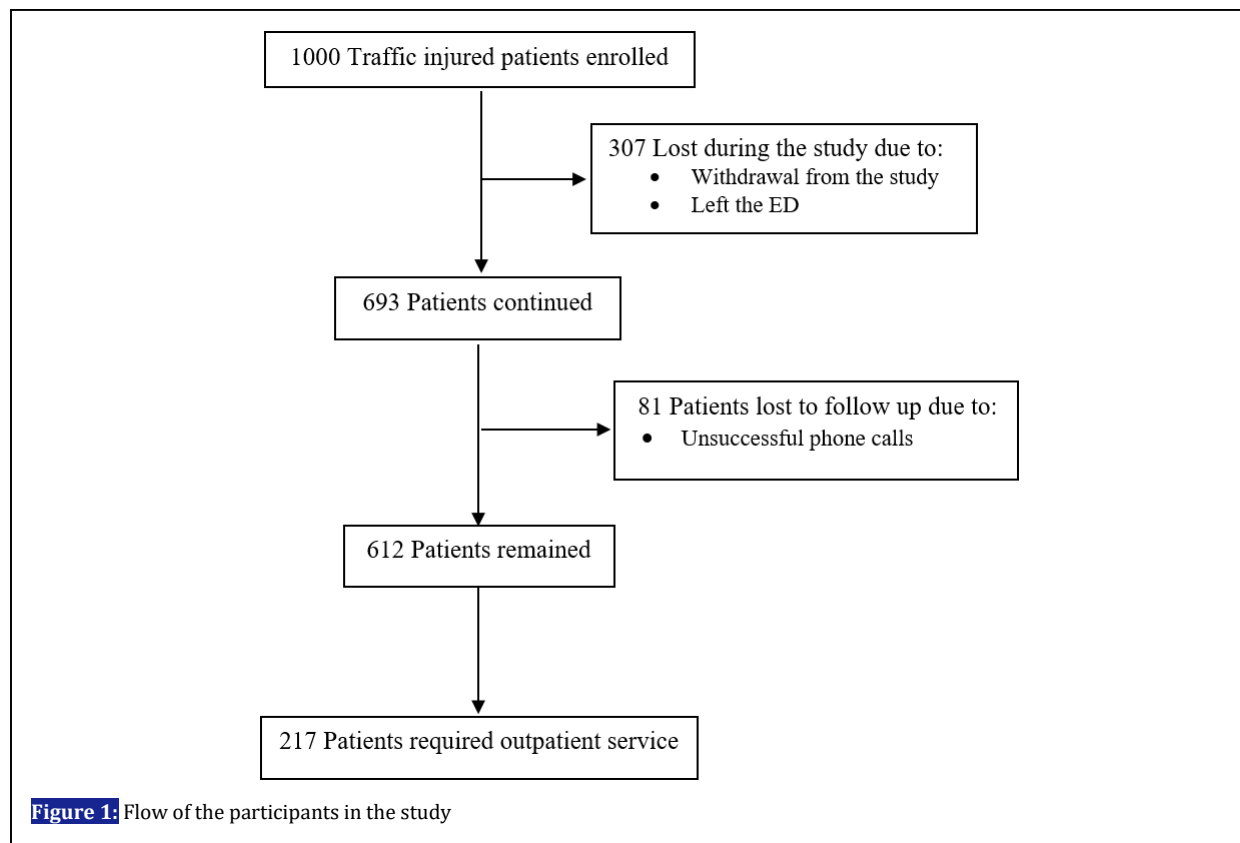
### Statistical analysis

Data were analyzed using SPSS software version 21. Quantitative data were reported as mean and standard deviation, and qualitative data were reported as frequency and percentage.

## RESULTS

### Baseline characteristics

One thousand patients aged  $34 \pm 16$  years were included, of which 62.1% were male. Table 1 shows demographic data of the study patients. The most frequent mechanisms of injury were motor vehicle collisions and vehicle pedestrian collisions, 22%, and 21.1% respectively. Most of the accidents occurred from 14:00 to 24:00 and mostly were transported by EMS. The average length of hospital stay was  $3.31 \pm 6$  (1-116) days. Figure 1 depicts flow of the study participants.



### Costs

The total expenses of the study patients were estimated 47.3 billion rials, equal to 1.7 million \$, of which the direct and indirect costs were 12.9 billion and 34.4 billion rials, 1.2 million and 0.47 million \$, respectively.

- **Direct Expenses**

The prehospital and hospital costs were computed 808.7 million and 10221.7 million rials that averaged 14.7 million rials, equal to 29.3 thousand \$ and 370.6 thousand \$, averaged 535.6 \$ for each patient. Almost 97% of the total costs was covered by insurance services and the rest was paid by patients due to discharge against medical advice in order to transfer to nonpublic hospitals, certain laboratory studies in centers other than the university hospitals, etc. Finally, the average paid expenses per patient were estimated 0.4 million rials, equal to 15.9 \$. Table 2 shows hospital costs in detail. The direct expenses were analyzed for study patients including further surgical interventions, hospital outpatient visits, and physiotherapy (Table 3). Outpatient visits were the most frequent service involved whereas further surgical interventions were the costliest.

- **Indirect Expenses**

From 693 patients at this stage, 15.6% suffered

temporary disabilities. The average period of disability was  $13.5 \pm 53$  (0 – 730) days and the average expenses of temporary disability were estimated 2934.4 million rials, equal to 106.4 thousand \$ (nearly 4.2 million rials or 153.3 \$ per patient). The permanent disability rate was reported 3.2 % with the mean age of 43 years old and the final costs of this factor was estimated 23.9 billion rials that was equal to 866.3 thousand \$ (1.1 billion rials or 39.2 thousand \$ per person). 6 patients died which imposed 7.6 billion rials, equal to 275.6 thousand \$ (mean of 1.3 billion rials or 45.7 thousand \$) on the National Health Service.

### DISCUSSION

The total costs for injured patients of road traffic accident presenting to Shohaday-e-Tajrish Hospital was measured 47.3 billion rials that was equal to 1.7 million \$ in 2015 out of which, 27.4% and 72.6% were related to direct, and indirect expenses, respectively. Moreover, this study shows that the imposed expenses of disability on injured employees and their employers were higher than the medical costs imposed on the government. Most of the developing countries estimate traffic accident costs with regard to the healthcare financing (6-9). According to the report of World

**Table 1:** Demographic and basic clinical information of studied patients

Variables	Number (%)
<b>Gender</b>	
Male	621 (62.1)
Female	379 (37.9)
<b>Age (Year)</b>	
25 >	179 (17.9)
34-25	374 (37.4)
44-35	201 (20.1)
45 <	246 (24.6)
<b>Level of Education</b>	
Up to Diploma	567 (56.7)
Bachelor's Degree	399 (39.9)
Master's Degree	34 (3.4)
<b>Mechanism of Injury</b>	
Motor-pedestrian	29 (2.9)
Vehicle-pedestrian	211 (21.1)
Motorcycle Rollover	60 (6.0)
Vehicle Rollover	179 (17.9)
Motor-vehicle	220 (22.0)
Auto Accidents	106 (10.6)
Others	195 (19.5)
<b>Time of Day Traffic Accident (Hour)</b>	
14-8	280 (28.0)
24-14	604 (60.4)
8-24	116 (11.6)
<b>Patient Transport to the Hospital</b>	
Emergency Medical Service	775 (77.5)
Private	225 (22.5)
<b>Length of Stay (Day)</b>	
1	486 (48.6)
2-7	409 (40.9)
> 7	105 (10.5)
<b>Patient Outcome</b>	
Temporary disability	108 (15.6)
Permanent Disability	22 (3.2)
Death	6 (0.8)

Health Organization, the annual costs of road traffic accidents in low and middle income countries include 1-2% of Gross Domestic Product (1). It was estimated that the road accidents' costs in Egypt was 10 billion pounds in 2008 which specified 1% of Gross Domestic Product (10). Additionally, this measure was assessed as 0.45% of Gross Domestic Product in Vietnam in 2005 (11). However, traffic collisions serve as a more crucial national problem in Iran consisting of 2.19% of Gross Domestic Product (12). Rezaei et al. reported that the hospital costs of injured patients in Iran was 11.18 million rials (1.1 thousand \$) in 2009 (4). Some other studies assessed the cost of road-traffic injuries with various methods in Iran (13-15).

#### Gender

Most traffic injured patients were male (62.1 %). Sehat et al. reported that men represented the

majority of injured and dead victims in road crashes and were 3 times more likely to die than women (16). This finding has been reported in other studies (17-19). It is thought that men are more often involved in risky driving, and motorcycle riding.

#### Age

In the present study, 57.5% of patients aged 25-45. Sehat et al. showed that the older the age, the less probable the road traffic accidents. The injured patients aged mostly 18-25 (16). Mohaymany et al. also reported that most venturesome patients for urban road collisions were 18-28 years-old (20). Besides, in the Anantharaman study, 90% were aged 18-59 and in another study by Kanchan et al. patients of the third decade of life were at increased risk for road crashes (21, 22). In a study by Yazan et al. age was the most important factor in traffic injuries as 60% of road collisions occurred in patients under 30 years-old and only 4% of accidents were attributed to people of over 50 years (23). Thus, it is suggested that the youth has an increased risk of road traffic accidents due to their risky behaviors.

#### Level of Education

From injured patients, 56.7% were educated till Diploma level. In addition, some other studies have demonstrated an increase in traffic accident rate in lower education levels (23). In this context, Sehat et al. have noted that driver training programs can reduce crashes and education influence may positively reduce traffic violations (16).

#### Mechanism of Injury

Furthermore, the commonest injury mechanisms were motor-vehicle and vehicle-pedestrian crashes. These factors are assessed in some other studies and they have reached similar results (6, 7, 24, 25). As a result, it seems that cultural and educational organizations can play crucial part in reducing traffic injuries by targeted driver training (26).

#### Time of Day

Most road traffic casualties occurred between 14:00 to 24:00 when most traffic congestions are experienced. According to Anantharaman et al. one third of the accidents were reported between 18:00 to 24:00 (21). The time of day when most crashes occur has been studied in other studies and the time was compatible with our finding (8, 9, 27). Kiran et al. have shown that most traffic accidents occurred between 12:00 to 18:00 whereas the least reported casualties have belonged to 24:00 to 6:00 (28). It is believed that traffic congestion and work exhaustion may be the possible culprits.

#### Length of Stay

**Table 2:** Hospital Expenses in details

Hospital Cost Type	Percent of the total cost	Mean cost	Total cost
		Iranian Rial (US Dollar)	
Laboratory	3.3	490307 (17.7)	339293127 (12303.5)
Medications	15.1	2223781 (80.6)	1538856878 (55802.2)
Medical Equipment*	21.3	3145939 (114.1)	2176989796 (78942.2)
Radiology	19.3	2859981 (103.7)	19791072040 (717665.9)
Inpatient Medical Consults	0.7	105364 (3.8)	72912011 (2643.9)
Patient Transfer	0.2	29495 (1.1)	20411000 (740.1)
Procedures	1.4	199864 (7.2)	138306419 (5015.3)
Hoteling	17.9	2641598 (95.8)	1827986000 (66286.6)
Inpatient surgical Interventions	9.2	136171 (4.9)	94094437 (3412.1)
Inpatient Visits	5.1	750840 (27.2)	519581618 (18841.1)
Physician Service	5.4	796335 (28.9)	551064500 (19982.7)
Nursing Service	1.1	167949 (6.1)	116221054 (4214.4)

\* Equipment that provides diagnostic/therapeutic benefits to a patient; Patient transfer: transport to another Health Care Facility to provide a continuation of care

**Table 3:** The costs related to further surgical interventions, outpatient visits, and physiotherapy

Direct Expenses	Physiotherapy	Outpatient Follow-up Visits	Further Surgical Interventions
Number of patients (%)	59 (8.5)	134 (19.3)	24 (3.4)
Total costs in million Rials (thousand dollars)	9737 (353.1)	6711 (243.3)	38708 (1403.6)
Mean cost million Rials (thousand dollars)	165 (5.9)	50 (1.8)	1612 (58.4)
Percent of total direct costs	15.4	10.6	61.2

The estimated average length of stay in hospital was 3.31 days. However, this measure varied widely in several studies from 5.5 to 21.5 days (23, 28-31). This is probably due to the differences in healthcare systems, study methodologies, injury patterns, and failure to post-discharge follow-ups.

#### Limitations

It is recommended to assess the length of stay and rehabilitation programs in better study settings to decrease the number of lost to follow-up patients, to evaluate the impact of transfers between hospitals, reliance on recall and to estimate loss of quality of life. The patients' costs were analyzed regarding the dollar cost at the time of the study. The results of this study were obtained from a level-1 trauma center university hospital and may not be representative globally.

#### CONCLUSIONS

Healthcare costs for traffic injuries is rather higher in Iran, especially the expenses related to the medical treatment and temporary or permanent

#### REFERENCES

1. Peden M, Scurfield R, Sleet D, Mohan D, Hyder AA, Jarawan E, et al. World report on road traffic injury prevention. World Health Organization Geneva; 2004.
2. World Health Organization- Statistics by country or region 2002 [Available from: [www.WHO.Int/Whosis/Country/Indicators](http://www.WHO.Int/Whosis/Country/Indicators)].
3. Ahadi MR, Razi-Ardakani H. Estimating the Cost of Road Traffic Accidents in Iran using Human Capital Method. IJTE. 2015;2(3):163-78.

disabilities for the families, and public health. Thus, the greater burden of traffic injuries urges the need for planning rigorous solutions, driver training, and cultural education.

#### ACKNOWLEDGEMENTS

We gratefully thank the emergency department personnel of Shohaday-e-Tajrish Hospital for their kind collaborations.

#### AUTHORS' CONTRIBUTION

All the authors met the standards of authorship based on the recommendations of the International Committee of Medical Journal Editors.

#### CONFLICT OF INTEREST

None declared.

#### FUNDING

This study was conducted with a grant from the Clinical Research Development Center of Shohaday-e-Tajrish Hospital.

4. Rezaei S, Sari AA, Arab M, Ghasempour S. Economic Burden of Road Traffic Crashes in Tehran Province, Iran in 2009. *Health Info Manag.* 2013;10(3):1-12.
5. World Health Statistics 2016, Monitoring Health for the Sustainable Developmental Goals [Available from: <http://www.who.int/countries/irn/en>].
6. Masoumi K, Forouzan A, Barzegari H, Rahim F, Zohrevandi B, Nabi S. Effective Factors in Severity of Traffic Accident-Related Traumas; an Epidemiologic Study Based on the Haddon Matrix. *Emerg (Tehran)*. 2016;4(2):78-82.
7. Soltani G, Ahmadi B, Pourreza A, Rahimi A. Investigating Prevalence of deaths from Traffic Accidents and Factors Associated with it in Yazd in 2009. *SSU\_Journals*. 2014;21(6):831-9.
8. Jha N, Srinivasa D, Roy G, Jagdish S, Minocha R. Epidemiological study of road traffic accident cases: A study from South India. *Indian J Community Med.* 2004;29(1):20-4.
9. Singh A, Bhardwaj A, Pathak R, Ahluwalia S. An epidemiological study of road traffic accident cases at a tertiary care hospital in rural Haryana. *Indian J Community Health.* 2012;23(2):53-5.
10. Ismail MA, Abdelmageed S. Cost of road traffic accidents in Egypt. *World Acad Sci Engin Tech.* 2010;66:1322-8.
11. Dao NX. The cost of road traffic accident in vietnam. *proceedings of the eastern asia society for transportation studies*, vol. 5. 2005.
12. Rezaei S, Arab M, Karami MB, Akbari SA. Extent, consequences and economic burden of road traffic crashes in Iran. *J Inj Violence Res.* 2014;6(2):57-63.
13. Ainy E, Soori H, Ganjali M, Le H, Baghfalaki T. Estimating Cost of Road Traffic Injuries in Iran Using Willingness to Pay (WTP) Method. *PLoS ONE.* 2014;9(12): e112721.
14. Maraci M, Tabaresfahani M. The Burden of Road Traffic Injuries in Isfahan, Iran in 2010. *J Kerman Uni Med Sci.* 2013;20(5):505-19.
15. Manouchehrifar M, Hatamabadi HR, Derakhshandeh N. Treatment Costs of Traffic Accident Casualties in a Third-level Hospital in Iran; a Preliminary Study. *Emergency.* 2014;2(1):40-2.
16. Sehat M, Naieni K, Asadi-Lari M, Foroushani A, Malek-Afzali H. Socioeconomic Status and Incidence of Traffic Accidents in Metropolitan Tehran: A Population-based Study. *Int J Prev Med.* 2012;3(3):181-90.
17. Fatmi Z, Hadden W, Razzak J, Qureshi H, Hyder A, Pappas G. Incidence, patterns and severity of reported unintentional injuries in Pakistan for persons five years and older: results of the National Health Survey of Pakistan 1990-94. *BMC Public Health.* 2007;7:152.
18. Karbakhsh M, Zandi N, Rouzrokh M, Zarei M. Injury epidemiology in Kermanshah: the National Trauma Project in Islamic Republic of Iran. *East Mediterr Health J.* 2009;15(1):57-64.
19. Onieva-García M, Martínez-Ruiz V, Lardelli-Claret P, Jiménez-Moleón J, Amezcua-Prieto C, de Dios Luna-Del-Castillo J, et al. Gender and age differences in components of traffic-related pedestrian death rates: exposure, risk of crash and fatality rate. *Inj Epidemiol.* 2016;3(1):14.
20. Mohaymany AS, Kashani AT, Ranjbari A. Identifying driver characteristics influencing overtaking crashes. *Traffic Inj Prev.* 2010;11(4):411-6.
21. Anantharaman V, Logaraj M. Epidemiology of Road Traffic Accidents (RTA) Reported at a Tertiary care hospital in Chennai. *National J Res Community Med.* 2015;4(1):101-5.
22. Kanchan T, Menezes RG, Bakkannavar SM. Age and gender variations in trend of road traffic fatalities in Manipal, India. *Med Sci Law.* 2010;50(4):192-6.
23. Issa Y. Effect of driver's personal characteristics on traffic accidents in Tabuk city in Saudi Arabia. *J transport lit.* 2016;10(3):25-9.
24. Fakharian E, Taghaddosi M, Masoud SA. Epidemiology of head trauma in Kashan. *KAUMS Journal (FEYZ).* 2003;7(1):64-70.
25. Javouhey E, Guerin A-C, Chiron M. Incidence and risk factors of severe traumatic brain injury resulting from road accidents: a population-based study. *Accid Anal Prev.* 2006;38(2):225-33.

26. Swedler DI, Bowman SM, Baker SP, editors. Gender and age differences among teen drivers in fatal crashes. *Annals of Advances in Automotive Medicine/Annual Scientific Conference*; 2012: Association for the Advancement of Automotive Medicine.
27. Mishra B, Sinha MN, Sukhla S, Sinha A. Epidemiological study of road traffic accident cases from Western Nepal. *Indian J community Med*. 2010;35(1):115-21.
28. Kiran ER, Saralaya KM, Vijaya K. A prospective study on road traffic accidents. *J Punjab Acad Forensic Med Toxicol*. 2004;4:12-6.
29. Mashreky SR, Rahman A, Khan T, Faruque M, Svanström L, Rahman F. Hospital burden of road traffic injury: major concern in primary and secondary level hospitals in Bangladesh. *Public health*. 2010;124(4):185-9.
30. Torabi A, Tarahi M, Mahmoudi GA. Epidemiology of motorcycle accident in Khoramabad, Iran. *Payesh*. 2009;8(3):253-62.
31. Hailemichael F, Suleiman M, Paulos W. Magnitude and outcomes of road traffic accidents at Hospitals in Wolaita Zone, SNNPR, Ethiopia. *BMC Res Notes*. 2015;8:135.