Original Article

Descriptive Epidemiology of Road Traffic Mortality Caused by Heavy Vehicles in Iran in 2018

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Abstract

Background: Road traffic accidents (RTAs) have become an important public health problem and the mortality rate due to RTAs in Iran is significantly higher than the international standards. There is no accurate information about the mortality rate caused by heavy vehicles in Iran. Therefore, this study aimed at evaluating road traffic mortality caused by heavy vehicles in Iran. **Materials and Methods:** In this cross-sectional study, the mortality rate caused by heavy vehicles was evaluated regarding age, sex, marital status, education, place and type of accident, and traffic classification. The relative frequency percentage was used for descriptive analysis. T-test, Chi-square, and one-way ANOVA were used to examine the relationship between the variables. **Results:** A total of 3560 persons died only due to heavy vehicle accidents, and the age-standardized mortality rate was 4.34 per 100,000 populations. The mean age of the victims was 38.9 ± 20.8 years. Furthermore, 80% of the victims were male. Results showed that 83% of all deaths occurred outside cities, and the most common type of vehicle used by the victims was truck and trailer. The highest percentage (57.3%) of accidents was related to heavy and light vehicles. **Conclusions:** The rate of RTAs-related mortality rate caused by heavy vehicles in Iran is higher than the basic international rate, and there is a need to investigate the causes of this issue.

Keywords: Heavy vehicles, Iran, mortality rate, road traffic accident

Introduction

Road traffic accidents (RTAs) are a growing problem in the fields of health (mortality, illness, hospitalization, and disability) and development (low socioeconomic status).[1] The number of road traffic deaths is more than 1.35 million people (18.2 per 100,000 populations) each year worldwide. Road accidents are the eighth cause of human death and the ninth cause of burden of disease. The World Health Organization (WHO) estimates that by 2030, road traffic deaths will be the third leading cause of burden of diseases and the fifth leading cause of death. Almost, 93% of road traffic deaths occur in low- and middle-income countries.[2,3] RTAs are the second leading cause of deaths, the first cause of years of life lost due to premature death, and the most common case of injuries in Iran.[3,4] According to a report by the WHO in 2016, 15,932 death incidents (19.85 per 100,000 population) were due to RTAs in Iran.[5]

Various factors such as a human factor, roads, increasing number of vehicles and population, poor infrastructure, and

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safety defects of roads can contribute to the occurrence of traffic accidents, the most important of which is the type of vehicle.[6,7] Heavy vehicles are one of the most important vehicles and cover the largest volume of transportation.[8] Motorized vehicles make up 57% and 75% of all deaths due to RTAs worldwide and in Iran, respectively.[9] The number of heavy vehicles has increasingly doubled from 2010 to 2016 in Iran and reached the number of 1,212,180 vehicles.[4] According to Iran Road Maintenance and Transportation Organization, heavy vehicles have the largest share in transporting passengers and goods in the country. Since even any minor mistake in driving heavy vehicles can endanger the lives of many people, it is inevitable to pay enough attention to driver health and assess their accidents frequently.[8]

The dynamic behavior of heavy vehicles has significant differences compared to passenger cars. When cars of similar wheelbase but different mass crash into each other, the fatality risk is higher in the lighter cars.[10] Heavy vehicle accidents often lead to personal injuries and fatalities as well as large financial costs. The most common accident in motorized vehicles is truck accident against passenger car accident, where the accident severity is much worse for the passenger car. A large percentage of accidents involving trucks lead to death.[11,12]

Limited studies have been conducted on mortality rates due to heavy vehicle accidents in the world and these studies have shown different results as follows: 49%, 6.2%, and 12.7% of RTA deaths were related to heavy vehicles in Sweden, Singapore, and Italy, respectively.[10,13,14] Most of the studies that have been conducted on RTAs focused on light motorized vehicles and pedestrian mortality; heavy vehicle accidents and their characteristic mechanisms were neglected.

Despite the low density of heavy vehicles compared to other vehicles, a substantial proportion of deaths from RTAs are due to heavy vehicles. This density is 4% for Iran; however, no study has been conducted to determine the proportion of mortality due to heavy vehicle accidents in Iran. Calculating the size and dimensions of RTAs is one of the most important tools of health policymakers in the country that can use them to make the necessary plans to control and prevent such mortality. Because there is no comprehensive research and information about the rate of mortality caused by heavy vehicles in Iran, this study aimed at evaluating data on mortality due to RTAs caused by heavy vehicles in Iran in 2018.

Materials and Methods

This cross-sectional study was conducted on fatality data collected from the Iranian Legal Medicine Organization (ILMO) and population data obtained from the Statistical Center of Iran in 2018 on all roads in this country. In Iran, the ILMO must issue a death certificate for all suspicious deaths. Since deaths in traffic accidents are categorized among the suspicious deaths, the data registered by the ILMO are considered as complete sources of data on traffic accidents. The mortality rate

due to heavy vehicle accidents was calculated in 2018 using the data collected by ILMO. Legal Medicine Organization, Islamic Republic of Iran, has approved all ethical considerations with the approval ID: IR.LMO.REC.1399.056.

The target population included all people who died (census) in RTAs and registered in ILMO in which one side of the accident was a heavy vehicle. In this study, the heavy vehicle accident was defined as an accident registered in the ILMO dataset in which at least one side was a heavy vehicle such as a bus, minibus, trunk, trailer, agricultural machinery, dangerous-goods tank vehicle, and road construction machinery.

ILMO dataset was used to collect and clean data on different variables including age, sex, marital status, education, role of deceased person (driver, passenger, pedestrian), province of accident, a type of vehicle involved in an accident, a type or mechanism of heavy vehicle accidents (collision between heavy vehicles, between a heavy vehicle and pedestrians, between a 4-weel light motor vehicle and a heavy vehicle, between a motorcycle or bike and a heavy vehicle, between a heavy vehicle and an unknown object, etc.,), the lighting status at the time of accident (day, night, sunset, or sunrise), and traffic classification (inside or outside city). The accidents occurring outside cities were defined as crashes happening outside urban geographical areas where covered and monitored by road police and accidents occurring inside cities were defined as crashes happening within an urban geographical area.

To calculate the mortality rate, the growth rate was calculated using the growth rate formula at first; for the population of Iran, the growth rate was not available in 2018. By multiplying its numerical value (growth rate) upon the population of the previous year, the population in 2017 was estimated.

Growth rate =

$$\left(\frac{\text{Population of country based on the 2016 census}}{\text{Population of country based on the 2011 census}} \right)^{\frac{1}{5}}$$

Then, using the growth rate again, the population of 2018 was calculated (81,921,349). The estimated population was used as the denominators of mortality rate. The numerator was the number of deaths.

In this study, all of the mortality rates are presented per 100,000 populations.

Mortality rate =

$$\left(\frac{\text{Number of deaths due to heavy vechicle accidents in 2018}}{\text{Total population in } 2018} \right) \times 100,000$$

After calculating the road-traffic mortality rate, this rate was standardized by the direct method to compare rates regardless of age differences, using the world standard population.[15]

The relative frequency percentage was used for descriptive analysis. Furthermore, Chi-square test was used to assess the association between traffic classification and lighting status and sex. One-way ANOVA was applied to find a relationship between age and the mechanism of heavy vehicle accidents. Weighted logistic regression was also applied for ascertaining the relation between mortality and demographic variables. Finally, the data were analyzed using Stata 15 (Stata Corp., College Station, TX, USA).

RESULTS

A total of 17,076 persons died due to RTAs and 3560 persons were victims of heavy vehicle accidents in Iran in 2018, which accounts for 20% of all mortality caused by RTAs. Crude mortality rates due to RTAs and heavy vehicle accidents were 20.84 and 4.34/100,000 population, respectively. The age-standardized mortality rate due to heavy vehicle accidents was 4.23/100,000 population (95% confidence interval [CI]: 4.09–4.37).

The mean age of the victims was 38.9 ± 20.8 years. The minimum and maximum ages observed were a neonate and a 92-year-old male. There was no significant relationship between the mean age of males (38.73 years old) and females (39.47 years old) ($P = 0.08$). Table 1 demonstrates the other demographic variables and traffic classifications. There was a significant relationship between sex and

traffic classification; so that, the risk of death for men was 1.4 times higher than the risk for women in inside-city roads (odds ratio = 1.4, 95% CI: 1.28, 1.53).

Although the highest mortality rate (5.24 per 100,000 population) was observed in the age of older than 60 years with a relative frequency of 13.6 but the highest relative frequency (73.0) was observed in a 20–59 age group with a mortality rate of 4.79 per 100,000 population [Table 2]. Table 2 shows the frequency and mortality rate regarding the age groups. Figure 1 presents the mortality rate regarding the province of accidents. It shows the highest mortality rates in Qazvin (11), Semnan (9.6), and Zanjan (7.4/100,000 population) provinces, and the lowest mortality rates were in Tehran (1.7), Alborz (1.7), and Hormozgan (3/100,000 population), respectively.

Relative frequency of mortality by lighting status at the time of the accident was 52.3% during the day, 37.5% at night, and 9.5% during sunset or sunrise. There was a statistically significant relationship between lighting status at the time of the accident and the traffic classification (inside or outside city) ($P = 0.001$). Concerning victims, the highest percentage was observed in drivers (48.6%), passengers (36.7%), and pedestrian (13.9%) [Table 1].

This study investigated the type of vehicles used by the deceased persons, and the results showed that the most common vehicles involved in accidents were trucks (7.12%),

Table 1: Traffic classification and demographic factors in people who died in heavy vehicle accidents in Iran in 2018

Variables	Frequency (%)	Mortality rate	P	OR (95% CI)
Sex				
Male	2858 (80)	6.87	0.001	1.00
Female	702 (20)	1.74		0.25 (0.23-0.27)
Marital status*				
Single	1132 (32.3)	5.53	0.007	1.00
Married	2383 (67.7)	5.01		0.91 (0.84-0.97)
Education†				
Illiterate	580 (17.5)	7.1	0.001	1.00
Elementary	672 (21.5)	8.7		1.23 (1.10-1.38)
Intermediate	664 (22.2)	21,0		2.96 (2.65-3.31)
High school and collage	864 (27.6)	37.3		5.27 (4.75-5.86)
Graduated	30 (10.7)	6.7		0.82 (0.57-1.19)
Traffic classification‡				
Inside city	599 (17)	0.75	0.001	1.00
Outside city	2578 (83)	3.59		4.3 (3.94-4.70)
Role of deceased person‡				
Driver	1728 (48.6)	2.11	0.001	1.00
Passenger	494 (13.9)	1.59		0.72 (0.67-0.77)
Pedestrian	1307 (36.7)	0.60		0.18 (0.16-0.20)
Lighting status‡				
Day	1843 (52.3)	2.30	0.001	1.00
Night	1324 (37.5)	1.62		0.28 (0.26-031)
Sunrise or sunshine	336 (9.5)	0.41		0.76 (0.70-0.81)

*The estimated population of single and married people in 2016 was used as the denominator to calculate mortality rate, †The estimated population of illiterate and educated people in 2016 was used as the denominator to calculate mortality rate, ‡Total population of the country was used as the denominator to calculate mortality rate. OR: Odds ratio, CI: Confidence interval
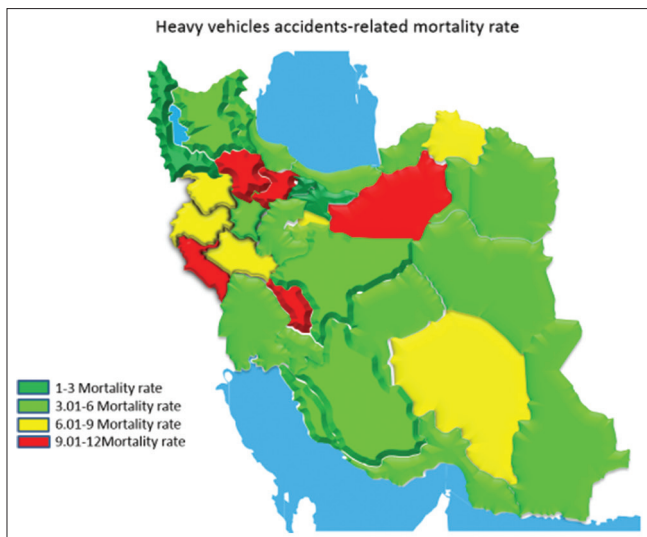
Figure 1: Mortality rate due to heavy vehicle accidents regarding the province of accidents and traffic classification, Iran, 2018

Figure 2: Relative frequency of mortality by the type of heavy vehicle accidents, Iran, 2018

followed by trailers, bus, minibus, construction machinery, agricultural machinery, and tank vehicles for the transportation of hazardous material. Figure 2 illustrates mortality percentages by the type of heavy vehicles. Figure 3 presents the mechanisms of heavy vehicle accidents; as shown, the most accidents were observed between heavy vehicles and 4-weel light vehicles with 2.3/100,000 population. The percentages of collisions in heavy versus 4-weel light motor vehicle, heavy versus motorcycle and bike, heavy vehicle and pedestrians, heavy versus heavy vehicles, and heavy vehicle versus others were 52.5%, 14.3%, 14.1%, 7.9%, 11.2%, respectively. There was a statistically significant relationship between age and the mechanism of heavy vehicle accidents ($P = 0.001$).

DISCUSSION

The current study is the first research that describes the epidemiologic characteristics of mortality rates due to heavy vehicle accidents in Iran. The results of this study showed that RTA-related mortality rate was 20.8 per 100,000 population in Iran, which is more than RTA-related mortality rate observed in the world (18.2/100,000 population) and Eastern Mediterranean Region (18/100,000 population). RTA-related mortality rate is 29.3, 23.6, and 5.1 per 100,000 populations in low-, middle-, and high-income countries, respectively. In developed countries such as Australia, Belgium, Canada, Denmark, and France, the RTA-related mortality rates are between 5.5 and 6/100,000 population; in undeveloped countries such as Malaysia, Venezuela, Thailand, and Saudi Arabia, these rates are between 23.5 and 32.5/100,000 population. This rate in Iran is between undeveloped and developed countries because this country is in the transition stage and becoming a developed country in the future. Although Iran is one of the highest ranked countries in RTA-related mortality rate in the world, the trend of RTA-related mortality is descending in the last decade.[4] This reduction seems to be the outcome of an
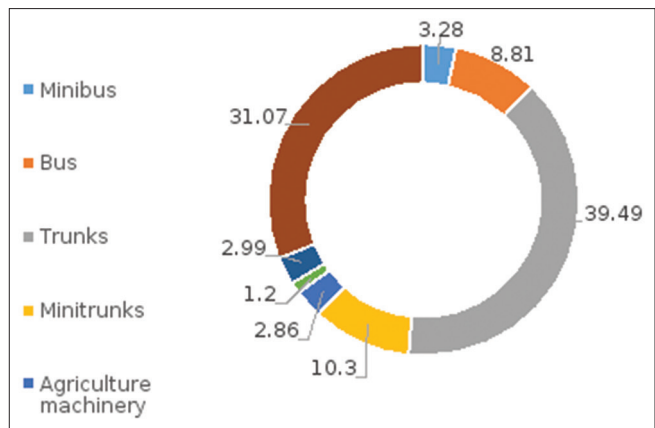
integrated collaboration between the Ministry of Health and Medical Education (by enhancing the emergency medical services in terms of technical, equipment, and operational) and traffic police (the enforcement of seat belt laws, motorcycle helmet law, speed limit laws, drunk driving law, and law on cell-phone use while driving).[16]

According to the WHO's report, heavy vehicles account for only 4% of all vehicles; our finding showed that heavy vehicles' mortality accounted for 20% of all RTA-related mortality. Heavy vehicles' mortality rate is 4.23/100,000 population in Iran. According to a study conducted in Australia in 2011, although 22% of all vehicles were heavy vehicles, they caused only about 33% of all RTA-related mortality.[17] In another study in Sweden, 49% of accidents are for heavy vehicles, although heavy vehicles account for only 9% of all vehicles of traffic stream in the area. The mortality rate due to heavy vehicle accidents was 2.8/100,000 population in Sweden.[13] In other studies in Singapore and India, 6.2% and 12% of mortality rates in all RTAs were related to heavy vehicles, respectively.[18,19] This significant difference could be attributed to wearing-out of heavy vehicles, undesirable road safety and quality, and unsafe features of vehicles in Iran.

In this study, most of victims were male (80%); similarly, males accounted for the largest part of mortality in other provinces of Iran[20-26] and other countries such as Kuwait, Vietnam, India, Singapore, and Saudi Arabia.[18,19,26-28] It could be due to their higher level of occupational exposure, cultural issues, and social features. However, this finding might also be attributed to other factors; for instance, women are more cautious than men when driving and they are less prone to use heavy vehicles.[23,24,29]

The highest percentage (73%) of the victims was related to the 20–59-year age group, similar to the age group of victims due to RTAs in the world.[4] In other studies, the age group with the highest level of involvement in RTA (both light and heavy vehicles) was the 18–37 years' age group in India,[30] 18–30 years' age group in China,[31] and 16–25 years' age group in Thailand.[32] This age group is the productive age group in community, especially in terms of socioeconomic activity.
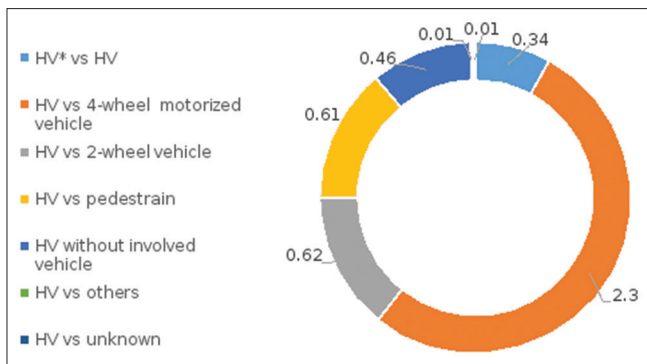
Shojaei, *et al*.: Heavy vehicles' mortality rate in Iran

Figure 3: Mortality rate of the mechanism of Heavy Vehicle (*HV) Accidents, Iran, 2018

Table 2: Mortality rate and frequency of heavy vehicle accidents by age groups in Iran in 2018

Age group	Frequency (%)	Mortality rate (per 100,000 population)
<5	130 (3.7)	4.32
5-19	323 (9.1)	1.74
20-59	2599 (73.0)	4.79
+60	485 (13.6)	5.24

Therefore, their death leads to the largest level of damage to the country's economy. Accordingly, controlling or minimizing such deaths will have positive economic and social effects. Our findings support the results of other studies in Iran[24-26,32-36] and in other countries.[27] It might be attributed to the higher rate of prevalence of travels among a young age group, more involvement in road transport, the greater tendency toward risky activities and behaviors, a lower level of tendency to obey traffic laws, and high tendency to drive at high speeds.[37]

The frequency of death in older people is lower than in younger people, while the RTA-related mortality rate in elderly people is much higher than in other age groups. This is consistent with the results of other studies conducted in Iran.[38,39] According to a study conducted in China, RTA-related mortality in + 65 years' age group is twice higher than young people.[40] The elderly people are more vulnerable in RTA, which is due to their low physical and psychological tolerance, old age and associated disorders, decreased cognitive abilities, and impaired vision and hearing in the elderly people; the mentioned factors could be the causes of the high rate of death in this age group. These findings are consistent with the results of studies conducted by Yazdani, Cherati, and Teravatmanesh.[34,41]

The level of education in most victims was at high school and college levels. Based on other studies, education is a proxy of socioeconomic status. According to other studies conducted in Finland, New Zealand, and Islamic Republic of Iran, an education level had a significant inverse relationship with the risk of accidents and mortality rate due to RTAs.[20,33,42]

This study shows that the most type of accident observed in collisions occurs between heavy vehicles and 4-wheel light vehicles. The issue is consistent with the results of the studies conducted in Australia, Sweden, and India[13,19,43] and a previous research on heavy vehicle accidents in Iran.[33] The consistency of our findings with the results of other studies can be attributed to the fact that the highest burden of road transfer is on buses, trucks, and long vehicles (which have the highest share in road accidents). Furthermore, the findings of this study revealed that the size of heavy vehicles compared with light vehicles is a vulnerable condition for light vehicles regarding the speed factor.

Mortality rate due to heavy vehicles in outside cities was higher than in inside cities. Similar results were seen in Sweden[13] and a prior study in Iran.[44] Apparently, it should be attributed to the factors as severity of accidents, the type of vehicle, weakness in postcrash care services for victims outside cities, lack of specialized rescue facilities and equipment especially outside cities, information system malfunction and poor conditions in roads outside cities (such as unsafe roads especially in rural areas), inappropriate geometrical structure of the roads such as arches and sharp angles in some routes, mountainous and spiral roads, lack of roadside protection (guardrail), lack of parking in dirt roads out of cities, and lack of optimal lighting in some roads. In addition to the abovementioned items, the most significant difference between the inside and outside of city accidents is the higher speed of vehicles in outside city roads that also increase the severity of accidents.[45-52]

This study had some limitations. First, the real high-risk population was not available to calculate RTA-related mortality rate, using the population of the whole country and the population of each province. Second, in this study, people living in each province (residents) were used as the denominator to calculate mortality rates, while the best option is to use not only the residents but also the nonresident population, i.e., the people traveling to each province or drive a car or the number of trips or kilometers traveled per year. However, after referring to the tourism agency, it was found that the statistical data on nonresident population were collected only for a new-year vacation period.

CONCLUSIONS

The RTA-related mortality rate caused by heavy vehicles is high in Iran. According to the results of this study, a low level of literacy and socioeconomic status and being young are some of the risk factors affecting the mortality rate. Hence, policymakers should prioritize interventions such as training men at the younger ages, which can be an appropriate solution to reduce the RTA. There are lots of preventable actions that can help minimize this rate. Therefore, policymakers should make some changes or do something new to reduce this rate. Furthermore, because most of the accidents have led to death in outside cities, it is recommended to conduct further analytic studies to investigate factors associated with the incidence of accidents on the outside of cities in Iran.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Peden M, Scurfield R, Sleet D, Mohan D, Hyder AA, Jarawan E, *et al*. World Report on Road Traffic Injury Prevention. Geneva: World Health Organization; 2004.
2. Organization WH. Global Status Report on Road Safety 2013: Supporting a Decade of Action: Summary. Geneva, Switzerland: World Health Organization; 2013.
3. Izadi N, Najafi Farid F, Khosravi A, Hashemi Nazari S, Salari A, Soori H. Estimation of mortality and calculated years of lost life from road traffic injuries. J Mazandaran Univ Med Sci 2014;24:51-8.
4. Organization WH. Global Status Report on Road Safety 2018: Summary. Geneva, Switzerland: World Health Organization; 2018.
5. Organization WH. Summary Report on the Expert Consultation on Road Safety in the Eastern Mediterranean Region. Cairo, Egypt: World Health Organization. Regional Office for the Eastern Mediterranean; 2016.
6. Touahmia M. Identification of risk factors influencing road traffic accidents. Eng Technol Appl Sci Res 2018;8:2417-21.
7. Khazaie H, Zakiei A, Rezaei M, Brand S, Komasi S. The role of traffic and road accidents in causing disabilities in Iran. Iran J Public Health 2020;49:1804-5.
8. Motevalian S, Jahani M, Mahmoodi MJ. Driving under influence of opiates in heavy vehicle drivers of Iran in 2001. Hakim health systems research journal 2004;7:1-8.
9. Tran N. Global Status Report on Road Safety 2018. Geneva: World Health Organization; 2018.
10. Evans L, Frick MC. Car size or car mass: which has greater influence on fatality risk? Am J Public Health 1992;82:1105-12.
11. Trigell AS, Rothhämel M, Pauwelussen J, Kural K. Advanced vehicle dynamics of heavy trucks with the perspective of road safety. Veh Syst Dyn 2017;55:1572-617.
12. Naderi H, Nassiri H, Sahebi S. Assessing the relationship between heavy vehicle driver sleep problems and confirmed driver behavior measurement tools in Iran. Transp Res Part F Traffic Psychol Behav 2018;59:57-66.
13. Björnstig U, Björnstig J, Eriksson A. Passenger car collision fatalities – With special emphasis on collisions with heavy vehicles. Accid Anal Prev 2008;40:158-66.
14. Pitidis A, Mamo C, Dalmasso M, Costa G. RT accident mortality in Italy: A population-based study in Piedmont on Vulnerable Road Users. Eur J Public Health 2019;29 Suppl 4:ckz185.
15. Ahmad OB, Boschi-Pinto C, Lopez AD, Murray CJ, Lozano R, Inoue M. Age Standardization of Rates: A New WHO Standard. Vol. 9. Geneva: World Health Organization; 2001.
16. Shahbazi F, Soori H, Khodakarim S, Ghadirzadeh MR, Hashemi Nazari SS. Analysis of the mortality rate of road traffic accidents and its trend in 11 years in Iran. Arch Trauma Res 2019;8:17-22.
17. Raftery S, Grigo J, Woolley JE. Heavy Vehicle Road Safety: Research Scan. Australia: Center for Automotive Safety Research, University of Adelaide; 2011.
18. Wong E, Leong MK, Anantharaman V, Raman L, Wee KP, Chao TC. Road traffic accident mortality in Singapore. J Emerg Med 2002;22:139-46.
19. Hsiao M, Malhotra A, Thakur JS, Sheth JK, Nathens AB, Dhingra N, *et al*. Road traffic injury mortality and its mechanisms in India: Nationally representative mortality survey of 1.1 million homes. BMJ Open 2013;3:e002621.
20. Mirzaei M, Mirzadeh M, Shogaei Far H, Mirzaei M. Trends in road traffic deaths in Yazd, Iran, 2004 – 2010. Arch Trauma Res 2016;5:e29266.
21. Monsef V, Asadi PJ, Prevention I. Mortality due to road traffic injuries in Guilan province in 2011–2012. Safety Promotion and Injury Prevention (Tehran) 2015;3:97-102.
22. Moharamzad Y, Taghipour H, Hodjati Firoozabadi N, Hodjati Firoozabadi A, Hashemzadeh M, Mirjalili M, *et al*. Mortality pattern according to autopsy findings among traffic accident victims in Yazd, Iran. Chin J Traumatol 2008;11:329-34.
23. Bahadorimonfared A, Soori H, Mehrabi Y, Delpisheh A, Esmaili A, Salehi M, *et al*. Trends of fatal road traffic injuries in Iran (2004-2011). PLoS One 2013;8:e65198.
24. Roudsari BS, Sharzei K, Zargar M. Sex and age distribution in transport-related injuries in Tehran. Accid Anal Prev 2004;36:391-8.
25. Fazel MR, Fakharian E, Mahdian M, Mohammadzadeh M, Salehfard L, Ramezani M. Demographic profiles of adult trauma during a 5 year period (2007-2011) in Kashan, IR Iran. Arch Trauma Res 2012;1:63-6.
26. Mahdian M, Sehat M, Fazel MR, Moraveji A, Mohammadzadeh MJ. The epidemiology of urban traffic accident victims was hospitalized for more than 24 h in a level III trauma center, Kashan County, Iran, during 2012–2013. Archives of Trauma research. 2015;4:e28465.
27. Ngo AD, Rao C, Hoa NP, Hoy DG, Trang KT, Hill PS. Road traffic related mortality in Vietnam: Evidence for policy from a national sample mortality surveillance system. BMC Public Health 2012;12:561.
28. Alghnam S, Palta M, Hamedani A, Remington PL, Alkelya M, Albedah K, *et al*. In-hospital mortality among patients injured in motor vehicle crashes in a Saudi Arabian hospital relative to large US trauma centers. Injury epidemiology 2014;1:21.
29. Hasanzadeh J, Moradinazar M, Najafi F, Ahmadi-Jouybary T. Trends of mortality of road traffic accidents in Fars Province, Southern Iran, 2004–2010. Iranian journal of public health 2014;43:1259.
30. Kumar A, Lalwani S, Agrawal D, Rautji R, Dogra T. Fatal road traffic accidents and their relationship with head injuries: An epidemiological survey of five years. The Indian Journal of Neurotrauma 2008;5:63-7.
31. Zhou JH, Zhao XC, Wang ZG, Zhu PF, Jian HG, Liu DW, *et al*. The analysis of epidemiological characteristics of road traffic crashes in a mountain city in Western China. Chin J Traumatol 2003;6:355-8.
32. Suriyawongpaisal P, Kanchanasut S. Road traffic injuries in Thailand: Trends, selected underlying determinants and status of intervention. Inj Control Saf Promot 2003;10:95-104.
33. Sadeghi-Bazargani H, Samadirad B, Shahedifar N, Golestani M. Epidemiology of road traffic injury fatalities among car users; A study based on forensic medicine data in East Azerbaijan of Iran. Bull Emerg Trauma 2018;6:146-54.
34. Taravatmanesh S, Hashemi-Nazari SS, Ghadirzadeh MR, Taravatmanesh LJ, Prevention I. Epidemiology of fatal traffic injuries in the Sistan and Baluchistan province in 2011. Safety promotion and injury prevention (Tehran) 2015;3:161-8.
35. Davoodi F, Hashemi-Nazari SS, Ghadirzadeh MR, Prevention I. An Epidemiology study of road traffic accidents resulting in death: In Lorestan province in 2012. Safety promotion and injury prevention (Tehran) 2016;3:257-62.
36. Khorrami Z, Nazari SS, Ghadirzadeh MR, Prevention I. An Epidemiology study of deaths from road traffic accidents. Safety promotion and injury prevention (Tehran) 2017;4:217-24.
37. Violence WHO, Prevention I, Organization WH. Global Status Report on Road Safety 2013: Supporting a Decade of Action. Geneva, Switzerland: World Health Organization; 2013.
38. Mehmandar M, Soori H, Amiri M, Norouzirad R, Khabzkhoob M. Risk factors for fatal and nonfatal road crashes in Iran. Iran Red Crescent Med J 2014;16:e10016.
39. Mahdian M, Fazel MR, Sehat M, Mohammadzadeh M, Akbari HJ. Years of life lost and mortality rate due to road traffic injuries in Kashan Region, Iran, during 2012–2013. Biosci Biotech Res Asia 2015;12:741-6.
40. Lee WY, Cameron PA, Bailey MJ. Road traffic injuries in the elderly. Emerg Med J 2006;23:42-6.
41. Yazdani Cherati J, Ahmadi Baseri E, Ghadami MJ. Mapping of mortality rate in suburban accidents, Mazandaran Province, 2007–2010. Journal of Mazandaran University of Medical Science 2013;22:50-8.
42. Monsef V, Asadi P, Ziabari SMM. Mortality due to road traffic injuries in Guilan province in 2011-2012. Safety promotion and injury prevention (Tehran). 2015;3:97-102.
43. Brodie L, Bugeja L, Ibrahim J. Coroners' recommendations following fatal heavy vehicle crash investigations. Aust N Z J Public Health 2010;34:136-41.

44. Khorasani Zavareh D, Mohammadi R, Laflamme L, Naghavi M, Zarei A, Haglund BJ. Estimating road traffic mortality more accurately: Use of the capture-recapture method in the West Azarbaijan Province of Iran. Int J Inj Contr Saf Promot 2008;15:9-17.

45. Sassi S, Hakko H, Räty E, Riipinen P. Light motor vehicle collisions with heavy vehicles – Psychosocial and health related risk factors of drivers being at-fault for collisions. Forensic Sci Int 2018;291:245-52.

46. Whitlock G, Norton R, Clark T, Jackson R, MacMahon S. Motor vehicle driver injury and marital status: A cohort study with prospective and retrospective driver injuries. Inj Prev 2004;10:33-6.

47. Khorrami Z, Nazari SSH, Ghadirzadeh MR. An Epidemiology study of deaths from road traffic accidents. Safety promotion and injury prevention journal (Tehran). 2016;4:217-24.

48. Ardalan A, MASOUMI G, GOUYA MM, Sarvar M, Hadadi M, Miadfar J, *et al*. Road traffic injuries: A challenge for Iran's health system. Iranian J Publ Health. 2009;38:98-101.

49. Weiss SJ, Ellis R, Ernst AA, Land RF, Garza A. A comparison of rural and urban ambulance crashes. Am J Emerg Med 2001;19:52-6.

50. Muelleman RL, Mueller K. Fatal motor vehicle crashes: Variations of crash characteristics within rural regions of different population densities. J Trauma 1996;41:315-20.

51. Muelleman RL, Walker RA, Edney JA. Motor vehicle deaths: A rural epidemic. J Trauma 1993;35:717-9.

52. Boland M, Staines A, Fitzpatrick P, Scallan E. Urban-rural variation in mortality and hospital admission rates for unintentional injury in Ireland. J Epidemiol Community Health 2005;59:557.