Research in Health & Medical Sciences *Original Article*

2022 December; 1(4)

Eleven Year Trend of Road Traffic Accident Mortality and Related Factors in Northeast Iran (2006–2016)

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Received: 2024/5; Revised: 2024/6; Accepted: 2024/8

Abstract

Every year, Road Traffic Accidents (RTAs) kill 1.2 million people worldwide. Deaths, injuries, and disabilities caused by RTAs are serious public health concerns that have not been adequately addressed. This study aimed to determine the 11-year trend of RTA deaths **in northeast** Iran and related factors.

This was a descriptive-analytic study. Relevant data were obtained from the Iranian Legal Medicine Organization. All data were based on the classification and coding of the ICD10 causes of death. Descriptive information of variables was analyzed using the SPSS software package (ver. 22). Trend line charting and forecast function were also predicted by using Microsoft Excel 2013 software package. Research variables included contextual variables, impact location, accident location (urban or non-urban), accident mechanism, deceased status, place of death, accident and death times, type of vehicle, and final cause of death.

A total of 17511 individuals, including 12709 (75.7%) males and 4080 (24.3%) females, died. The mean age of the deceased was 38.64±22.28. About half the people died at the scene. Most of the deaths were among drivers, followed by passengers and pedestrians. The forecast function predicts a downward trend in RTA deaths over the next five years (from 2006 to 2016). There was a significant relationship between the location of the injury and the cause of death ($p < 0.001$). In the early years of the study, the cause of death mainly was bleeding and, in recent years, head injuries. This study showed that despite the increase in population and number of vehicles, the rate of RTA deaths has decreased and will continue to do so. However, due to the multifactorial causes of deaths from RTAs, significant policies need to be revised to improve public health and safety.

Key words: road traffic death, accident victim, fatal traffic accident, road traffic death forecasting

Introduction

Road Traffic Accidents (RTAs) kill 1.2 million people worldwide each year, 90% of which are in low- and middle-income countries (1, 2, and 3). RTAs are the second leading cause of death, the first cause of years of life lost due to premature death, and the most common cause of injury (4, 5). The average death from accidents in European countries is 11 per 100,000, and in Iran, 33 per 100,000 (6). One percent of the world's population lives in Iran, but 2.5 percent of the world's RTAs occur in Iran (7). In 2007 alone, 27,567 people, primarily young and children, died in RTAs, and 276,762 suffered injuries (8). Also, Iran has been the leading country in terms of the number of years of life lost due to RTA premature deaths (9). RTAs are also estimated to cost US$ 518 billion annually, accounting for about 1–5% of countries' GDP (6). The burden of deaths, disabilities, and injuries due to RTAs has harmed many nations' health, economic and social development, especially in low- and middle-income countries (10). The UN General Assembly called the 2011-2020 decade as the decade of action for road safety and called on all member states to implement preventive programs to reduce RTAs (11). In recent years, RTAs in developed countries have been declining, but the damage has increased (12). According to the World Health Organization's forecast in the next two decades, in high-income countries, the rate of RTA fatalities will be reduced by up to 28%; but in low- and middle-income countries, the figure will increase by 92%–147% (6). In Iran, the government's Sixth Development Plan wants to reduce RTAs by 31 percent by reinforcing and completing emergency relief networks and medical emergencies (13).

Injuries, deaths, and disabilities caused by RTAs are some of the serious health concerns of the community that have not been adequately addressed. Death from RTAs is one of the significant health care problems that can be prevented according to the experience of developed countries. It is also needed to implement appropriate prevention and control programs for health events, review past and present situations, and determine possible future consequences. Trend assessment and data forecasting can provide helpful information that ultimately enhances policymakers' decision-making quality (14). The first necessary step to mitigate and control these events is to identify and carefully examine the current status (15).

One way to reduce RTAs is to examine the trend of accident fatalities and the effects of different interventions (16). Unfortunately, due to the lack of comprehensive studies on RTAs in the country, there is no accurate assessment of traffic injuries (17). Despite efforts to improve the behavior of road users, such as more use of speed cameras and increased fines, the annual death toll is still high, and the epidemiology of RTAs needs further investigation (12). Despite efforts to reduce RTA injuries by the Ministry of Health, Traffic Police, and Ministry of Roads and Urban Development, due to a lack of relevant planning and health-based view, casualties and economic losses in this sector are still high (18). Although there have been numerous studies on accidents in Iran, the study of RTAs in Iran is limited (19). The purpose of this study was to determine the 11-year trend of RTA deaths and related factors.
Setting: The study was conducted in Khorasan Razavi province, the second-most populous province of Iran, with 6434501 (according to the 2016 census). The center of this province is Mashhad (the second most populous city of Iran). Every year 20 million pilgrims visit the Imam Reza holy shrine (in Mashhad), many of them by road travel (21).

Methods

This descriptive-analytical study was performed after obtaining the required authorization from Mashhad University of Medical Sciences. The data relating to those killed in the last 11 years of RTAs (from the beginning of 2006 until the end of 2016) were obtained from the Iranian Legal Medicine

Organization. The form containing the data is completed monthly by all Iranian Legal Medicine centers for each accidental death referral and sent to the relevant provincial center. All relevant data are based on the classification and coding of the ICD10 causes of death. According to the available data from different Iranian Legal Medicine centers, data validity was checked so that data were sorted by year and incomplete data were deleted, and the final data bank was created in Microsoft Excel. Research variables included type of accident, location of impact, underlying variables, location of the accident (urban or non-urban), mode of the accident, deceased status at the time of accident, place of death, time of accident and death, type of vehicle, mode of transport from the scene of the accident, and the final cause of death. The data obtained from the Iranian Legal Medicine Organization were entered into the SPSS software package (ver. 22), and descriptive variables were analyzed. T-test and ANOVA were used to compare the quantitative variables between the two groups and more, and the chi-square test was used to examine the relationship between the qualitative variables. A multivariate logistic regression test was used to investigate predictors of death (at the scene, during transfer, in the hospital, or after discharge; up to 30 days after discharge). The significance level for all tests was $p < 0.05$. Trendline charting and forecast function were also predicted using Microsoft Excel 2013. The following formula was used in the forecast function: $Y = a + bx$, where Y is the dependent variable (mortality rate), and X is the independent variable (year).

Result

From 2006 to the end of 2016, 17511 people died in RTAs in Khorasan Razavi province, of which 13255 (75.7%) were males, and 4255 (24.3%) were females. The mean and standard deviation of the deceased's age was 38.64 ±22.28, maximum and minimum ages were 112 years and less than one month, respectively. The highest mortality rate was in the 18–30 year age group (27.7%), and the lowest was in the 0 to 7 year age group (7.2%). During these 11 years, the highest mortality rate was in 2007 with 2107 deaths (12.63% of total fatalities), and 2016 with 1246 (6.84%) had the lowest deaths. The highest fatality rate was 2052 cases (12.2%) in September and the lowest in January with 925 cases (5.5%). The overall trend of accident deaths by year is shown in Figure 1. The mortality rate per 100,000 population was also calculated and reported in Table 1. The highest mortality rates were reported in 2006 with 37.7 percent and in 2016 with 19.4 percent. Urban RTAs were 4407 (32.5%), non-urban 6587 (48.5%), and 3190 (19%) elsewhere. Examination of the place of death showed 7817 cases (46.6%) at the scene of the accident, 1557 cases (9.3%) during transport, 7181 cases (42.8%) in the hospital, and 184 cases (1.1%) died at home. The causes of death were 9004 (53.6%) head trauma, 3329 (19.8%) multiple trauma, 1848 (11%) bleeding, and 1480 (8.9%) other causes such as burns and suffocation. The deceased were 6757 (40.3%) drivers, 4273 (25.5%) pedestrians, 5638 (33.6%) passengers, and 121 (0.7%) were unknown. The deceased vehicle was in 6387 cases (37.9%) light vehicles, 5252 cases (31.3%) motorcycles, 763 cases (4.85%) heavy vehicles, 113 cases (0.7%) bicycles, and the rest were pedestrians. The site of injury was 8554 (51.4%) head and face, 6326 (38%) multi-trauma, 1078 (6.5%) chest and abdomen, and 831 (4.1%) other organs.

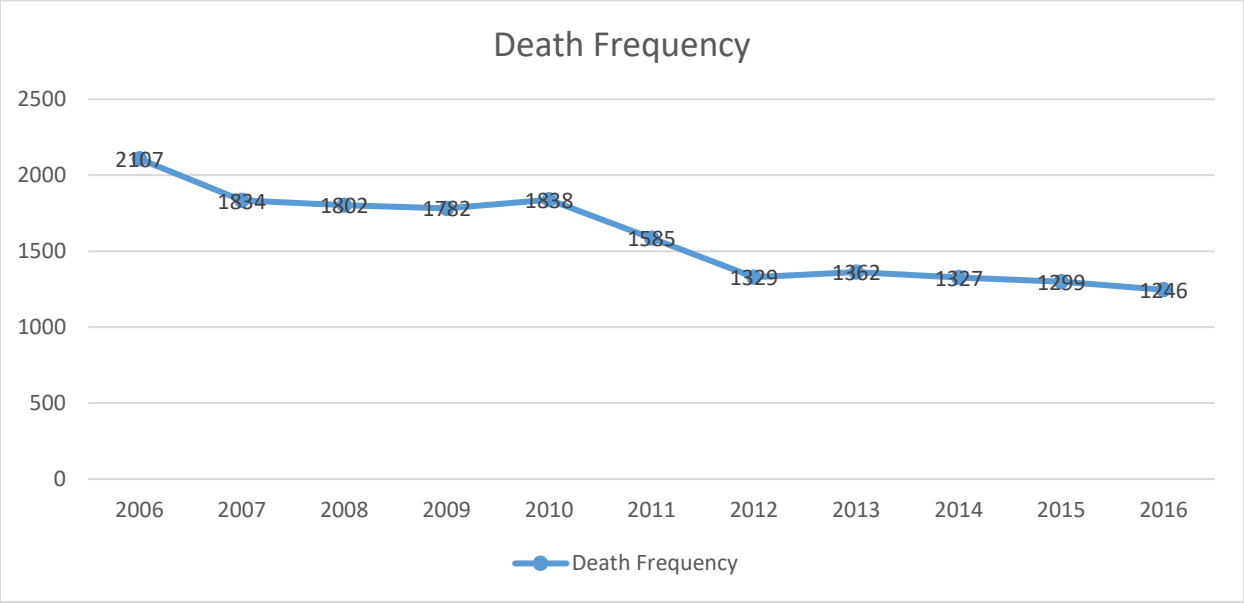

Figure 1: Overall trend of accident deaths by year

Table 1: Distribution of deaths per 100,000 population by year in Khorasan Razavi province

Mortality rate per 100,000	Number of deaths	population of the province	Year
37.7	2107	5593000	2006
32.3	1834	5668000	2007
31.4	1802	5746000	2008
30.6	1782	5826000	2009
31.1	1838	5909000	2010
26.4	1585	5994000	2011
21.8	1329	6082000	2012
22	1362	6171000	2013
21.2	1327	6262000	2014
20.4	1299	6453000	2015
19.4	1246	6434501	2016

Nearly 60 percent of deaths were in Mashhad, Neyshabur, Sabzevar, and Mashhad to Tehran road. A declining mortality rate over the next five years from 2016 to 2021 is predicted using the forecast function. Y= -0.0056x + 7.8163

Analysis showed a statistically significant relationship between the location of the injury and the cause of death ($p < 0.001$). In head and face, and chest and abdominal cases, the leading cause of death was head trauma and bleeding, and in the case of neck injury, the primary cause of death was bleeding. There was a statistically significant relationship between the year of death and the cause of death (p: 0.02). In the early years, most of the deaths were due to bleeding, and in recent years most deaths were due to head injury. There was no correlation between year of death and place of death (p=0.41), but there was a statistically significant relationship between year of death and impact (p=0.02). In the early years, the site of trauma was mainly the abdomen and neck, and in the last years it was mainly head and face trauma. There was no significant relationship between the cause of death and other

variables such as age, gender, education, city of accident, place of death, deceased status, type of accident, type of vehicle involved, and type of accident ($p>0.05$). Statistical analysis of the above variables and cause of death was also performed separately for different years. In almost all years (except 2011 and 2012), pelvic involvement may have occurred when the cause of death was multiple trauma. In death cases due to bleeding, both the chest and abdomen mainly were traumatic or had multiple traumas.

Table 2: Relationship between cause of death and location of injury by year

Variables/year of death	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cause of death and location of impact	<0.001	<0.001	0.08	0.02	0.001	0.24	0.35	0.04	<0/001	<0/001	0.06

Multivariate logistic regression was performed to investigate the predictors of death. The variables of age, sex, vehicle involved, involved car, deceased condition, cause of death, location of trauma, and mode of occurrence were entered into the model. Among the variables, only the involved car variable was considered a predictor variable.

Discussion

The present study results showed that the trend of deaths from RTAs is downward, which could be due to strict law enforcement by the police, such as by enforcement of speed limits and seat belt use and increased relative safety of cars. The results of the forecast function over the next five years (from 2016 to 2021) also show a continuation of this declining trend, which is in line with the increasing trend in India and Kuwait and line with the trend of Nigeria (22, 23, 24). The mean age of the deceased in Khorasan Razavi province (38.64/22.2) was younger than the mean age of Peyman and colleagues' study in Fars province of Iran (26.2/47.2) (25) but was in agreement with the results of Yousefzadeh *et al.* in Zanjan province, Iran (14). The 18–30 year age group had the highest risk of death, unlike the Kashan study, where those 60 years and older had the highest risk of death (26), but it was consistent with the results of the Wong study in Singapore (27). The high percentage of RTA deaths of young people increases the burden of illnesses and years of life lost and inflicting significant social, cultural, and economic damages. The likely reasons for the high rate of young fatalities in accidents include higher employment in this age group, more mobility than other age groups, inexperience, and lack of knowledge of laws. The frequency of accidents in this age group reflects the need for the community to plan appropriately for community education, especially for the younger age groups.

The results of this study showed that the ratio of men to women was three to one. In the study of Sanaizadeh et al., this ratio was 4: 1 (28). Most traffic fatalities occurred in September. The main reason for the increase in traffic fatalities in September is the late summer trips and more traffic on the roads; thus, corrective action plans should be implemented to prevent traffic accidents at this time of year. From 2006 to 2016 the number of traffic road death decreased from 37.37 to 19.4 per 100,000 people, which is consistent with other studies (8). This study showed that most people died at the scene of the accident, followed by hospital deaths. In some studies, deaths at the scene were higher (59% vs. 48.5%), probably due to the slower transfer of casualties to the hospitals and subsequently death at the accident scene (6). Head injury was the most common cause of death in 8554 cases (51.4%), which is consistent with Sanaei Zadeh et al. (28). However, in the Izadi et al. study, the head injury rate was 71.6%, which is higher than

in our study (30). The study results showed that after a head injury, another major cause of death was multi-trauma. Another important finding is that in the early years of the study, the primary cause of death was bleeding, but the leading cause of death was a head injury in the later years. Drivers were also more at risk of death than passengers and pedestrians. Most involved vehicles were light cars, motorcycles, heavy cars, and bicycles, which agrees with Valent et al.'s study (31). RTAs outside of urban areas were more remarkable than urban RTAs, but due to urban speed limit, the cause of high urban RTAs (32.5%) requires further investigation, identification of hazardous areas, and more stringent enforcement of laws.

According to the study results, Mashhad had the highest number of RTAs; this statistic seems reasonable, and could be attributed to urban size, population growth, presence of Imam Reza shrine, and tens of millions of pilgrims and tourists visiting this city annually, many of whom travel by car;. Also, about 58 percent of the deaths occurred in the three cities of Mashhad, Sabzevar, and Neyshabur, which require more attention and management of the Mashhad-Tehran highway. Due to the multidimensional nature of traffic accidents, to reduce further fatalities, it is essential to improve car safety, use helmets and seat belts, observe speed limits (16), and prevent unauthorized overtaking and other high-risk behaviors, which essentially prevent traffic accidents resulting in deaths.

References

1. World Helath Organization. Global Status Report on Road Safety 2015. WHO; 2015.
2. Global, regional, and national disability-adjusted life-years (DALYs) for 315 diseases and injuries and healthy life expectancy (HALE), 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet (London, England). 2016;388(10053):1603-58.
3. World Health Organization. Global Status Report on Road Safety 2018.
4. Borowy I. Road Traffic Injuries: Social Change and Development. Medical History. Cambridge University Press; 2013;57(1):108–38.
5. Hatamabadi HR SH, Vafaee R, Hadadi M, Ainy E, EsnaAshari HR. Epidemiologic pattern of road traffic injuries in Tehran- Ab-ali road: a cohort study. Payesh. 2011;1(1):29-37.
6. Hamzeh B, Najafi F, Karamimatin B, Ahmadijouybari T, Salari A, Moradinazar M. Epidemiology of traffic crash mortality in west of Iran in a 9-year period. Chinese journal of traumatology = Zhonghua chuang shang za zhi. 2016;19(2):70-4.
7. Nantulya VM, Reich MR. The neglected epidemic: road traffic injuries in developing countries. BMJ (Clinical research ed). 2002;324(7346):1139-41.
8. Akbari ME, Naghavi M, Soori H. Epidemiology of deaths from injuries in the Islamic Republic of Iran. Eastern Mediterranean health journal = La revue de sante de la Mediterranee orientale = al-Majallah al-sihhiyah li-sharq al-mutawassit. 2006;12(3-4):382-90.
9. Naghavi M, Abolhassani F, Pourmalek F, Lakeh M, Jafari N, Vaseghi S, et al. The burden of disease and injury in Iran 2003. Population Health Metrics. 2009;7:9-.
10. 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(5):e65198.
11. Peden M. Global collaboration on road traffic injury prevention. International journal of injury control and safety promotion. 2005;12(2):85-91.
12. Global Plan for the Decade of Action for Road Safety 2011–2020, (2011).
13. IRAN (ISLAMIC REPUBLIC OF): Law on the Sixth Five- Year Economic, Cultural and Social Development Plan for 1396-1400 - Sixth Five-Year Development Plan (2016-2021).
Available at: https://policy.asiapacificenergy.org/node/3671
14. Yousefzadeh-Chabok S, Ranjbar-Taklimie F, Malekpouri R, Razzaghi A. A Time Series Model for Assessing the Trend and Forecasting the Road Traffic Accident Mortality. Archives of trauma research. 2016;5(3):e36570.
15. Fleury D, Brenac T. Accident prototypical scenarios, a tool for road safety research and diagnostic studies. Accident; analysis and prevention. 2001;33(2):267-76.
16. Mehmandar M, Soori H, Mehrabi Y. Predicting and analyzing the trend of traffic accidents deaths in Iran in 2014 and 2015. International journal of critical illness and injury science. 2016;6(2):74-8.

17. Brijs T, Karlis D, Wets G. Studying the effect of weather conditions on daily crash counts using a discrete time-series model. Accident; analysis and prevention. 2008;40(3):1180-90.

18. Saadat S, Soori H. Epidemiology of traffic injuries and motor vehicles utilization in the capital of Iran: a population based study. BMC public health. 2011;11:488.

19. Heydari ST, Hoseinzadeh A, Sarikhani Y, Hedjazi A, Zarenezhad M, Moafian G, et al. Time analysis of fatal traffic accidents in Fars Province of Iran. Chinese journal of traumatology = Zhonghua chuang shang za zhi. 2013;16(2):84-8.

20. Mirzaei M, Mirzadeh M, Shogaei Far H, Mirzaei M. Trends in Road Traffic Deaths in Yazd, Iran, 2004 - 2010. Archives of trauma research. 2016;5(2):e29266.

21. Unesco world heritalge convention Awailable at: https://whc.unesco.org/en/tentativelists/6194/

22. Mahata D, Narzary PK, Govil D. Spatio-temporal analysis of road traffic accidents in Indian large cities. Clinical Epidemiology and Global Health. 2019;7(4):586-91.

23. Ziyab AH, Akhtar S. Incidence and trend of road traffic injuries and related deaths in Kuwait: 2000–2009. Injury. 2012;43(12):2018-22.

24. Venkatraman C, Olowu O, Turkmani D, Hynan L, Nwariaku FE. Decreasing Trends in Road Traffic Injury Incidence and Mortality in Nigeria: A Ten-Year Analysis. Journal of Surgical Research. 2020;249:163-7.

25. Peymani P, Heydari ST, Hoseinzadeh A, Sarikhani Y, Hedjazi A, Zarenezhad M, et al. Epidemiological characteristics of fatal pedestrian accidents in Fars Province of Iran: a community-based survey. Chinese journal of traumatology = Zhonghua chuang shang za zhi. 2012;15(5):279-83.

26. Mahdian M, Sehat M, Fazel MR, Akbari H, Rahimi H, Mohammadzadeh M. Road traffic deaths in Kashan region, Iran: An eight-year study (2006-2013). Chinese journal of traumatology = Zhonghua chuang shang za zhi. 2018;21(1):54-7.

27. Wong ZH, Chong CK, Tai BC, Lau G. A review of fatal road traffic accidents in Singapore from 2000 to 2004. Annals Academy of Medicine Singapore.2009;38(7):594-6.

28. Sanaei-Zadeh, H., Vahabi. R. Nazparvar. B. Amoei. M. An Epidemiological Study and Determination of Causes of Traffic Accidentrelated Deaths in Tehran, Iran (during 2000-2001). Journal of Clinical Forensic Medicine. 2002; 9(2): 74-77.

29. Wang L, Ning P, Yin P, Cheng P, Schwebel DC, Liu J, et al. Road traffic mortality in China: analysis of national surveillance data from 2006 to 2016. The Lancet Public health. 2019;4(5): e245-e55.

30. Izadi N, Khoramdad M, Jamshidi P, Zanganeh Ar, Shafiei J, Firouzi A. Epidemiological Pattern and Mortality Rate Trend of Road Traffic Injuries in Kermanshah Province (2009-2014). Journal of Community Health Research. 2016;5(3): 158-168.

31. Valent F, Schiava F, Savonitto C, Gallo T, Brusaferro S, Barbone F. Risk factors for fatal road traffic accidents in Udine, Italy. Accident Analysis & Prevention. 2002;34(1):71-84.