Original Article

Analysis of Mortality Rate of Road Traffic Accidents and Its Trend in 11 Years in Iran

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Abstract

Background and Objectives: Road traffic accidents (RTAs) are the second cause of death, the first leading cause of years of life lost due to premature mortality, and the most common source of injury in Iran. According to the World Health Organization estimates, Iran located in the countries that have the highest rates from RTAs. The present study aimed to measure road traffic mortality rates and also to depict a view of the trend for a period of 11 years which started from 2006 to 2016. **Materials and Methods:** In this cross-sectional study, we collect data on all road traffic deaths in Iran between 2006 and 2016 using records from the Legal Medicine Organization. For doing this research, demographic and epidemiological data of the deceased were extracted using a checklist designed by the forensic experts. Content validity of this form was determined by obtaining comments of professors and scholars in the field. Directly standardized mortality rates were calculated. Finally, the information was analyzed by descriptive statistics. **Results:** During the 11-year period of this study, 226,514 people in Iran died from RTAs. The age-adjusted mortality rate that caused by road traffic decreased from 41.5/100,000 people in 2006 to 20.4 in 2016 during the study period. There were significant differences in mortality rates between males and females and between outside city and inside city roads. The age-adjusted mortality rate was significantly higher among men than in women. The majority of death has occurred in illiterate young men aged 15–34 years and also in self-employed people. **Conclusions:** During the 2006–2016, mortality from RTAs decreased from 41.5 to 20.4/100,000 populations. This decreasing trend was observed in both sexes and in outside city and inside city roads. However, this reduction trend in the last years of the study is not suitable. These findings highlighted that training programs and harm reduction approaches for reducing the mortality from traffic accident are still needed.

Keywords: Accidents, Iran, mortality, traffic, trend

Introduction

The process of modernization and consequently increased demand for road traffic has aggravated the tragedy of road traffic accident (RTA) in developing and developed countries.[1] RTAs are a serious public health problem worldwide that refers to the unintended and unforeseen events involving at least one motor vehicle.[2] This issue is a leading cause of disability, morbidity, and premature mortality, especially in low- and middle-income countries.[3-5] In terms of economics, death from RTAs is a major source of expense and human resources. The total cost of mortality and morbidity due to RTAs in the Eastern Mediterranean area is estimated $704 billion annually.[6]

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According to the World Health Organization (WHO) report, every year between 20 and 50 million peoples suffer from nonfatal injuries and the loves almost 1.25 million men and women are cut concise as a result of RTAs and are estimated to become the third leading cause of deaths by 2030.[7] Many studies have shown an increasing trend of death caused by RTAs in Africa, the Eastern Mediterranean, and Asia over recent years. The Eastern Mediterranean region (EMR) has the second-highest traffic-related death rates in the whole world, and Iran is shown to have the highest rate of RTAs among EMR countries.[8]

RTAs are the second cause of death, the first leading cause of years of life lost (YLL) due to premature mortality, and the most common cause of injury in Iran.[8,9] According to the WHO report in 2015, the mortality rate that is caused by RTAs in Iran is 32 deaths/100,000 persons, but local estimates according to the Legal Medicine Organization (LMO) of Iran are lower and around 25.6 deaths/100,000 persons.[10,11] Iran with this mortality rate (32/100,000) is located in the countries that have the highest rate from RTA.[12]

Therefore, deaths that caused by RTAs should be of particular concern in Iran, where only in 2007, 27,567 people mostly the young and children lost their lives prematurely and 276,762 injured.[8,13] Therefore, reducing mortalities due to RTAs should be the most important priorities for the government and health-care system in particular. The finding of this study let us provide useful information for local, national, and international administrators to design intervention for those who take the most advantage from it. The present study investigated the trend of RTAs leading to death in Iran for a period of 11 years which started from March 2006 to March 2016.

Materials and Methods

Data source and study population

This research was a cross-sectional study. In Iran, all deaths including the suspicious deaths should be referred to LMO center, and death certificate can just be issued after evaluation and confirmation by this organization; therefore, the best place for doing this research was centers of LMO. All suspicious deaths that occurred due to RTAs from 2006 to 2016 were studied by census method. Based on the 10th edition of the International Classification of Disease, the codes V01–V99 were classified as RTA deaths.

Data processing

After collecting the data, the process of data cleaning was done. Repeated items were omitted based on the similarity in the victims' names, national codes, time of death, and identification number for burial. When we encountered with missing or inaccurate codes in our data set, the death registry coordinator tried to revise this by calling and interviewing the responsible doctor in LMO and obtaining a verbal autopsy summary. If the value of age is not stored for some people in the observation, the median value of the age is used in place of the missing data. When we encountered the missing value for the sex variable, they were amendment based on the victims' first names. If not registered the person first names, relative frequency of males and females in the data set was used to correct missing values.

Ethical considerations

This study was approved by the Ethical Committee of LMO, Tehran, Iran. The deceased family was assured of the confidentiality of their information. Since death records include sensitive information, we analyzed the data anonymously and strongly protected information with regard to ethical consideration.

Statistical analysis

RTA mortality rates were estimated by dividing the number of RTA deaths in each province during each year by the mid-year population of that province. The population numbers were obtained from the Statistical Center of Iran. All the rates were directly aged standardized by the world (WHO 2000–2016) standard population. Due to the length of the research period (11 years) and given that the country population grew by 11.8% in 2016 compared to 2006, we used from directed age standardized to compare rates regardless of age differences during the study period. The rates are presented per 100,000 populations.

The population of Iran was not available from 2006 to 2016; the population of the 2006, 2011, and 2016 census (equal 1385, 1390, and 1395 Hijri), which was officially counted and published by the Statistics Center of Iran, was considered as the basic population for estimating of the country's population in the other years. The average growth rate for 2006–2011 was 1.01 and for years later was 1.02. The population of 2006–2016 was estimated using the linear interpolation method, with population based on different age, sex, and educational group. The growth rate was calculated using the geometric method and the following formula:

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

Data analysis

Data were entered into Stata-MP version 14. This software was designed by Stata corporation LP in the state of Texas, USA and licensed to Andrey in 1985. Results were presented using descriptive statistics as mean value, standard deviation, percentage, tables, and charts.

Results

Our study showed that during the study period, 226,514 people in Iran died from RTAs. The age-standardized mortality rate from RTAs has decreased from 41.5/100,000 population in 2006 to 20.4 in 2016 [Figure 1]. The same decreasing trend was also observed when we analyzed RTAs mortality rates by inside and outside city roads. The number of deaths and mortality rate in each year by sex and place of death are illustrated in Table 1.

The mean age of victims in our study was 36.11 ± 20.6 years (male: 35.95 ± 19.96 years and female: 36.9 ± 22.84 years), and the median age was 31 years (male: 31 years and female: 35 years). The most affected age group was those aged 15–24 and 25–34 years (42.23% of all mortality).

Among all deceased, 80.1% were male and 19.8% were female (male/female ratio, 3.94:1). This gender difference was statistically significant ($P < 0.05$). In 2006, the RTA mortality rate in male population was 62.3/100,000 population, which decreased to 30.64 in 2016. This reduction trend was observed in the female population (from 15.5 in 2006 to 8.78 in 2016) [Table 1].

During the study period, most of the people were illiterate and people with university education had the lowest mortality rate from a traffic accident. More information about the age-standardized mortality rates by educational level is presented in Table 2.

Most of the deaths due to RTAs occurred predominantly in young men at the age of 15–24 and 25–34 years. The majority of death occurred in self-employed people, workers, and homemakers. Investigation of the road traffic death by season reveals that most of the deaths occurred in the summer season during the study period and the fewest road traffic deaths occur in the winter [Table 3].

Discussion

In this study, we documented that the mortality rate due to RTA decreased from 41.5/100,000 populations in 2006 to 21.5 in 2015, and this finding was consistent with previous researches. This decline was observed for both outside and inside city rates during the study period. This reduction in trend can be justified by the simultaneous collaboration of traffic police and the Ministry of Health and Medical Education (MOH and ME). The most important police action in reducing road accidents and its consequences were the legislation of wearing of seatbelts and motorcycle helmets mandatory, amplification of traffic rules, and production of mass media training programs (all these interventions began in 2005 in Iran).[2,14,15] The MOH and ME activities were to minimize the postaccident

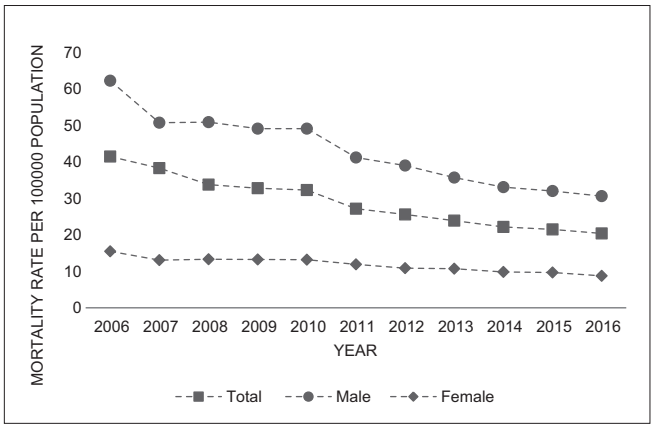

Figure 1: Age-adjusted road traffic accident mortality rates/100,000 population by sex between 2006 and 2016 in Iran

Table 1: The number of road traffic death and age-standardized mortality rate by sex and place of death in 11-year period from 2006 to 2016 in Iran

Year	Population of the country	Number of death			Mortality rate per 100,000		
		Total	Male	Female	Total	Male	Female
2006	70,495,782	27,567	22,105	5462	41.5	62.30	15.50
2007	71,402,911	22,918	18,255	4663	38.3	50.78	13.08
2008	72,321,714	23,362	18,559	4803	33.8	50.94	13.33
2009	73,252,339	22,974	18,139	4835	32.8	49.14	13.26
2010	74,194,939	23,249	18,386	4863	32.3	49.15	13.19
2011	75,149,669	20,068	15,624	4444	27.2	41.22	11.92
2012	76,081,588	19,089	14,988	4101	25.6	39.02	10.88
2013	77,025,063	17,996	13,907	4089	23.9	35.73	10.73
2014	77,980,238	16,872	13,059	3813	22.2	33.11	9.84
2015	78,947,258	16,584	12,807	3777	21.5	32.04	9.69
2016	79,947,258	15,932	12,470	3462	20.4	30.64	8.78

Table 2: Crude mortality rate by year and educational level per 100,000 population in 11-year period from 2006 to 2016 in Iran

Educational level	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Illiterate	59.01	49.00	52.65	53.48	50.92	42.34	40.24	39.36	36.27	37.8	37.23
Elementary	41.36	34.43	33.89	39.93	33.60	28.23	26.65	24.35	21.66	20.34	20.19
Guidance	48.72	40.23	39.54	46.13	39.58	33.60	31.83	29.49	27.14	28.50	27.93
High school	30.61	25.39	26.23	36.65	27.50	23.84	27.37	29.34	27.88	25.18	24.16
University	26.35	21.61	22.19	28.14	15.83	14.76	14.20	13.82	12.10	11.92	10.85

Table 3: Percentage of road traffic deaths that classified by season, age groups, and employment status over the 11-year study period (2006-2016) in Iran

Variables	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Season											
Spring	22.31	25.2	23.2	22.06	24.52	24.70	23.07	23.06	31.87	25.13	24.56
Summer	29.88	30.21	31.02	28.54	29.17	27.65	28.91	28.20	36.14	26.57	27.48
Autumn	25.66	26.47	25.5	26.88	26.05	26.78	26.31	25.89	17.94	25.54	25.22
Winter	22.15	18.11	20.24	22.52	20.26	20.87	21.71	22.85	14.05	22.76	22.74
Age group											
0-4	3.28	3.28	3.49	3.57	3.85	4.00	4.12	5.08	4.40	4.44	4.08
5-14	6.47	6.38	6.12	6.03	5.49	5.77	6.37	5.84	5.84	5.81	5.72
15-24	24.77	23.98	24.14	22.1	21.17	21.71	20.93	19.23	18.31	18.26	18.78
25-34	20.49	20.83	20.11	20.4	21.52	20.94	20.85	20.63	20.35	20.56	20.66
35-44	13.79	13.75	13.44	13.84	14.26	13.85	13.79	14.06	14.53	14.51	14.14
45-54	11.60	11.53	1158	12.05	11.53	11.95	11.54	12.18	12.07	12.36	11.91
55-64	7.08	7.34	7.78	8.62	8.95	8.88	9.38	9.37	10.34	10.24	11.21
+65	12.53	12.90	13.23	13.40	13.24	12.91	13.03	13.62	14.15	13.82	13.50
Employment status											
Student	9.63	8.86	8.5	8.10	7.30	7.57	8.09	7.25	6.96	7.44	7.28
University student	2.57	2.74	3.01	2.91	3.11	3.36	3.74	3.61	3.39	3.21	3.14
Homemaker	13.39	13.91	14.06	14.79	14.57	15.40	14.52	15.47	15.61	15.52	15.61
Employee	6.18	6.24	5.41	5.44	4.41	4.46	4.59	4.81	4.39	4.28	4.17
Worker	14.18	14.10	14.92	14.75	15.26	15.18	13.35	11.45	11.98	11.78	10.93
Self-employed	27.93	27.87	27.60	27.33	29.57	28.45	30.59	30.02	31.10	31.04	31.12
Solider	1.23	1.31	1.25	1.21	1.07	1.16	0.93	1.30	1.01	1.22	1.23
Retried	3.72	3.72	4.48	4.61	4.28	4.47	4.84	5.12	5.61	5.54	5.47
Unemployed	4.08	3.86	3.54	3.67	3.64	4.04	3.55	3.73	3.63	3.58	4.16
Driver	5.79	5.75	5.62	5.71	5.79	5.02	5.03	4.68	4.77	4.53	4.48
Farmer	7.21	7.18	7.00	6.90	6.18	5.72	5.54	6.15	5.99	6.03	6.19
Others	4.09	4.46	4.62	4.58	4.84	4.97	4.25	6.40	5.56	5.83	6.22
Place of death											
Inside city roads	18.31	33.77	34.03	34.24	31.98	32.49	31.39	28.14	29.51	29.08	29.46
Outside city roads	81.69	66.23	65.97	65.76	68.02	67.51	68.61	71.86	70.49	70.92	70.54

phase by enhancing the emergency medical services in terms of technical, equipment, and operational; these services included increasing the number of ambulances, air ambulance facilities, motorbike emergency services, and emergency medical service stations and reducing the average time to provide emergency services.[16-18]

According to the information that presented in Table 1, the decreasing trend in the number of deaths from traffic accidents in the last years of the study was not suitable compared to the early years of the research (the number of deaths dropped to 4449 cases in 2007 compared with 2006, while the number of deaths in 2016 fell to 652 cases compared to 2015). This means that, despite the increase of effectiveness of measures in reducing the mortality from RTAs, the power of existing policies and programs to reduce death has declined. Hence, policymakers must think about designing new interventions to prevent and manage death from traffic accidents.

In this study, 80.1% of all people who died from RTAs were male, and this difference between men and women was observed in every year of the study ($P < 0.005$). In the EMR, 75% of all deceased from RTAs were male.[19] Male dominance in road traffic deaths has been seen in similar studies in other research of Iran[20-22] and other countries.[23-25] This gender difference can be attributed to the increased susceptibility and exposure of men due to specific occupational, cultural, and social properties.[24]

This study highlights that maximum of road traffic deaths occur in the summer season. This pattern is also seen in other studies in Iran. These result attributed to an increased level of road travel by at this time. Previous researches suggest that summer heat is an important factor that leads to increased stress and the decreased performance of intellectual tasks which require considerable physical effort and motor skills. Furthermore, the high temperature in summer is associated with increased heart rate, exacerbation of heart problems, emphysema, and decreased visual acuity. Consequently, prolonged exposure to heat must be considered as a hazard to the safety and health of drivers and a factor leading to an increased incidence of RTAs.[6,26]

According to our results, the mortality rate from RTAs in the outside city is almost twice the inside city. Similar results were seen in prior researches. Many different types of risk factors may contribute to the increased injury mortality rates

in outside city roads including lack of safety on outside city roads, especially on rural roads, the high average speed of vehicles traveling on the suburban roads, inappropriate geometric structures on these roads such as the presence of arcs or steep angles on some of the roads, existence of spiral mountain roads, the absence of safeguards on the edge of the roads, lack of parking or earthly shoulders on the roads, and undesirable lighting on these roads.[6,27-30]

During the whole study period, the age group of 15–34 years (young people) had the highest frequency. This age group is an active age group for national productivity and economic growth. This leads to an increase in YLL due to premature mortality. Since this group is active in social and economic programs in society, reducing their death has a positive economic and social impact. In the EMR, 60% of road traffic deaths occur in this age group.[19] The high percentage of deaths in this age group is due to the higher involvement in road transportation, greater tendency toward high-risk activities, and lower willingness to follow the traffic rules in this age group.[20-23]

The second peak for road traffic death is seen in elderly people. This matter attributed to the reduced physical tolerance and cognition abilities for injury in the elderly population. According to the information presented by the Statistics Center of Iran, the process of the aging population has increased in our country. With the aging population, the number of road users as pedestrians as well as passengers and drivers increases; hence, these findings suggest that elderly people are in danger of an accident. It seems that effective and regular training about injury prevention and providing a secure living environment for the elderly is necessary.[31,32]

Our results reveal that most of the people who died from RTA were illiterate. In an earlier study, in Iran, 81% of people involved in RTA deaths between 1999 and 2000 have preuniversity education. Interestingly, we find that compared to lower educational levels, higher educational levels (especially university degrees) have a lower rate of death which means that they are involved in less dangerous accidents. Our results are partially explained as drivers with higher educational level have better economic and cultural status and so using more expensive and standard vehicles as well as showing more respect to the driving laws. Similar previous studies have reported lower educational status as a predictor of risky driving behaviors. On the other hand, people with low employment status are at risk for deadly accidents due to the use of unsafe vehicles.[33]

Strengths and limitation

We used data on death from RTA recorded in the LMO. According to Iran law, all suspicious deaths should be investigated in this organization; hence, our data are the most comprehensive information about crash deaths in Iran. There were some limitations in our study. First, the cross-sectional nature of the survey limits the ability to draw any causal inference. Second, in this study, a denominator for the rate calculation was the population of the place of residence. People exposed to the risk of RTAs in both residence and no residence areas, but there is no information available on the population of nonresidents. At the end of, in this ecological study, we must be careful about the occurrence of ecological bias in the interpretation of the results. This means that when we study in an aggregate level in ecological studies, our conclusion must be in that level not at the individual level because the observed relationship between variables on the group levels does not necessarily represent the association that exists at an individual level.

Conclusions

Our study showed that age-adjusted mortality rate from a RTA in the total country and in both sex and place of death reduced during the study period. However, the reduction trend in the last years of the study is not suitable [information that is presented in Table 1 in the column death]. These findings suggest that interventions for reducing mortality from road traffic, especially in the illiterate young men aged 15–34 years and in outside city roads, are still needed. These findings highlighted that training programs and harm reduction approaches for reducing the mortality from traffic accident should be focused on these groups.

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Conflicts of interest

There are no conflicts of interest.

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