

# Epidemiology of Road Traffic Injuries in Iran: Based on the Data from Disaster Management Information System (DMIS) Of the Iranian Red Crescent

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## Abstract

**Background:** Road traffic injuries (RTIs) are the leading cause of injuries and the second cause of mortality in Iran.

**Objectives:** The aim of this study was to investigate the epidemiological pattern of RTIs in Iran based on the data from disaster management information system (DMIS) of the Iranian Red Crescent.

**Methods:** In this cross-sectional study, the pattern of RTIs in Iran was studied based on the data from DMIS in the period from 20 March 2012 to 19 February 2016 (35 months). All of the 78775 RTIs recorded were selected through census. Data analysis was done using the SPSS.16 software package. P value less than 0.05 was considered statistically significant.

**Results:** Among the 19 types of accidents whose data are recorded, road traffic accidents with a 78775 number of occurrence ( $136.1 \pm 86.5$  per 100000 people), 186860 injuries ( $332.1 \pm 220$  per 100000 people) and 12596 deaths ( $22.6 \pm 11.1$  per 100000 people) were the highest in ranking. The most common annunciator of the accidents was the emergency. Receiving the first report of the rescue operation was most done by telephone. The mean number of the operational forces involved in RTIs per 100000 people was  $529.2 \pm 407$ . The results showed that there was a significant difference between high, moderate and low population rate provinces in the mean number of injuries cases, the mortality of RTIs and the total number of Red Crescent operational forces ( $P < 0.05$ ).

**Conclusions:** Considering the high occurrence of the mortality and the injuries of the RTIs compared to that of the other types of accidents, more attention to RTIs in planning and interventions seems necessary.

**Keywords:** Road Traffic, Injuries, Accidents, Epidemiological Mortality

## 1. Background

Road traffic injuries (RTIs) are considered the leading cause of the disabilities and the mortality in the world (1). The most cases of hospitalization in the hospital emergency rooms are due to RTIs that impose enormous direct and indirect costs on the government and the people, and account for a major share of the country's annual budget (2, 3). It is estimated that 2 million people worldwide lose their lives in traffic accidents and 50 million people in the world are injured each year (4). According to the results anticipation, it is expected that such figures will increase about 65 percent over the next 20 years (5). Around 85% of the deaths and 90% of the permanent damages caused by driving accidents take place in low and middle income countries (LMICs) (5). As well, it is predicted that 16 cases lead to hospitalization and 400 cases of the injuries need outpatient services or occur along with the restrictions of

passing activity for each death due to the injuries (6).

In Iran, RTIs are the leading cause of the injuries and the second cause of mortality (7-9), and their prevalence is 4 times higher than those of the high income countries (HICs) (10). As well, the mortality caused by RTIs in Iran had the highest rate in comparison with the other LMICs (11, 12). It is estimated that RTIs in Iran each year cause the loss of 2271 years of life and also damage amounting to 6 billion dollars (13, 14).

Like other kinds of injuries, RTIs have high prevalence and burden of disease in LMIC (15, 16). As in other LMIC, in Iran RTIs are one of the serious public health problems (17). Regarding this issue many studies were published in recent years, for supporting these studies and their results, a clear definition of the regular process for gathering data is required (18).

The study results of Soori and colleagues (2009) (19) indicated that different organizations are involved in the

field of RTIs in Iran, and the most important of them are: traffic police, ministry of transportation, ministry of industry, ministry of health and medical education, ministry of culture & Islamic guidance, ministry of education, forensics, central insurance organization, ministry of justice, ministry of interior, emergency medical services (ems), law enforcement force of Islamic republic of Iran, Islamic republic of Iran broadcasting (IRIB), the judiciary and the Red Crescent.

The Red Crescent society of the Islamic republic of Iran is a non-profit organization and a member of the International Red Cross and Red Crescent movement that carries out relief and humanitarian activities in Iran and in other countries in some cases. This organization has several departments that embrace a wide range of medicine, health, education and relief services (20). This organization has had an important role in the field of RTIs for about two decades; the Red Crescent roadside assistance centers were initially established in defiled and impassable areas of the country's main roads for the accommodation, nutrition and emergency relief of the stranded travelers, and their transmission and dispatching to the medical centers. Recently, this organization has attempted the establishment of fixed bases and temporary and portable stations, and the use of ambulance and rescue vehicle and more operational forces on heavily traveled roads and entrances of the cities in the framework of its humanitarian duties to perform rapid search operations, rescue and relief to road traffic accidents (21).

Contrary to other injuries, RTIs are preventable (22, 23). In this regard, having knowledge of the epidemiology pattern of the RTIs has a recognizable role in the prevention of RTIs (24, 25). Reviewing the existing literature shows that Iran and other LMIC have limited information in this area, which may cause some serious problems in planning for the prevention and performing effective actions (26).

## 2. Objectives

In 2011, this organization i.e. DMIS launched the Red Crescent. Information of the accidents that the organization was involved in and worked within is recorded online in the system. One of the most important of these accidents are the RTIs. Due to the fact that the pattern of RTIs in Iran has not been yet investigated based on the data recorded in DMIS of the Iranian Red Crescent rescue organizations, the aim of this study was to investigate the epidemiological pattern of RTIs in Iran according to DMIS data by Red Crescent rescue organizations.

## 3. Methods

### 3.1. Study Design

In this analytical cross-sectional study, the epidemiology of RTIs in Iran was studied based on DMIS data by the Iranian Red Crescent rescue organizations in the period since 20 March 2012 to 19 February 2016 (35 months). Given that this system was launched for the first time in 2011, the information related to this year was excluded from the study. To prevent the distortion of the data, the study results of the information entered since the beginning of the year 2012, which were more valid and reliable, were reviewed, debriefed, and processed by the statistics and information experts in the Red Crescent rescue organization center.

### 3.2. Data Source and Selection

#### 3.2.1. DMIS of the Iranian Red Crescent

This system is available through <http://www.rarodmis.ir> address and the user name and password of each person.

There are six sections in the main part of the system (registration form of the accidents and disasters, periodic 24-hour reports, rescue operation reports, case reports, management reports and accidents reports), and the basic information needed for the study has been extracted from the accidents reports section. This information is entered in the system online by the Red Crescent experts in the provinces, and then it is reviewed, debriefed, and processed by statistics and information experts in the Red Crescent rescue organization center.

According to the objectives of the study and the information included in this system, the following information was extracted and reported from the system by one of the researchers (AA-S).

- Type of the accidents whose data is recorded in DMIS (the information of 19 accidents is recorded in the system),
- Pattern of the occurrence of RTIs according to the country's provinces,
- Pattern of the injuries caused by traffic accidents in terms of the country's provinces,
- Pattern of the deaths from traffic accidents in terms of country's provinces,
- Pattern of the annunciator source of RTIs from the outside,
- The way of receiving the first rescue operation report,
- Facilities and equipment used (relief-operational forces, transport fleet used in an incident, operational equipment used in an incident and relief aid) in RTIs by the Red Crescent,

The criteria for the selection of data included: ensuring the accuracy of the data, data related to RTIs, data recorded

in the period since 20 March 2012 to 19 February 2016 and the data which we have permission to report.

### 3.3. Data Analysis

Descriptive statistics (frequency, percentage, mean  $\pm$  standard deviation) and One Way ANOVA test used for the data analysis was done using the SPSS.16 software package. A P value of %5 was considered statistically significant.

The number of occurrence, injury, mortality pattern of RTIs and the total number of the Red Crescent operational forces involved in the road traffic accidents were adjusted according to the provinces' population size based on the 2011 Iranian population and housing census (27). In this regard, the provinces of the country were categorized in three groups: high population (> 3 million people), moderate population (3million > people > 1.5million) and low population (< 1.5 million). Then the three groups were compared in statistical tests.

To draw the number of the occurrence of RTIs per 100000 people according to the country provenance that the Red Crescent attended since 20 March 2012 to 19 February 2016, GIS method was used by Arc GIS: 10.3 software packages. Country provenance with 0 to 99 number of the occurrence of RTIs per 100000 people ranked as low occurrence and is shown by green color on the map, provenance with 100 to 199 number of occurrence ranked as moderate occurrence and is shown by blue color and province with more than 200 number of occurrence of RTIs per 100000 people ranked as high occurrence and is shown by red color.

To draw the in in the study, Excel 2010 software of Office set was used.

### 3.4. Ethical Issues

The protocol of this study has been approved by the ethics committee at Iran University of Medical Sciences (ethical code = IR.IUMS.REC 1394.9221557209) which is in compliance with the Helsinki Declaration. Also the necessary permission to access the data was obtained from the Iranian Red Crescent officials.

## 4. Results

Among the 19 types of the accidents whose data is recorded in DMIS, the results showed that, RTIs with frequency of 78775 times and 12596 deaths have the highest frequency and mortality rate due to accidents in Iran. Reilly (occurrence of 14 times and 1death) and dust disaster (occurrence of 34 times and 0 deaths) have the lowest frequency and mortality due to accidents in Iran (Figure 1).

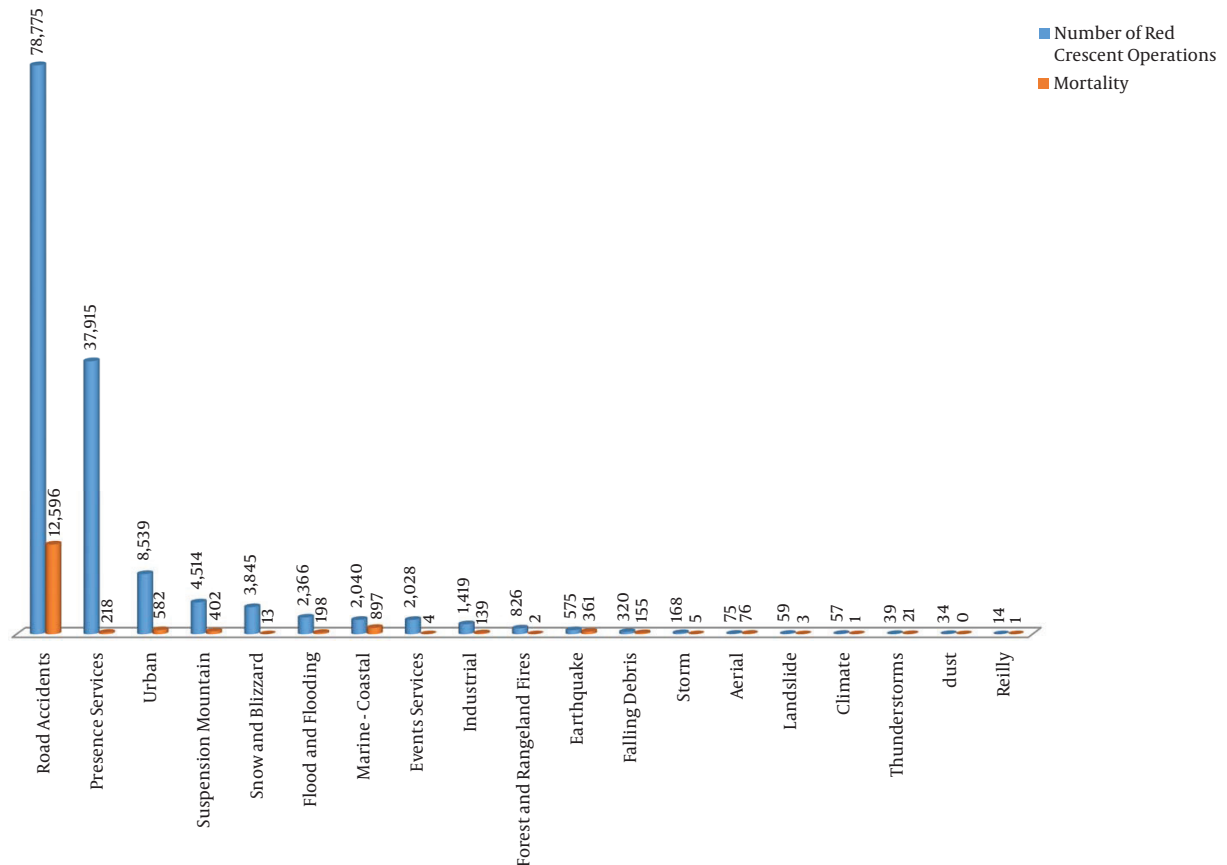
The results of the occurrence number of RTIs per 100000 people which the Red Crescent rescue forces attended, indicated that 15 provinces of the country have low, 11 provinces have moderate and 5 provinces have a high occurrence number of RTIs (of course by our ranking system) (Figure 2).

The results of the number of road traffic accident occurrence per 100000 people showed that the provinces of Semnan (with 388.5 per100000), South Khorasan (with 350.6 per 100000), and Qazvin (with 285 per 100000) have the highest and the provinces of Tehran (with 29.2 per 100000), Khuzestan (with 36.2 per 100000), and Qom (with 41.9 per 100000) have the lowest occurrence (Figure 3). The mean number of occurrence pattern of RTIs per 100000 people was  $136.1 \pm 86.5$ . The results of the injury's pattern caused by traffic accidents which the Red Crescent rescue forces attended, indicated that the provinces of Isfahan (with 21350), Mazandaran (with 11698) and Khorasan Razavi (with 10814) have the highest and provinces of Qom (with 1213), Ilam (with 1531) and Bushehr (with 2084), have the lowest rate of injuries caused by traffic accidents (Figure 4). In the whole country, 186860 cases of injury caused by traffic accidents have been recorded in DMIS. The mean number of injuries caused by traffic accidents per 100000 people was  $332.1 \pm 220$ .

The results of the mortality pattern caused by RTIs that the Red Crescent rescue forces attended, indicated that provinces of Kerman (with 885), Sistan and Baluchistan (with 869), Fars (with 868), and Isfahan (with 855) have the highest and provinces of Bushehr (with 122), Alborz (with 165), and Ilam (with 179) have the lowest rate of mortality caused by RTIs (Figure 5). In the whole country, 12596 deaths caused by RTIs have been recorded. Out of 12596 deaths, 436 deaths occurred on the way to the hospital and 12160 occurred during the accident. The mean number of mortality caused by traffic accidents per 100000 people was  $22.6 \pm 11.1$ .

The source of RTIs annunciator from the outside and the way of receiving the first rescue operation report have been shown in Figure 6. The most frequent annunciator source of the accidents was the emergency department (with 45%) and the most frequent way of receiving the first rescue operation report was by telephone (with 60%).

The statues of using facilities and equipment (relief operational forces, transport fleet used in the accidents, operational equipment used in the accidents and relief aid) in RTIs by the Red Crescent in the provinces of the country and the total of them have been shown in Table 1. Isfahan province had the highest (10.9%) and Qom province the lowest (0.5%) of the total number of operational forces involved in RTIs; the total number of the operational forces involved in RTIs in the whole country was 271133 people.



**Figure 1.** The number of Red Crescent Operations and Mortality Caused by Accidents in Iran Since 20 March 2012 to 19 February 2016

The mean number of operational forces involved in RTIs per 100000 people was  $529.2 \pm 407$ .

The results of the statistical comparison of the number of occurrence, injury, mortality of RTIs and total number of Red Crescent operational forces involved in the road traffic accidents in high, moderate and low population rate provinces are shown in Table 2. The results showed that there were significant relationships between high, moderate and low population rate provinces in number of injury ( $P = 0.048$ ) and mortality rate ( $P = 0.001$ ) of RTIs and the total number of Red Crescent operational forces ( $P = 0.003$ ) variables. The mean number of occurrence, injury, mortality of RTIs and the total number of Red Crescent operational forces involved in road traffic accidents were high in low population rate provinces.

## 5. Discussion

The results of the present study showed that RTIs have a more number of occurrence and mortality rate among the

other accidents that the Red Crescent contributed to and their data is recorded on DMIS of the Iranian Red Crescent (19 accidents). In the whole country, 78775 RTIs, 186860 injuries caused by traffic accidents and 12596 deaths due to RTIs have been recorded in the period since 20 March 2012 to 19 February 2016. The most common annunciator source of the accidents was the emergency. Receiving the first report of the rescue operation was most done by telephone. There were significant relationships between high, moderate and low population rate provinces in the number of injury ( $P = 0.048$ ) and mortality rate ( $P = 0.001$ ) of RTIs and the total number of Red Crescent operational forces ( $P = 0.003$ ) variables.

The results of this study showed that RTIs-induced injuries and mortality have high incidence rates among all the other accidents causing injuries and mortality. In alignment to the results of this study, the study by Soori and colleagues (2008) showed that RTIs have the highest prevalence and mortality among non-fatal accidents. The prevalence rate is 237 people per 100,000 people, and

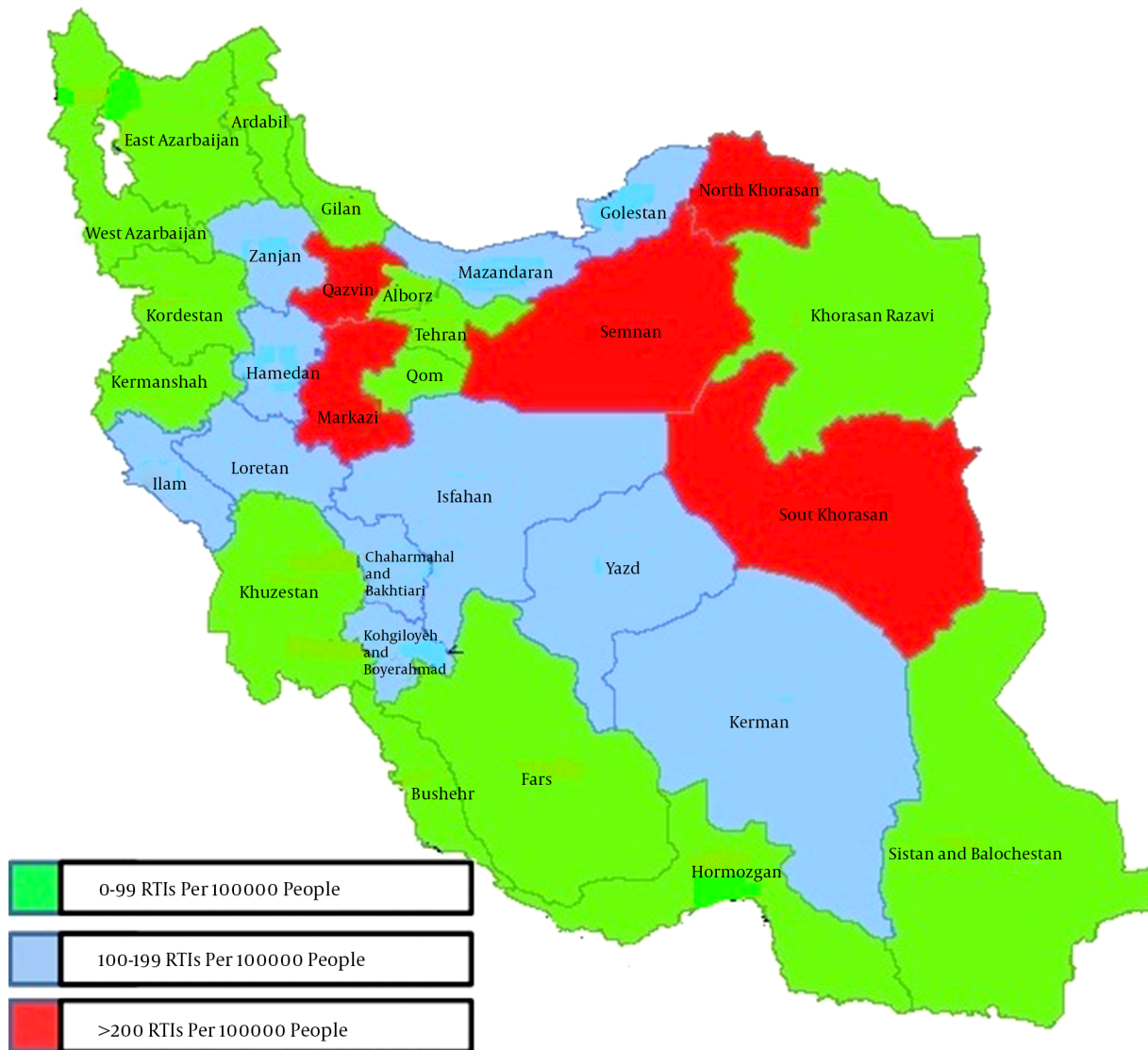
**Table 1.** Applying Facilities and Equipment Used in RTIs by the Red Crescent in Provinces of Iran Since 20 March 2012 to 19 February 2016

Province	Operational-Relief Forces					Total Number of Operational Forces	Transportation Fleet Used			Operational Equipment Used		
	Number of Operational Teams	Physician	Nurse	Savior-Personnel	Rescuer		Ambulance	Rescue Vehicle Type 1 and 2	Light Auxiliary Vehicle	Fire Fighting Equipment	Light Rescue Set	Rescue Hydraulic Set
East Azarbaijan	3,462	13	12	10,231	439	10,695	2,967	532	42	59	154	290
West Azarbaijan	3,290	19	166	5,498	7,866	13,549	3,058	275	33	28	56	107
Ardabil	1,281	1	2	3,971	44	4,018	1,160	201	34	20	72	120
Isfahan	10,888	38	155	27,227	2,366	29,786	9,457	1,943	42	134	683	983
Alborz	2,751	5	5	8,038	130	8,178	2,483	296	8	18	61	60
Ilam	685	1	1	2,048	11	2,061	553	159	9	8	61	88
Bushehr	1,020	58	231	2,391	878	3,558	925	188	13	2	59	56
Tehran	4,113	183	55	11,736	290	12,264	3,557	720	31	63	122	137
Chaharmahal and Bakhtiari	1,151	0	18	3,854	74	3,946	979	302	22	16	54	93
South Khorasan	2,707	1	118	8,286	141	8,549	2,048	893	38	34	384	321
Khorasan Razavi	4,432	2	2,013	10,532	280	12,827	3,863	569	71	35	185	219
North Khorasan	2,782	0	343	7,011	45	7,399	2,290	539	18	17	92	140
Khuzestan	1,988	1	6	5,740	482	6,229	1,609	453	32	21	193	236
Zanjan	2,981	0	1	4,015	4,581	8,601	1,800	1,238	7	20	472	387
Semnan	2,726	1	5	4,095	3,481	7,582	2,321	410	29	25	124	132
Sistan and Baluchestan	1,642	1	5	5,918	434	6,358	1,271	591	41	89	534	527
Fars	4,498	4	8	12,358	1,393	13,763	3,543	939	46	58	746	736
Qazvin	4,300	4	9	7,584	4,007	11,604	3,407	875	39	43	167	363
Qom	509	2	5	1,491	50	1,548	52	464	1	13	181	147
Kordestan	1,554	2	11	4,502	286	4,801	1,270	289	21	16	109	200
Kerman	4,654	2	15	12,659	1,647	14,323	4,019	706	56	99	1,842	1,009
Kermanshah	1,323	3	26	4,242	517	4,788	1,241	737	25	13	298	298
Kohgiluyeh and Boyer-ahmad	1,134	2	235	2,884	448	3,569	949	317	33	49	220	178
Golestan	3,248	14	57	7,978	617	8,666	2,684	514	37	13	85	108
Gilan	2,573	1	3	6,974	1,266	8,244	2,307	294	34	18	117	193
Lorestan	2,963	0	9	7,732	1,159	8,900	2,675	374	16	29	265	381
Mazandaran	6,372	18	11	18,386	421	18,836	5,627	606	74	77	280	284
Markazi	3,192	12	183	6,598	2,931	9,724	3,013	207	16	19	98	117
Hormozgan	1,394	0	0	4,364	41	4,405	1,178	297	9	16	46	115
Hamedan	2,672	3	7	8,109	8	8,127	2,524	254	43	29	458	214
Yazd	1,174	34	80	3,619	494	4,235	853	354	35	27	133	125
<b>Total</b>	<b>89,459</b>	<b>425</b>	<b>3,795</b>	<b>230,071</b>	<b>36,827</b>	<b>271,133</b>	<b>75,683</b>	<b>16,536</b>	<b>955</b>	<b>1,108</b>	<b>8,351</b>	<b>8,364</b>

**Table 2.** Statistical Comparison of the Number of Occurrence, Injury, Mortality Pattern of RTIs and Total Number of Red Crescent Operational Forces Involved in Road Traffic Accidents Between High, Moderate and Low Population Rate Provinces<sup>a</sup>

Provinces Variable	High Population Rate (8 Provinces)	Moderate Population Rate (9 Provinces)	Low Population Rate (14 Provinces)	P Value
Number occurrence of road traffic accident per 100000 people	98.6 ± 61.1	110.2 ± 38.8	174.1 ± 106.9	0.077
Road traffic injuries per 100000 people	224 ± 129.9	266.6 ± 95.7	436.4 ± 275	0.048
road traffic accident mortality per 100000 people	13.2 ± 5.5	20.1 ± 9.3	29.9 ± 9.9	0.001
total number of Red Crescent operational forces involved in road traffic accident	293.5 ± 189.9	342.6 ± 247.4	783 ± 444	0.003

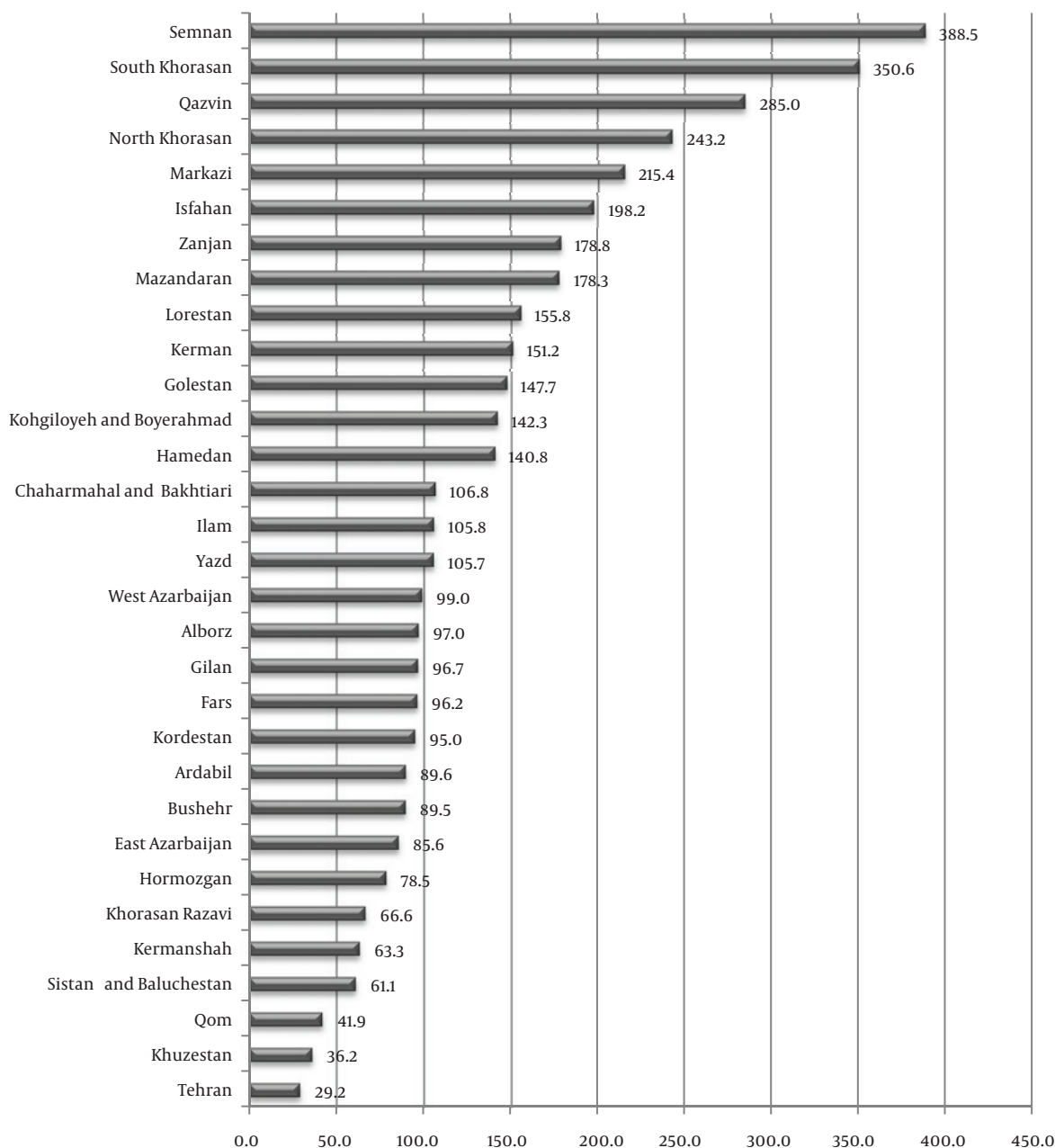
<sup>a</sup>Values are expressed as mean ± SD.



**Figure 2.** The Number of the Occurrence of RTIs Per 100000 People According to the Country Provenance That the Red Crescent Attended Since 20 March 2012 to 19 February 2016

mortality numbers are 38 deaths per 100,000 people (28). The study results of Yusef-Zadeh and colleagues in Rasht also showed that RTIs are the greatest cause of injuries among trauma patients (29). And other Study results of Salimi and Zare'i in Ahvaz (30) Moini and colleagues in Tehran (31), Modagheh and colleagues in Mashhad (32), Karbakhsh and colleagues in Kermanshah (33), Abbasi and colleagues in Shiraz (34), Beigzadeh and colleagues in Kerman (35), Solhi and colleagues in Arak (36) and Zamani and colleagues in Isfahan (37) showed that RTIs have the highest frequency of occurrence and mortality rate among

all types of accidents. Also, several studies in other countries have shown that RTIs are the leading cause of injuries and mortality compared to other accidents (38-43). The data of this study has been taken from the Red Crescent organization records for road traffic accident related injuries and mortality. This data reports a low number of road traffic related accidents and mortality. There is a discord between the number of RTIs-related mortality reported by the Iranian officials and the numbers reported by the world health organization (WHO). For the years 2013 - 2014, Iranian officials reported 17,994 RTIs-related mor-



**Figure 3.** The Number of the Occurrence of RTIs Per 100000 People That the Red Crescent Attended Since 20 March 2012 to 19 February 2016

tality, while in 2015, WHO (44) report estimates this number to be 24,896. These low numbers can be attributed to the fact that the Red Crescent is not present at all the RTIs scenes and is only able to account for those accidents in which there is a requirement of clinical specialized services of the organization's personnel. Or it may also have records of only those RTIs-related injuries and deaths

which occurred near the various relief bases of the organization. The commission process of safety management of transportation and accidents was approved by the council of ministers and the Red Crescent society of the Islamic Republic of Iran in 2007. According to Article 16 paragraph 4 of the commission, the Red Crescent is required to provide specialized services for relief and rescue, release and

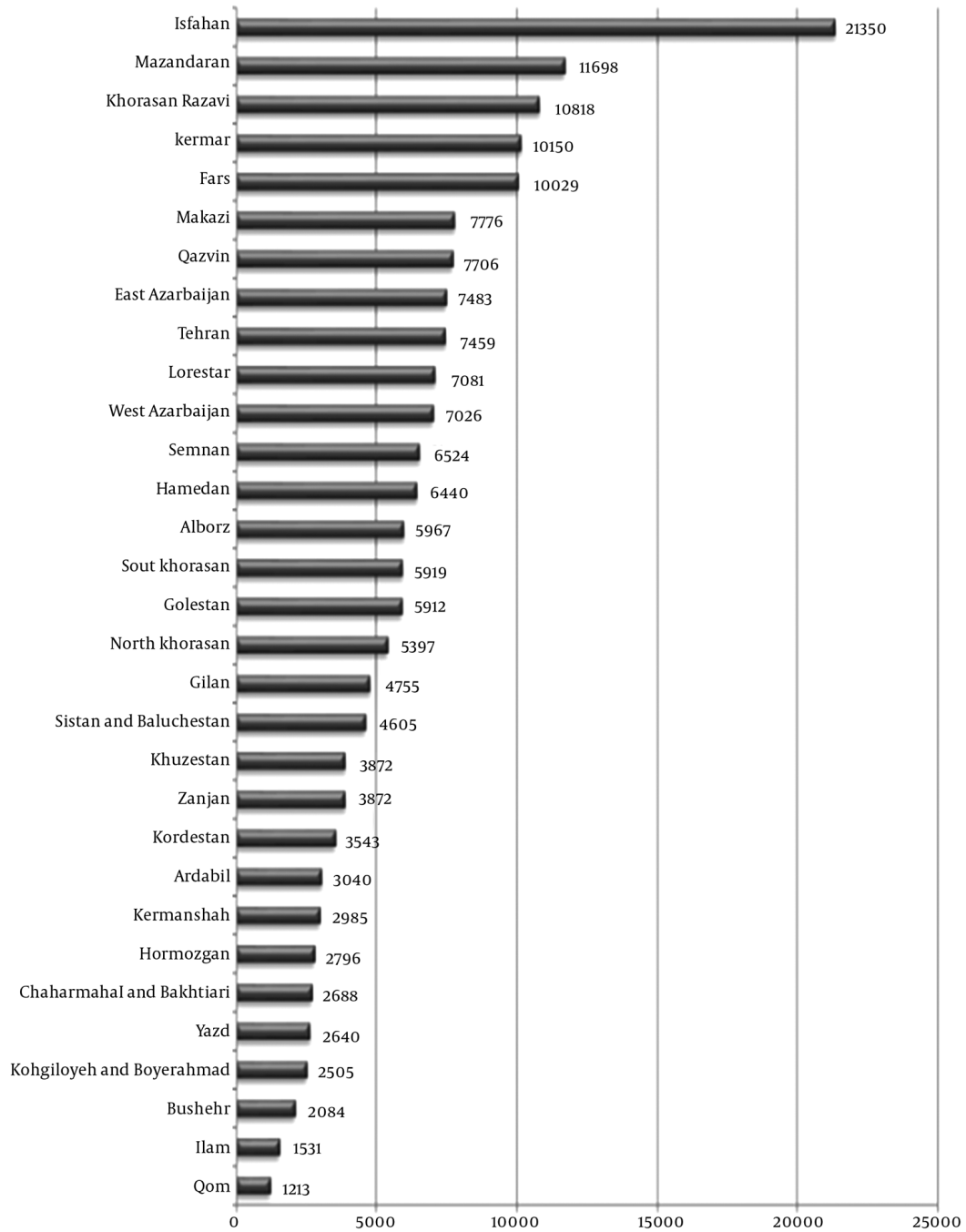


Figure 4. Pattern of the Injuries Caused by Traffic Accidents That the Red Crescent Attended Since 20 March 2012 to 19 February 2016



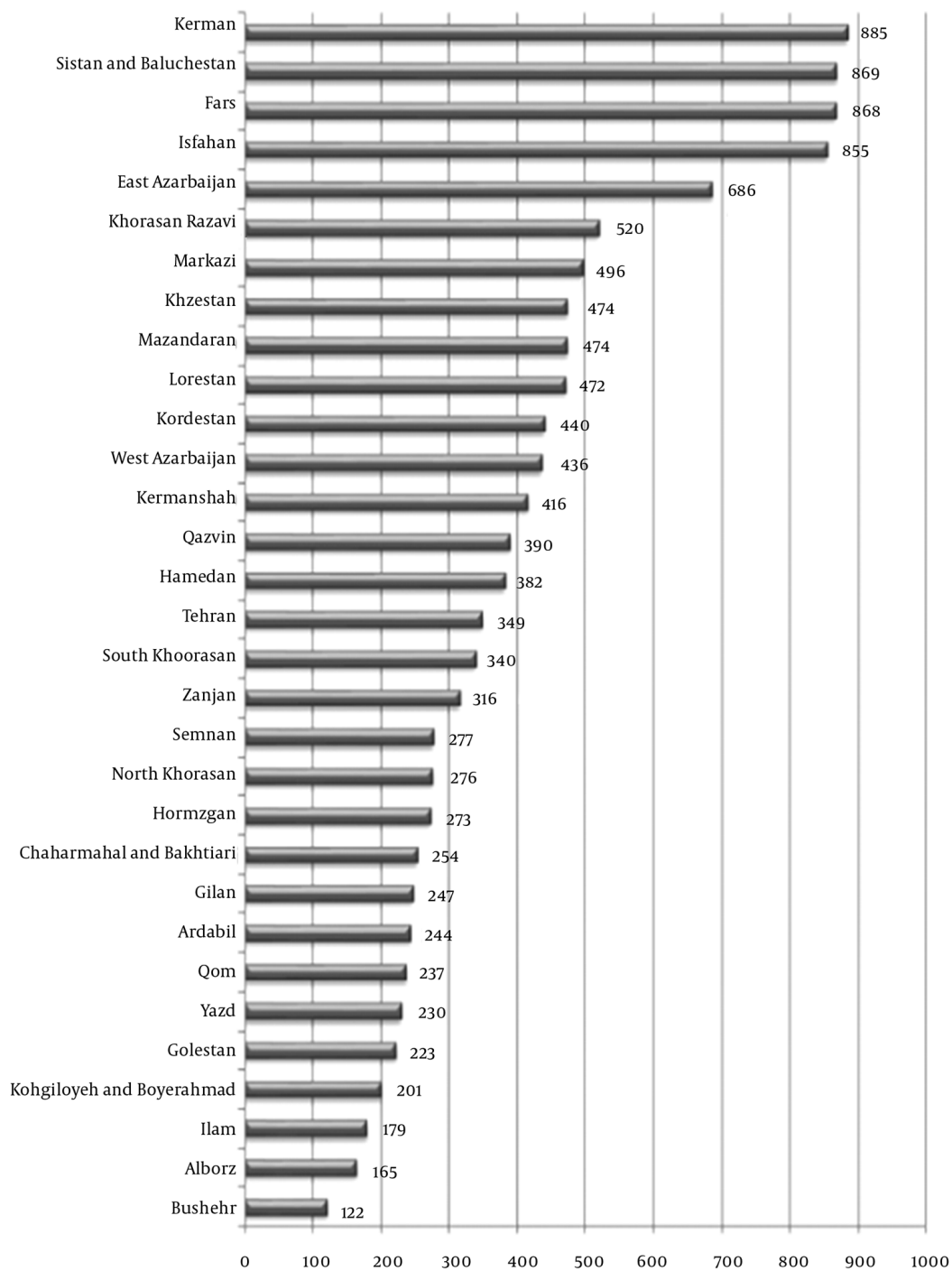
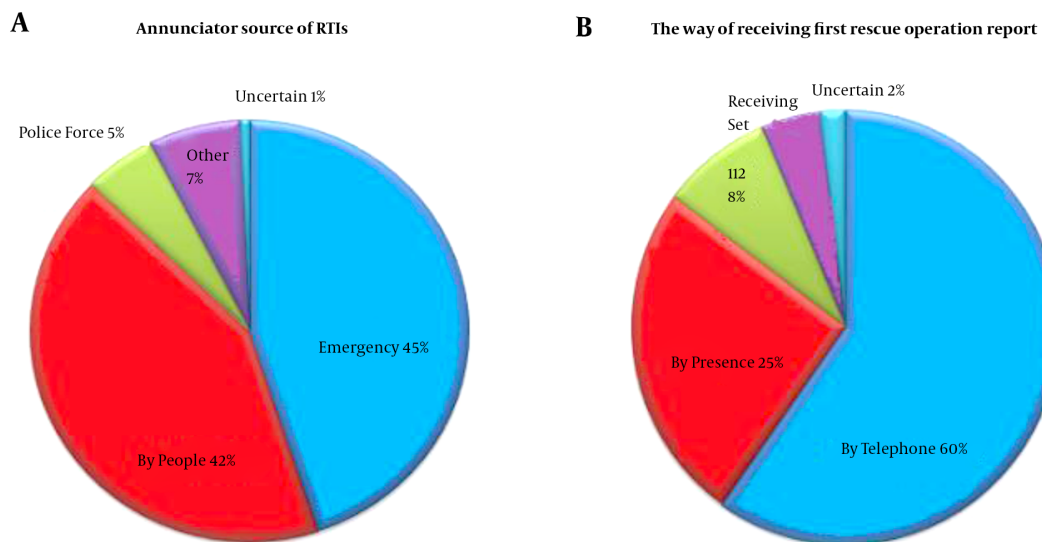


Figure 5. Pattern of Mortality Caused by RTIs that the Red Crescent Attended Since 20 March 2012 to 19 February 2016



**Figure 6.** The Pattern of Annunciator source From the Outside (A) and the Way of Receiving the First Rescue Operation Report (B) in RTIs That the Red Crescent attended Since 20 March 2012 to 19 February 2016

fire-fighting in road accidents. However, in addition to this study, other similar studies and data from other relevant organizations, exhibit that RTIs have the highest incidence and mortality. Hence, it is necessary to devote special attention to these accidents and allocate more resources to the prevention of road traffic accidents and to providing improved assistance to the victims of these accidents.

The results of the current study showed that the highest number of occurrence and injuries rate of traffic accidents occurred in the provinces of Isfahan and Mazandaran. While the highest mortality rates were due to the provinces of Kerman and Sistan and Baluchistan. The reason for more RTIs in Isfahan province can be the specific geographic location of this province, because Isfahan province is the country's communication highway as it is located in the center of the country, and this province is the road axis between different neighboring provinces. The highest number of occurrence of traffic accidents in Mazandaran province can also be due to the tourism position of the province. Receiving a large number of passengers for natural attractions would be effective in increasing RTIs in the province. One reason for the high probability of mortality in the provinces of Kerman and Sistan and Baluchistan can be the very great vastness of these two provinces and, therefore, the length of the communication ways of the provinces that increases the round trip paths and also the lack of standard separators on their roads. With the increase in the road length and the vastness of the area, the distance between the Red Crescent rescue &

relief bases and the emergency will be naturally significant, and this could also create delays in aiding. Another possible reason could be the low facilities and equipment in these two provinces, because despite the large area and high mortality rates, the results of this study showed that facilities and equipment in these provinces compared to Isfahan and Mazandaran provinces are low. Therefore, given the highlighted role of appropriate facilities and equipment and reducing the time to reach the scene of the accident in reducing casualties caused by traffic accidents (45), suitable arrangements of Rescue & Relief facilities and equipment in different regions of the country is necessary. To achieve this goal, identifying the high risk areas and regions with high losses is a basic issue. This becomes more important when we know that the study results of Jahangir and colleagues (2015) (46) showed that 51% of the Red Crescent society road bases had no appropriate facilities and equipment for providing rescue services and required to be strengthened and developed.

The losses caused by RTIs constitute very large rates. Apart from emotional losses, financial losses such as hospital costs and costs of the funeral and blood money and costs related to vehicle smoothing, painting and repairs are imposed on the driver or his family in any accident or incident. These figures will be a large amount in each year (15, 47-52). According to the study by Ainy and colleagues (2014) (2), it was estimated that the costs resulting from RTIs include 6.46 percent of the gross domestic product (GDP) in Iran with some costs not probably included in

these calculations. Taking a look at the facilities and equipment used in RTIs by the Red Crescent which is only one of the several organizations involved in RTIs discussion, makes very visible the importance of the costs and the resulting liability of RTIs. Hence, a comprehensive and coherent planning and the efforts of all organizations and institutions of the country seem an inevitable issue for preventing the RTIs.

According to our best knowledge and literature review results, this study is the first epidemiological survey of RTIs in Iran using DMIS data by the Iranian Red Crescent rescue organizations. The major limitation of this study is the low number of the data recorded by the Red Crescent and the failure to register some information. This is due to the nature of the tasks and the missions of the organization. Considering the beneficiaries of the various organizations and organs involved in RTIs and the responsibility of these organizations, each of these organizations has its own proprietary information systems such as Traffic police, forensics, Red Crescent, emergencies, and other organizations. Given the vital role of valid and reliable data systems in planning and designing effective and optimized interventions, designing a comprehensive and reliable data system through using a combination of the information contained in the various organizations seems quite necessary.

### 5.1. Conclusion

Due to the high number of occurrence, mortality, injuries and costs of traffic accidents compared to the other types of accidents, more attention to RTIs in planning and intervention seems necessary. Designing a comprehensive and reliable data system through using a combination of information contained in various organizations interested in RTIs seems quite necessary for planning and designing effective and optimized interventions.

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