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Epidemiology of traffic crash mortality in west of Iran in a 9 year period

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ABSTRACT

Purpose: In Iran, the most common cause of injuries and the second leading cause of deaths are traffic accidents, and those problems impose a substantial financial burden on the society. This study aims to determine traffic accident mortality trends and their epidemiologic characteristics in the Kermanshah province, west of Iran.

Methods: In a cross sectional study, road traffic fatality data from 2004 to 2013 were analyzed to determine the epidemiological pattern of traffic accident mortality. Trend assessment was performed to ascertain the decreasing or increasing status. Chi-square and one-way analysis of variance (ANOVA) tests, as well as Poisson regression were used to determine the significance of the data in time. Data were analyzed using Excel and statistical package of SPSS version 19.

Results: Out of 5110 people that died in traffic accidents, 4024 (78.7%) were males. The state of accidents indicated that 404 (43.8%) female pedestrians died as a result of car crashes, and 1330 (41.4%) males died because of car collisions. 1554 (31.9%) deaths happened to pedestrians and 1556 (32.1%) to vehicle drivers, and the rest belonged to vehicle passengers. Head trauma was the cause of death for as much as 3400 (69.9%) cases. Fatal crashes in which pedestrians were involved mostly occurred between the hours 13:00 to 15:00, while the time for vehicle drivers was between 16:00 to 18:00. 2882 people (59.1%) died before reaching to health care facilities. Traffic crash mortality trend for pedestrians follows a linear pattern with a gentle downward slope, but the trend shows various swings when it comes to vehicle drivers.

Conclusion: The number of traffic crash deaths from 2004 to 2013 indicates a decreasing trend in two groups of road users: vehicle drivers and car occupants. This can be due to some interventions such as modification of traffic rules and enhancement of police control which has been implemented in recent years. Moreover, more attention should be paid to promote the optimal health care services to save the lives of the injured from traffic accidents.

Introduction

Traffic accidents kill 1.2 million people worldwide each year, which comprises 2.1% of total deaths.[1] It is estimated that traffic accidents cost over 518 billion dollars worldwide, which in average attributes to 1%–5% of countries' GDP.[2] In Iran, there is one vehicle for every 4 people, which indicates the highest number of vehicles per capita within Eastern Mediterranean countries. According to Iranian Mining and Industries Organization data, nearly 1.5 million vehicles are added annually.[3–5] In Iran, the death and disability rates caused by traffic accidents are higher than the global average: 22.7% of the total disabilities and 17% of the total deaths in Iran are as a result of traffic accidents.[6,7] The average rate of fatal traffic crashes in the world is 20 deaths per each 100,000 people; while in European high income countries, it equals to 11 per 100,000 people; in the Eastern Mediterranean and African, it is 26.8 and 28.3 per 100,000 people; and in Iran it is 33 per 100,000 people.[7,8] The World Health Organization (WHO) and World Bank estimate that,

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within the next two decades, the rate of fatal traffic crashes in high income countries will be reduced by as much as 28%; however, in low and middle income countries the fatal crash rate will increase nearly 92%–147%.[7,9] Therefore traffic crashes worldwide, particularly in developing countries including Iran, requires prioritization.[10]

In Iran, road traffic injuries and deaths are important concerns of the government and in recent years some interventions have been carried out to prevent accidents and reduce mortalities. Imposing heavy fines for offending drivers and enhancement of police control are two of the main activities in recent years.

To determine the effects of these activities, assessing the trends of accidents and mortalities in previous years can be useful. The present study investigates the trends and epidemiological status of fatal traffic crashes and epidemiological status in Kermanshah province, Iran from 2004 to 2013.

Materials and methods

Kermanshah is the most western Iranian province, sharing a border with Iraq, with a population of nearly 2,000,000 people, it has nearly 3% of the total Iranian road length, including 2428 km of highway and main road as well as 4434 km of rural road, out of which 25.7% are asphalted. The present study is a cross-sectional one based on available data in Kermanshah province forensic files, which are related to those who died in traffic crashes during the years 2004–2013. The files included data such as age, gender, marital status, time of the crash and death, site of the crash, type of vehicle, state of the crash, site of trauma, and cause of death. The data were recorded on a daily basis in Forensic Medicine Offices in all 14 divisions of the province but data collection from all over the province took place in a monthly manner. Information related to cause of death was recorded by a coroner in each city. To increase the accuracy and validity of the forensic data, other sources of information such as cemeteries, hospitals and health care centers, as well as traffic police were also used to complete the forensic data.

Data were analyzed with Excel and SPSS (version 19) statistical package. In addition to the data description, Chi-square test was used to compare the proportions, one-way analysis of variance (ANOVA) to compare inter-groups means, and Poisson regression to determine change significance. Level of significance for all the tests was $p < 0.05$.

Results

During 2004 to 2013, traffic accidents killed 5110 people in Kermanshah province, including 4024 (78.7%) males and 1086 (21.3%) females. The average age of traffic accident victims was (39.5 ± 22) years, (38.7 ± 21) for males and (41.9 ± 26) for females with a significant difference between genders ($p < 0.001$).

An assessment of the deceased's situation at the time of death (road users) showed that the highest number of deaths belonged to car occupants and vehicle riders with 1750 (36.0%) and 1566 cases (32.1%), respectively. 83 out of 1566 (5.3%) vehicle riders who died in traffic accidents were riding two-wheel vehicles.

Regardless of the road users' characteristics, the cause of death was different in males and females: 404 (43.8%) female pedestrians died as a result of car crashes, and 1330 (41.4%) males died because of a car accident with another vehicle. ($p < 0.001$, Fig. 1).

As Table 1 indicates, 878 (56.0%) of the deceased drivers died at the site of crashes while 820 (52.8%) of pedestrians died in health care centers. Head trauma was the main cause of death for 1144 (73.1%) drivers and riders and 998 (64.3%) pedestrians.

The assessment of crash times indicates that most fatal crashes for pedestrians occurred between 16:00 and 18:00, those for car occupants occurred mostly in hours between 13:00 and 15:00, and those for most vehicle riders also occurred between 16:00 and 18:00 (Fig. 2).

The trend in male traffic mortalities has a downward slope. The observed variation in the trend plot is statistically significant ($p < 0.001$). However, between the years 2009 and 2010 this trend had been interrupted. Assessment of the female traffic mortality trend shows that the trend has an almost steady pattern ($p = 0.9$, Fig. 3).

Furthermore, there is a decreasing trend in pedestrians' road injury mortalities ($p < 0.001$). The trends of crash mortality in drivers, riders and car occupants indicate that there are fluctuations over the time of study. (Fig. 4).

Discussion

Age and gender

Regardless of the deceased situation at the time of death (road user type), the male traffic crash mortality rate is 4 times higher than female's. Similar studies in Iran, the United States, France, Sweden, Spain, India, Thailand, Turkey, Brazil and many other countries have shown similar higher male mortality rates caused by traffic crashes.[10–12] In Iran, women receive less than 30% of driving licenses,[13] which justifies most of the observed gender mortality differences occurring on vehicle drivers because of the higher number of male drivers.

Regarding the average age of the deceased at the time of death, vehicle drivers have the lowest mean age. Considering the public

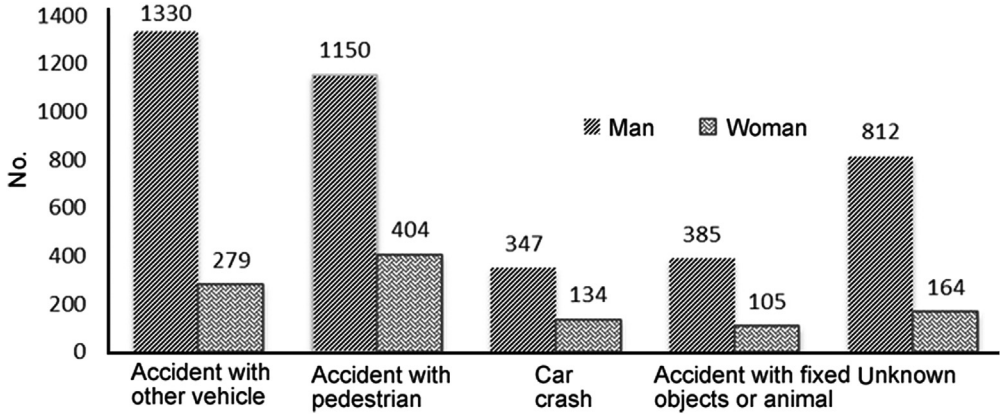

Fig. 1. State of car driver fatal crashes in Kermanshah province during 2004–2013.

Table 1
Traffic crash death characteristic.

Road users' characteristics		Total	Occupants	Drivers or riders	Pedestrians	*p* Value
Number (%)[a]		4870 (100)	1750 (36.0)	1566 (32.1)	1554 (31.9)	
Mean age ±SD		39.5 ± 22	35.7 ± 54	35.4 ± 35	48.8 ± 65	0.001
Single/married (proportion)[b]		632/1153 (54.8)	259/372 (69.6)	211/442 (47.7)	162/339 (47.7)	0.001
Man/woman (proportion)		3807/1063 (3.6)	1116/634 (1.7)	1541/25 (61.6)	1150/404 (2.8)	0.001
Time to death[b]	<1 h (%)	962 (55.5)	418 (65.8)	319 (54.0)	225 (44.2)	0.001
	1 h– <1 day (%)	383 (22.0)	105 (16.5)	154 (26.0)	124 (24.5)	
	1–3 days (%)	80 (4.7)	23 (3.7)	24 (4)	33 (6.5)	
	3 days + (%)	308 (17.8)	89 (14.0)	93 (16)	126 (24.8)	
Death place	At the scene of crash (%)	2348 (48.2)	963 (55.0)	878 (56.0)	507 (32.6)	0.001
	On the way (%)	534 (11.0)	195 (11.2)	164 (10.4)	175 (11.3)	
	In a health facility (%)	1905 (39.1)	569 (32.5)	516 (33.1)	820 (52.8)	
	At home (%)	83 (1.7)	23 (1.3)	8 (0.5)	52 (3.3)	
Direct cause of death	Head injury (%)	3400 (69.9)	1258 (71.9)	1144 (73.1)	998 (64.3)	0.001
	Multiple injuries (%)	613 (12.6)	219 (12.5)	208 (13.3)	186 (12.0)	
	Burn (%)	51 (1.0)	29 (1.7)	22 (1.4)	–	
	Limb injury (%)	366 (7.5)	133 (7.6)	99 (6.3)	134 (8.6)	
	Others (%)	440 (9.0)	111 (6.3)	93 (5.9)	236 (15.1)	

[a] 240 deceased had an unknown situation at the time of the accident.
[b] Data of deceased between 2011 and 2013.

transport vehicles, men make up the largest proportion of drivers in Iran. Also, men have a more active role in Iranian families, especially in low income families. When they die because of traffic crashes, their families encounter a lot of problems.

Vulnerable road users

This study indicates that 1/3 of traffic incident mortalities belong to pedestrians. Similar studies in other countries resulted in different outcomes: 11.2% in Vietnam,[14] 13% in the United States, 12% in Canada, 12% in Malaysia,[15] 9% in Thailand,[16] 46% in Sub-Saharan African countries,[17] 67% in Hong Kong,[18] and 48% in Sri Lanka.[19] To explain the above differences among these countries and regions, the researchers listed many reasons such as economic condition, proper infrastructure for pedestrians including bridges, underpasses, hampers, pedestrian crossings, as well as cultural awareness. On the other hand, many countries allocated a special route to two-wheel vehicles particularly bicycles but not in Iran. Considering the high pedestrians' traffic crash mortality rate in the west of Iran, it is necessary to strongly and strictly take proper safety measures into consideration so as to reduce traffic incidents. Increased pedestrian safety requires the development and implementation of better engineering, more educational resources, and more effective executive strategies that will demand comprehensive cooperation and contributions from the relevant organizations and agencies.

The other outcome of this study indicated that less than 2% of fatal traffic accidents were related to two wheel vehicles, which is lower than the similar studies in the capital of Iran 30%,[20] New Zealand 20%,[21] Japan and Australia 17%.[22]

Direct cause

In almost all the conducted studies, head trauma has been the most common cause of death. For instance, in Vietnam it was 78.7%,[14] In Tehran, the capital of Iran 79.8%,[23] Karachi, Pakistan 66.4%,[24] and Nigeria 48.3%.[25] The outcomes of this study indicate that head trauma occurrence is higher in vehicle drivers than occupants and occupants are higher than pedestrians. Therefore, one of the probable reasons for having different head trauma percentages in different places can be due to various road user types. Another possible reason could be due to differences in death recording methods, for example head trauma as the cause of death could be recorded as multiple traumas.[4] In general, head trauma has a higher rate among vehicle driver compared to the occupants and occupants have a higher rate compared to pedestrians. Various studies have indicated that using a helmet and seat belt could reduce traffic accident mortality by at least 50%,[23] thus it is highly suggested that relevant authorities enforce strict regulations to the use of helmets and seat belts, and additional resources should be used to increase public awareness.

Time of death

Present study data show more than half of the vehicle riders and 1/3 of the pedestrians died at the site of the incident. Previous

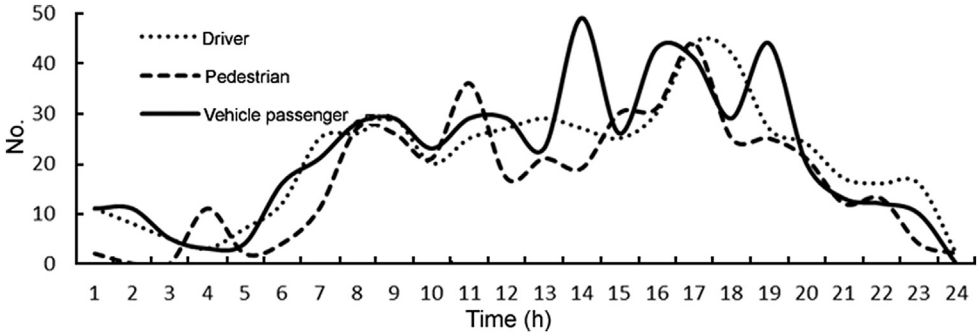

Fig. 2. Fatal traffic crash occurrence time in Kermanshah by 24 h.

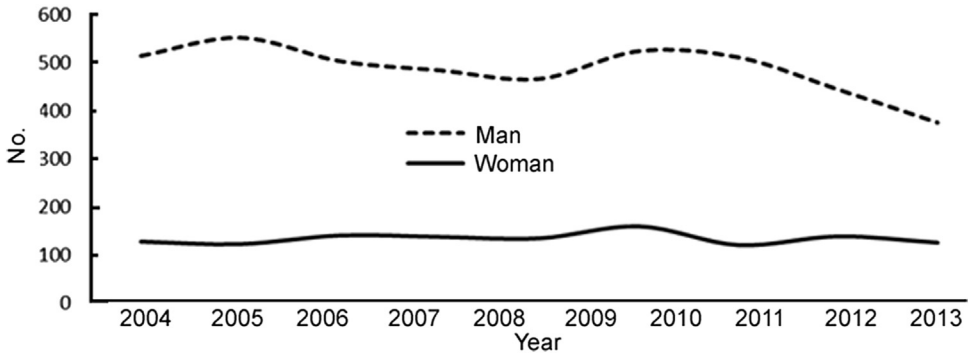

Fig. 3. Traffic incidents mortality trend by gender between 2004 and 2013.

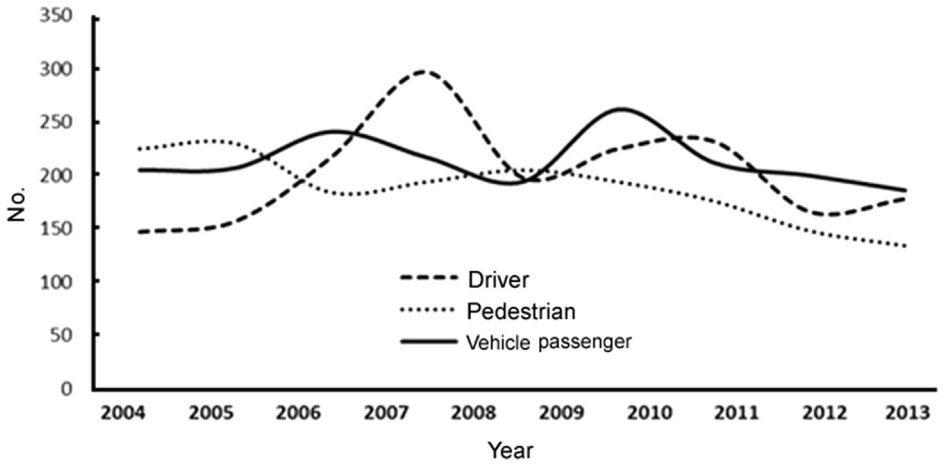

Fig. 4. Traffic incident mortality trend by deceased situation between 2004 and 2013.

studies indicated that timely transfer of casualties to heath care facilities can reduce up to 39% of traffic incident mortalities.[14] It is required that ambulances and rescue service providers constantly patrol the roads, particularly accident prone areas. Furthermore, well-established health care centers and emergency services at the main high traffic routes can accelerate the transfer of victims to health care facilities. It should be noted that the proportion of people who died before reaching the health centers in this study is much higher than that in other studies.[15]

Vehicle crash

Most fatal traffic incidents were caused by vehicle crashes. Similar studies in other parts of the world resulted in similar outcomes. For example, 47% of fatal traffic incidents in Japan and 42% in the United States[22] are caused by vehicle crashes. All three studies considered vehicle crashes as the most prominent cause of death though mortality is different among road users. In the United States most of the victims are vehicle drivers whereas in Japan they are vehicle occupants.

Time of accident

Assessment on traffic incident time, depending on the deceased person's situation at the time of death (road users), shows various time frames during the 24 h. Most occupants get involved in the incidents while returning from work at midday, within such time frame single-passenger vehicles are not usually seen in the city. However, a probable reason for drivers and pedestrians to have accidents mostly around sunset is because at such time frame people prefer shopping and fun hence the streets are packed. The time of traffic incidents in different regions differ because of differences in the deceased road users' situations at the time of death as well as sociocultural differences in different societies. For instance, in Saudi Arabia, Jordan, Turkey, and China traffic accidents mostly occur between the hours 12:00 to 18:00, Sweden 10:00 to 12:00, Italy 13:00 to 17:00, and Canada 16:00 to 18:00.[26,27] However, in general, it could be stated that most fatal traffic accidents occur at sunset.

Impact of regulations

Pedestrians' traffic mortality trend assessment indicates a downward pattern. This can be due to modifying traffic rules and imposing heavy fines for offending drivers especially in cities. This declining trend is observed despite the increase of vehicles. However, the drivers' traffic mortality trend indicates two quite obvious downward changes, in which the first change is likely because of increased fuel prices since June 2007, and the second one since May 2011 was because traffic violation fines were multiplied. The regulation enforcement not only reduced drivers' traffic mortality, but also lowered occupants' traffic incidents mortality. The impact of these regulations on males' mortality trend is quite obvious, but the impact on females' mortality trend is unclear since females' involvement in traffic crashes is mostly as pedestrians and occupants not vehicle drivers. Therefore, the authors recommend that

different subgroup mortality trends should be taken into consideration while assessing the impact of regulations.

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