

Original Article

Epidemiologic study of traffic crash mortality among motorcycle users in Iran (2011–2017)

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ABSTRACT

Purpose: Motorcycle accident is a major cause of road traffic injuries and the motorcyclists are considered as vulnerable road users. The present study aimed to determine the epidemiological characteristics of fatal motorcycle crashes in Iran.

Methods: In this cross-sectional study, a total of 28,356 motorcycle traffic fatalities registered in the Legal Medicine Organization of Iran were analyzed during the period between March 2011 and March 2017. The examined variables included demographic characteristics, helmet use, crash mechanisms, crash location, position state, type of counterpart vehicle, cause of death and place of death. In the study, road traffic mortalities involving drivers and/or passenger of motorcycles were included. Cases or events registered without these conditions were excluded from the study. To analyse the data, SPSS statistics 25 and GraphPad Prism 8 softwares were used.

Results: Of the 122,682 fatal traffic injury cases, 28,356 (23.1%) were motorcycle users, of whom 95.3% were male and 4.7% were female. Most of the motorcycle fatalities belonged to the age group of 18–24 years (29.1%). Head trauma was the major cause of death (59.0%). Also, the overall proportion of safety helmet use among motorcycle crash victims was estimated at 37.4%. Most of the road traffic crash cases (46.8%) happened out of city and half of people (49.9%) died in hospital. About 77.4% of the victims were motorcycle riders and 21.1% were pillion passengers. The highest rate of mortality belonged to the self-employed (38.4%) and then workers (21.8%) and students (10.2%). In addition, most fatalities occurred in people with low education (77.5%) and the least occurred in university graduates (5.5%). Among 31 provinces of Iran, Fars had the highest (9.3%) occurrence rate and Kohgiluyeh and Buyer-Ahmad had the lowest (0.5%). Most of the crash mechanisms were due to motorcycle-vehicle crashes (80.2%), followed by rollover (9.8%).

Conclusion: Comprehensive public education and special rules are needed to reduce the rate of deaths in motorcycle crashes.

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Introduction

Road traffic injury (RTI), according to the World Health Organization, is the 8th main cause of death worldwide and the main cause of death among young people aged 15–29 years. Also nearly 3400 people die every day on roads (one death on road every 24 s) in the world.^{1,2} Recent trend shows that by 2030 road traffic deaths will become the 7th main cause of death if urgent action is not taken, and that about 90% of the global road traffic mortalities occur

in low- and middle-income countries. Each year, about 1.3 million fatal damages and 20–50 million non-fatal damages happen as a result of road traffic crashes.^{3,4}

Almost a quarter of global road traffic deaths happen among motorcyclists, which shows that motorcyclists are the most susceptible road users. In comparison to other types of motor vehicles per mile travelled, motorcycle users have a 34-fold higher risk of death in a crash.⁵ It has been shown that in eastern Mediterranean region countries including Iran, motorcycle injuries are a major public health problem.⁶ From 1999 to 2000, about 5000 people died and 70,000 were injured in motorcycle crashes in Iran.⁷ Furthermore, not only economic active population but also children and teenagers are highly involved in motorcycle crashes, so

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that much attention has been paid to this type of crash due to the high mortality and costs.⁸

Road traffic mortality in Iran is considerably higher than many other low- and middle-income countries, and traffic injuries in Iran are suggested to be remarked as one of the highest public health priorities to be noted efficiently.^{9,10} In this context, it is necessary to determine epidemiological patterns of motorcycle user traffic fatalities to have an in-depth view in further decision making for reducing this kind of RTIs. The present study investigates some epidemiological characteristics of motorcyclist fatalities in Iran during 2011–2017.

Methods

This is a cross-sectional study based on available data sources in the Legal Medicine Organization of Iran. We collected data from motorcyclists who were injured in road traffic crashes during 2011–2017. The variables measured in the analysis were demographic factors (age, sex, marital status, educational level, occupation), position state (driver and pillion), helmet use (yes or no), type of counterpart vehicle (cars, bus, truck, minibus, etc.), cause of death (head trauma, bleeding, multiple fracture, burns, etc.), place of death (crash scene, in transferring, hospital, home), crash location (inner city, outer city, rural road), crash mechanisms (motorcycle-vehicle crash, vehicle-fixed object, rollover, crash-caused fall, etc.).

Data analysis was performed using SPSS software version 25 and Graphpad Prism version 8. One-way analysis of variance, independent-samples *t*-test and Chi-squared test were used to compare proportions. A $p < 0.05$ was considered statistically significant.

Results

A total of 122,682 fatal traffic injury cases were registered during 2011–2017 where motorcycle users were involved in 23.1% (28,356) of all these fatal crashes. The annual mortality rates for road traffic fatalities and motorcycle user fatalities were 21.9 and 5

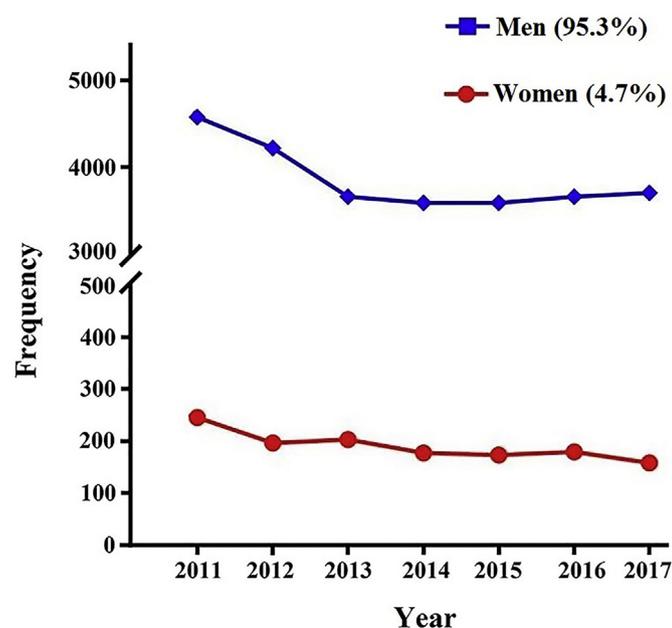


Fig. 1. Gender distribution among motorcycle-related fatal injury in Iran, 2011–2017.

per 100,000 people, respectively. This study showed that among motorcycle users, 27,025 victims were men (95.3%) and 1331 were women (4.7%) (Fig. 1). The difference between the two genders was significant ($p < 0.0001$). As far as age was concerned, most of the fatal crashes were related to the age group of 18–24 years with 8251 (29.1%) cases who showed a significant difference with other age groups ($p < 0.001$); the least frequency belonged to the age group < 10 years with 495 (1.7%) cases (Fig. 2).

The results also showed that there was a downward trend in motorcycle user fatalities and other fatal traffic injuries during the study period (Fig. 3).

In terms of the victims' status, 21,955 cases (77.4%) were drivers, 5972 cases (21.1%) were pillion passengers and 429 cases (1.5%) were unknown (Table 1).

An assessment of education level indicated that the highest frequency of the victims was pertinent to individuals with elementary ($n = 7670$, 27.0%) or secondary school education ($n = 8352$, 29.5%). Approximately 1369 (4.8%) of the victims had academic education, 4272 (15.1%) were illiterate, and the remainder had other levels of education (Table 1). Both elementary school and secondary school had significant difference with other education groups ($p < 0.05$).

In terms of occupational status, the highest rate of mortality belonged to the self-employed group ($n = 10,733$, 37.9%, $p = 0.0001$), followed by workers ($n = 6032$, 21.3%) and students ($n = 2803$, 9.9%) (Table 1).

The results also showed that private cars had the highest frequency ($n = 10,921$, 38.5%) ($p = 0.0001$) of involving in motorcycle crashes, and 3884 cases (13.7%) were related to heavy vehicles (Fig. 4).

Head trauma was the major cause of death for 16,724 (59.0%) cases, followed by multiple fractures ($n = 5488$, 19.4%) and mixed causes ($n = 2741$, 9.7%) (Table 1). Regarding the safety helmets, most of the motorcycle crash victims did not wear helmets at the time of crash ($n = 17,740$, 62.6%) and only 10,616 (37.4%) of them wore helmets (Table 2). Victims who had a helmet at the time of crash sustained significantly less frequent head trauma compared to those without a helmet ($p < 0.001$).

Most of the fatal crashes occurred out of city with frequency of 13,272 (46.8%) followed by inner city with 11,206 (39.5%) and rural road with 3748 (13.2%). Regarding the place of death, the highest

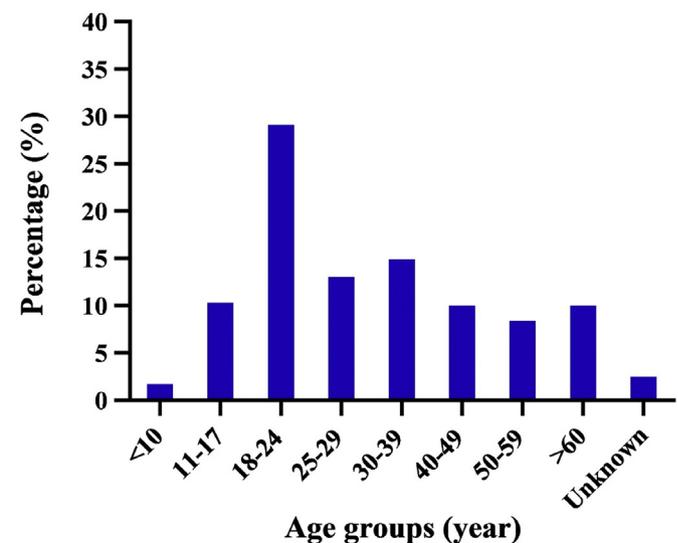


Fig. 2. Age distribution among motorcycle-related fatal injury in Iran, 2011–2017.

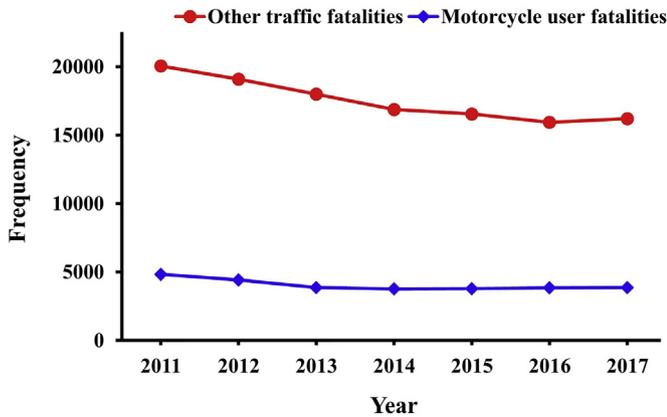


Fig. 3. Trend of mortalities compared for motorcycle traffic injuries and other traffic injuries, Iran 2011–2017.

Table 1
Distribution of variables in fatal motorcycle crashes, Iran 2011–2017.

Variables	n (%)	95% confidence interval
Educational level		
Illiterate	4272 (15.1)	14.5–14.9
Elementary school	7670 (27.0)	25.9–26.4
Secondary school	8352 (29.5)	28.4–29.0
High school	2463 (8.7)	8.2–8.6
Diploma	3760 (13.3)	12.6–13.0
University students	629 (2.2)	2.0–2.1
Associate of arts	336 (1.2)	1.1–1.2
Bachelor of science	372 (1.3)	1.2–1.3
Master of scienc	32 (0.1)	0.08–0.1
Unknown	470 (1.7)	1.5–1.6
Position state		
Driver	21955 (77.4)	76.9–77.4
Pillion	5972 (21.1)	20.6–21.1
Unknown	429 (1.5)	1.4–1.5
Occupation		
Children	378 (1.3)	1.2–1.3
Students	2803 (9.9)	9.5–9.9
University students	881 (3.1)	2.9–3.1
Housewife	973 (3.4)	3.2–3.4
Clerk	649 (2.3)	2.1–2.3
Worker	6032 (21.3)	20.8–21.3
Self-employed	10733 (37.9)	37.3–37.9
Soldier	627 (2.2)	2.1–2.2
Retired	783 (2.8)	2.6–2.8
Unemployed	828 (2.9)	2.7–2.9
Driver	185 (0.7)	0.6–0.7
Farmer	2499 (8.8)	8.5–8.8
Military	143 (0.5)	0.4–0.5
Others	296 (1.0)	0.9–1.04
Unknown	546 (1.9)	1.8–1.9
Cause of death		
Head trauma	16724 (59.0)	58.4–59.5
Bleeding	2253 (8.0)	7.6–8.2
Multiple fracture	5488 (19.4)	18.8–19.8
Burns	46 (0.2)	0.12–0.21
Under test	86 (0.3)	0.24–0.37
Mixed causes	2741 (9.7)	9.3–10.0
Others	925 (3.3)	3.0–3.4
Unknown	93 (0.3)	0.26–0.4
Crash location		
Inner city	11206 (39.5)	38.9–40.0
Outer city	13272 (46.8)	46.2–47.3
Rural road	3748 (13.2)	12.8–13.6
Unknown	130 (0.5)	0.38–0.54
Death location		
Crash scene	11879 (41.9)	41.3–42.4
In transferring	2098 (7.4)	7.1–7.7
At hospital	14149 (49.9)	49.3–50.4
At home	85 (0.3)	0.24–0.37
Unknown	145 (0.5)	0.43–0.6

rate of deaths occurred in hospital ($n = 14,149, 49.9\%$) and at the scene of the crash ($n = 11,879, 41.9\%$) (Table 1).

In terms of marital status, our findings showed that out of 28,356 cases, 13,507 (47.6%) were single and 14,594 (51.5%) were married. There was no significant difference between the two groups.

According to the results mentioned in Fig. 5, the most frequent mechanism of motorcycle accident were related to vehicle crashes ($n = 22,744, 80.2\%$) followed by rollover ($n = 2785, 9.8\%$). Among the 31 province in Iran, Fars had the highest rate of incidence with 2629 cases (9.3%), and Kohgiluyeh and Buyer-Ahmad with 142 cases (0.5%) had the lowest frequency in fatal motorcycle crash injuries.

Discussion

In the current study, the annual rate of road traffic deaths in Iran was 21.9 per 100,000 people and the mortality rate for motorcycle users was 5 per 100,000 people. In 2015, the estimated annual mortality rates were 19.2 and 3.3 per 100,000 people. Global status report on road safety 2015 showed that 32.1 road traffic fatalities per 100,000 people occurred in Iran, 21% of which related to motorcycle riders.¹¹ The lower mortality rate observed in our study could be due to sampling and methodological variations.

Similar to other studies,^{12,13} fatal motorcycle traffic injuries were more frequent in males than females. Male-to-female ratio was calculated about 20.3:1. It could be explained that men were more active than women in the places outside the home. Also, because of the cultural and religious background of eastern Mediterranean countries, men were more likely to ride motorcycles in their social activities compare with women.¹⁴

The highest mortality of road traffic accidents occurred in 18–24 years age group, which is correlated with other studies.^{15,16} Motorcycling fatal injuries among young people that occur in developing countries like Iran might be due to the lack of driving experience and risk-taking behaviors such as over speeding, drink

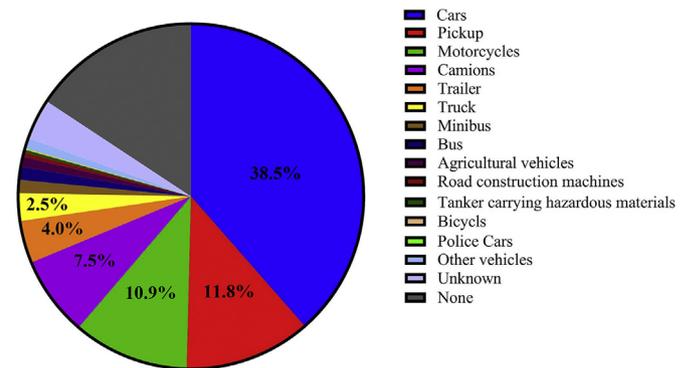


Fig. 4. Distribution of motorcyclist crash resulted in death according to counterpart vehicle type, Iran 2011–2017.

Table 2
Distribution of helmet use among motorcycle crash victims, Iran 2011–2017, n (%).

Variables	Helmet use		Total
	Yes	No	
Head injury	6036 (36.1)	10,688 (63.9)	16,724 (59.0)
No head injury	4573 (39.6)	6966 (60.4)	11,539 (40.7)
Unknown	7 (7.5)	86 (92.5)	93 (0.3)
Total	10,616 (37.4)	17,740 (62.6)	28,356 (100)

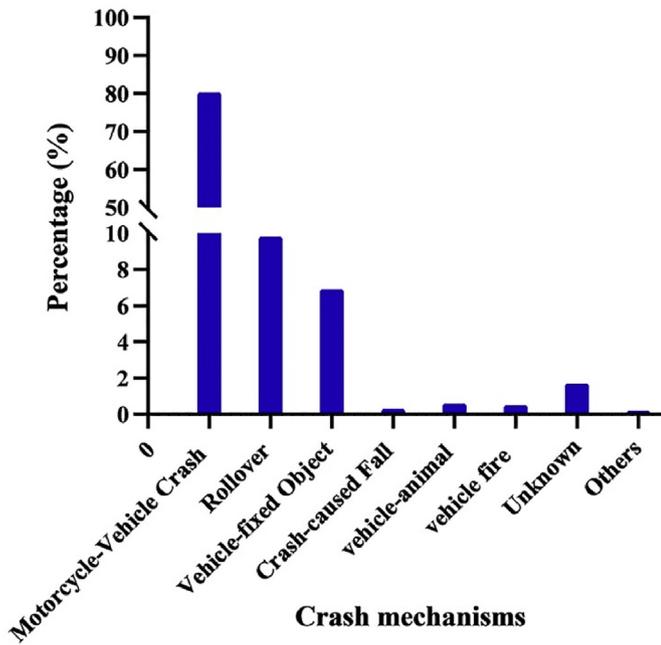


Fig. 5. Traffic crash mechanisms among motorcycle users died of traffic injuries, Iran 2011–2017.

and drug driving, disobedience of traffic regulations and neglecting safety measures.¹⁷

In our study, a decreasing trend of motorcycle fatalities was observed over the study period. This suggests that perhaps regulations applied for promoting the safety of motorcyclists achieved an effect.

Similar to other studies,^{4,18,19} head trauma was more prevalent and the major cause of death in motorcyclists. In addition, only a small proportion of motorcycle crash victims (37.4%) used helmets, while the majority of victims (62.6%) did not use helmets at the time of crash. On the other hand, we found that victims wearing helmets were less likely to sustain head trauma. This result is in accordance with other studies showing that the use of safety helmets effectively decreases head injuries in motorcycle crashes.^{20,21} Therefore, more attention should be paid by the legal system to use safety and protective devices. Also it should be prioritized in the education programs as well as law enforcement to encourage motorcycle users to wear a helmet.

Besides motorcycle riders that account for 77.9% of fatal road traffic accident victims, pillion passengers also comprised 21.5% of this population. It revealed that wearing helmet should be compulsory for both the motorcyclists and their passengers.

According to our findings, most fatal motorcycle accidents were caused by vehicle crashes (80%), which is consistent with more studies in other parts of the world reporting that motorcycle-vehicle crashes are the most common mechanism of road traffic accidents.^{7,22} For instance, 50% motorcycle crashes in the United Arab Emirates resulted from hitting a moving vehicle followed by turnover (30%).⁶ Moreover, private cars were the most prevalent type of vehicles that motorcycle crashed into followed by heavy vehicles. This result is in line with a study conducted in Mazandran which found that 59.9% of motorcyclist injuries were due to the collision between motorcycle and car.²³

Motorcycle speed is one of the most serious risk factors in fatal motorcycle crashes.²⁴ Our results showed that higher frequency of fatal crash occurred in outer city compared with the inner city. This

may be due to the fact that motorcycle users in the outer city areas have higher speed than in inner city.

Motorcycle fatalities were higher among people with low education level (under diploma), similar to other studies.^{25,26} The most frequent deaths occurred in hospitals ($n = 14,149$, 49.9%) followed by accident scenes ($n = 11,879$, 41.9%). Notably, the number of deaths during transferring to the hospital was 7.4% according to 115 emergency personnel information. Given that primary operation on injured people is vital after crash, it is predictable that appropriate emergency operation during transferring will save the lives of the injured people.

In conclusion, it seems paying more attention to young age group, applying special rules and comprehensive public education on proper helmet wearing are essential to reduce the rate of deaths in motorcycle accidents.

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Nil.

Ethical Statement

Ethical affirmation has been achieved from the ethical committee.

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Declaration of Competing Interest

The authors declare that they have no competing interests.

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