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Head and face injuries and helmet use among injured motorcyclists with road accidents in Isfahan, Iran

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Original Article

Abstract

BACKGROUND AND AIM: The study aimed to assess the frequency of head and face injuries in motorcyclists who had an accident and to find out the relationship between helmet use and frequency of these injuries.

METHODS: A cross-sectional study with multi-stage sampling method provides data on the injured motorcyclists with road accidents. Data came from a registration form which has documented information of each injured person who had a road accident and hospitalized in the biggest hospital of Isfahan University of Medical Sciences, Iran (Al-Zahra). All the registration forms were surveyed for hospitalization period, treatment costs, severity of injury, and date of accident during 2010 (n = 1626). Later, among the list of injured motorcyclists during the last 3 months of the registration form, 125 cases were randomly selected and interviewed by phone regarding occurrence of the head and face injuries and whether wearing helmet during the accident. Confidence intervals (CI), Chi-square, and Phi and Cramer's correlation coefficient were applied. The ethical approval was provided.

RESULTS: Accident by motorcycle was 31.0% of all road accidents. The frequency of motorcycle accidents was higher in the autumn and among 21-25 year olds. The mean period of hospitalization was 4.3 days and the mean of hospital costs was about 9000000 Rials [about 8200 United States dollar (USD), in 2010]. Of motorcyclist, 35.0% reported they were helmeted when they had the accident. The frequency of head and face injuries was 51.0% among all the injured motorcyclists, 22.0% and 78.0% among the helmeted and non-helmeted motorcyclists, respectively (P = 0.009, r = -0.267).

CONCLUSION: Motorcycle accidents comprise a large number of road accidents and cause substantial morbidity and financial impact for the community members. Head and face injuries are the most common trauma in motorcyclists, and the injury rate is higher among non-helmeted motorcyclists.

KEYWORDS: Helmet, Motorcycle, Accident, Costs, Hospital, Head Injury, Facial Trauma

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Accidents, both natural and man-made, lead to a great amount of years of life lost.[1] Road accidents are the part of man-made accidents.[2] The increase in road traffic injuries (RTI) and death caused by motor vehicles is the growing problem for the public, worldwide.[3] This public health concern leads to about 1.2 million death and 20-50 million disabilities, annually.[4] Among these mortalities, the majority are related to road accidents in countries with a low to moderate economic status.[5] Based on the previous studies, Iran had the highest rank of accidents and RTI in comparison with other countries, with 44 RTI deaths per 100000 populations.[6,7]

Among all kinds of motor vehicles, motorcycles play a significant role to cause

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transportation accidents.[8,9] The risk of injury and death in motorcycle accidents are 3 and 16 times/mile more than the cars, correspondingly.[10,11] Similar to many other Asian countries, motorcycle is the most common vehicle for transportations in Iran.[12] Studies showed in recent years, Iran has been confronting about 10.0% increase in number of mortality and injuries caused by road accidents.[13]

Head and leg injuries are the most prevalent injuries among those who experienced a motorcycle accident.[9,14] Head injuries are detected as the reason for half or more of all death in motorcyclist in crashes.[15] The use of a helmet significantly decreased the mortality rate due to damages to the head,[16] this rate is 3-4 times less than the mortality rate of those who did not use it.[17] On the other hand, not wearing the helmet have resulted in a significantly higher incidence of cranial injury and death among patient involved in motorcycle crashes. The put helmets as the best way to decrease motorcycle deaths and injuries.[18] In addition, helmet use reduces the average of hospitalization cost per casualty by 6000 United States dollar (USD).[19] Legislation of helmet law in California decreased 35.0% of the total cost of medical care, mostly (73.0%) costs of hospitalization due to casualties with head injury.[20]

RTIs are one of the most important cause of death, disability, hospitalization expenses, and economical costs to the society,[21] in addition, road accidents make psychological damages on the motorcyclists, their families, and their society;[1,21] therefore, the World Health Organization (WHO) has focused for future research on this field.[22] Isfahan, Iran, one of the biggest cities in the country, has heavy traffic and high number of motor vehicles, especially motorcycles. The road accident in the city is one of the highest in the country. The aim of this study was to assess the frequency of head and face injuries in motorcyclists who had an accident and to find out the relationship between helmet use and frequency of these injuries.

Methods

This is a cross-sectional study with multi-stage sampling method was conducted on a representative sample of injured motorcyclists with a road accident during the year of 2010. At the first stage, a registration form was assessed to provide data of all road accidents including motorcycle accidents. This form is based on the article 92 of the Fourth Development Plan of Iran Governance. According to this law, all public and private hospitals must to urgently do acceptance and treatment for all inpatients and outpatients who have been injured due to road accidents and referred to them. The casualty's information, then, is documented and registered by Deputy of Treatment of Universities of Medical Sciences.

In the present study, among all hospitals of Isfahan, the Al-Zahra Hospital, the biggest and the central hospital, was selected because of its high referral frequency and high accuracy of its registration forms that makes possible to define types of accidents separately (motorcycle, car, or pedestrian accidents). To find out the impact of different seasons on the frequency of motorcycle accidents, the registration forms of whole year of 2010 (from the beginning of Dey, 1388 to the end of Azar, 1389) were evaluated. A total number of 1626 cases from the whole registration forms of the Al-Zahra Hospital were assessed by one of the researchers to find out the information about motorcycle accidents during the year.

The registration forms provided data for each injured motorcyclist consisting of his name, date of accident (month and year), hospitalization duration (day), and hospitalization costs including the costs of medical equipments, medications, paraclinic and laboratory services, and a part of payments to the hospital' physicians as fee for service (2k)-not including their salary. In

addition, severity of injury was evaluated as superficial (< 6 h hospitalization), severe (more than 6 h hospitalization), organ impairment (amputation of any part of body because of the accident during the hospitalization time), or death (during hospitalization).

In the second stage, a sub-sample of cases was randomly selected from all documented motorcycle accidents during the last 3 months. Based on the statistical evaluation 95 cases were assumed, and then considering the probability of the unavailability of subjects and deficiency in patient's files, as observed in the pilot study, the sub-sample were increased to the 125 cases (30.0% more). Choosing the last 3 months of year was for avoiding recall bias among motorcycles about detailed information of their accidents. After going to the Al-Zahra Hospital, the patient files of these cases were requested from Medical Records Department of the hospital and looked for casualty's age, accurate type of injury, and his telephone number. The incomplete patients' files were excluded and a number of 107 patients' files provided data for final phase of study.

In the third stage, one of the researchers who had been trained and calibrated for the purpose of study called the phone number of each case and interviewed with him. In a few cases that the injured motorcyclist had died due to the accident or was absent when calling, the interviewer talks with his close relative who was present at home and informed about the accident. A total of 97 subjects participated (response rate = 91.0%). The questions was about type of accident (to make certain about accident by motorcycle), type of injury and injured site of the body, and whether the casualty had used helmet while accident.

Statistical evaluation was performed through SPSS software (version 16, SPSS Inc., Chicago, IL, USA) for descriptive analyses. Confidence intervals (CI) and Chi-square test were used. To find out the correlation between head and face injuries and helmet use the Phi and Cramer's correlation coefficient was applied. The ethical approval was obtained from Research Committee of Dentistry Institute of Isfahan University of Medical Sciences (no 390151).

Results

The findings of this study showed that motorcycle casualties constitute 31.0% of the total road accident casualties in the Al-Zahra Hospital. The highest rate of motorcycle accidents in the year occurred during the autumn (29.3%; 95% CI = 26.9-31.5) and in the Mehr (the 1st month of the autumn) (11.3%; 95% CI = 9.7-12.8). The lowest rate of motorcycle accidents was in the winter (18.6%; 95% CI = 16.7-20.5) (Figure 1). The highest rate of motorcycle accidents occurred in the age group of 21-25 years (35.0%). In addition, most of the accidents (75.0%) happened among people younger than 30 year olds. The mean of hospitalization time due to motorcycle accidents in the Al-Zahra Hospital was 4.3 days [standard deviation (SD) = 8.7]. Duration of hospitalization has ranged from 1 to 213 days, while more than half of the casualties (55.0%) had been hospitalized for 1 day (median = 1). Only one patient was hospitalized for a very long time (213 days).

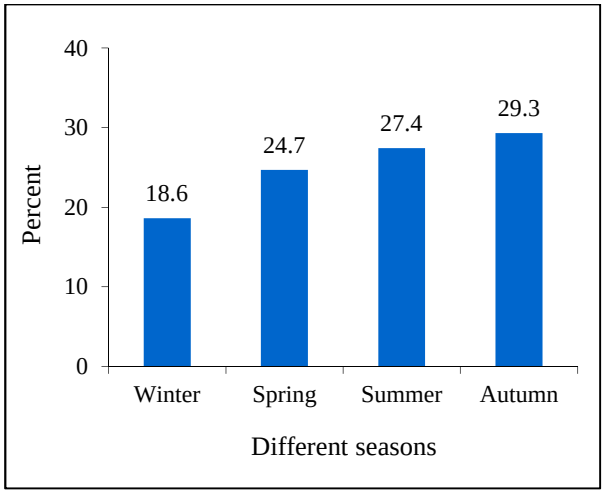

Figure 1. Percentages of motorcycle accidents among motorcyclists hospitalized in the Al-Zahra Hospital during different seasons

Many of the injuries (61.3%) during the accidents were described as severe (Table 1). Accidents occurred during the summer, and the autumn were more severe than the accidents during other seasons (P = 0.003). No differences were found for severity of injuries regarding age and marriage status of motorcyclists (P > 0.050). 3.0% of the hospitalized motorcyclists had died during hospitalization. This death rate was not constitute those had died immediately after the accident and not refer to the hospital.

Table 1. Severity of injuries among motorcyclists hospitalized in the Al-Zahra Hospital

Severity of injury*	n (%)
Superficial	575 (35.4)
Severe	997 (61.3)
Organ impairment	4 (0.2)
Death	50 (3.1)
Total	1626 (100)

*Severity of injury was evaluated by a treatment expert in the treatment Deputy of Isfahan University of Medical Sciences as superficial (< 6 h hospitalization), severe (more than 6 h hospitalization), organ impairment (amputation of any part of body because of accident during the hospitalization time), or death (during hospitalization)

The mean medical cost of motorcycle accidents was 8842558 Rials per casualty (about 8200 USD in 2010). The expenses have included medications (16.0%), medical equipments (16.0%), paraclinic and laboratory services (59.0%), and the rest were for payments to the hospital physicians. Head and face injuries constituted half of the injuries (50.5%) among the sub-sample of motorcyclists hospitalized in the Al-Zahra Hospital (Table 2). Face injuries, per se, occurred in the 28.0% of motorcycle accidents.

Table 2. Types of injuries due to motorcycle accidents among a sub-sample of motorcyclists hospitalized in the Al-Zahra Hospital

Injured site	n (%)
Head and face only	45 (41.2)
Head and face along with other parts of the body	9 (9.3)
Other parts of body except head and face	48 (49.5)

Of the sub-sample of motorcyclists, 35.0% had wearing a helmet when they had the accident. No differences were found for wearing the helmet regarding age and marriage status of motorcyclists (P > 0.050). Helmet use among helmeted motorcyclists had reduced head and face injuries by 55.0% compared to those were not helmeted (Figure 2). An estimation of Phi and Cramer's correlation coefficient reveals a statistically significant reverse correlation between head and face injuries and helmet use (P = 0.009, r = -0.27).

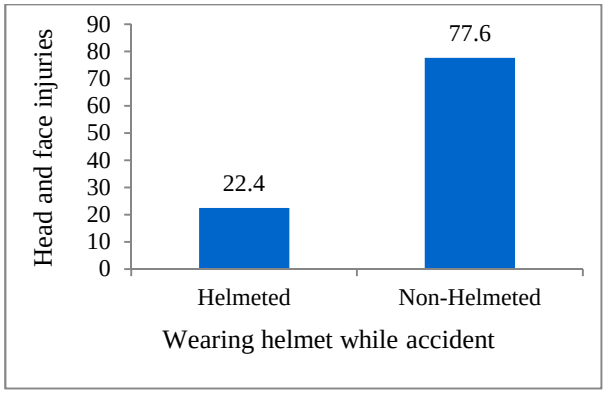

Figure 2. Percentages of head and face injuries among motorcyclists hospitalized in the Al-Zahra Hospital according to their helmet use Phi and Cramer's correlation coefficient (P = 0.009, r = −0.27)

Discussion

The findings of the present study showed that casualties due to motorcycle accidents constitute one-third of the casualties due to the road accidents in Isfahan. The average duration of hospitalization was 4 days. Most of the motorcycle accidents occurred during autumn and among the young people. Half of the body injuries affected head and face area while only 35.0% of the motorcyclists had wearing a helmet during driving. The results showed wearing a helmet have decreased head and face injuries in half.

Casualties due to motorcycle accidents make one-third of the total road accident casualties. The results showed a lower rate of motorcycle accidents in Isfahan compared

with other study in other city that half of the hospitalized casualties were motorcyclists.[6] The high rate of motorcycle accidents may be attributed to unsafe design and specific structure of motorcycle. Not using safety equipment such as helmet by motorcycle drivers face them in more potential danger than other drivers.

The findings showed that the highest rate of motorcycle accidents occurred during the autumn, especially its 1st month (Mehr), and the lowest rate was during the season of winter, especially in its first and almost the coldest month (Dey). The reason for the high accident rate in Mehr may be attributable to increase in load of traffic and rush hour which coincides with the opening of schools and universities in Iran. Decreasing in accidents during the winter may be due to getting cold, rainy, and snowy weather, which reduces the use of motorcycles. These findings are in line with the findings of another study in Iran that reported the lowest rate of mortality due to motorcycle accidents occurred in Dey, while the highest rate was during the summer and autumn (Tir, late Shahrivar, and early Mehr).[23] In other countries such as China[24] and Turkey,[25] most of the accidents have been happened during the summer and spring.

Most of the motorcycle accidents occurred among younger motorcyclists in this study. This finding is similar to the other findings in Iran.[26,27] While in India[28] and Saudi Arabia,[29] youth and middle-age people were the main injured group in traffic accidents, in the US the majority of the motorcycle accidents occurred among elder people.[30] The higher risk of motorcycle accident among the youth in Iran will face the country to the economical, emotional and social dilemmas.

The mean length of hospitalization for motorcycle casualties was 4.3 days which is similar to the findings of Coben et al. who reported 5-days duration of hospitalization for this group of casualties.[30] It is notable that this time forms only a part of the time, which motorcyclists miss their job and social activities. Most of the casualties need to stay at home for more rest after discharge from hospital. This inflicts more indirect expense and costs on the society.

The average medical charge among our injured motorcyclists was 9000000 Rials (8200 USD in 2010). Although different studies in Iran and the US depends on the place and time of the study, have found different medical costs, however, these research have shown that motorcycle accidents compel heavy expenses on the family and societies in general.[30,31] This is notable that medical charge is a part of total cost due to the accident. A plenty of other expenses such as overhead costs, ambulance, manpower, as well as, absence from the workplace for injured person and relatives should be considered.

Of motorcyclists in this study, 35.0% reported to had used a helmet when the accident. This is similar to the finding of Zamani-Alavijeh et al. reported a 33.0% of helmet use by motorcyclists.[32] However, another study in Tehran, Iran, showed that only 9.0% of motorcyclist had used a helmet.[12] In the other countries, the helmet wearing is different; 20.0% in Spain, 56.0% in Pakistan, and 90-99% in Vietnam.[33,34] The reason for different percentages of using helmet by motorcyclist may be due to cultural behaviors and mandatory motorcycle helmet law. While despite the obligatory law to use helmet, only one-third of Iranian motorcyclists have wearing the helmet during driving; legislation, administration, and controlling for more restrict safety laws, as well as public education programs on helmet use is crucial.

Here, injuries to head and face formed half of the total trauma happened in the motorcyclists. These injuries comprised 22.0% of the total trauma among those who used a helmet and 78.0% among those who had not worn it. It seems that helmet use can result in more than three-fold decreasing in head and

face injuries. Physical trauma occurred in the face region of the motorcyclists was 28.0%. The similar results found elsewhere.[35] Their findings also showed trauma to the face of casualties with a helmet was 37.0%, while of those without a helmet was 54.0%. Liu et al. reported that the use of a helmet resulted in a 42.0% decrease in head trauma.[36] A study by Hemmati et al. on motorcycle casualties showed 83.0% and 14.0% of head and neck trauma and face injury, respectively.[8] Rutledge and Stutts reported that the risk of head trauma in motorcyclists with a helmet was two-fold less than those without a helmet.[37]

The above-mentioned findings show the head and face injuries are among the most common kind of trauma in motorcycle casualties, and helmet use can decrease head and face injuries and consequently death due to the brain trauma among motorcyclists.

This study has benefitted from a hospital-based study; therefore, the generalization of the findings for the frequency of the head and face injuries among injured motorcyclists should be considered with caution. Particularly, because the Al-Zahra Hospital is a center for the maxillofacial surgery and accepts head and face injury cases more than other hospitals. On the other hand, the injured motorcyclists who died immediately after motorcycle accidents were not included in this study while one of the most frequent injuries in these casualties may be head and face injuries.

Conclusion

Motorcycle accidents comprise a large number of road accidents and cause substantial morbidity and financial impact for the community members. Young adults who constitute a major part of the manpower in the country are highly involved in these accidents. Head and face injuries are the most common trauma in motorcyclists, and the injury rate is greater among non-helmeted motorcyclists. Stricter laws and more facilities for motorcyclists to use the helmet in order to reduce the frequency of head and face injuries are warranted.

Conflict of Interests

Authors have no conflict of interest.

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