

Pattern of inflicted injuries to motorcyclists referred to Hazrat-E-Rasoul Akram hospital in Tehran during 2015 – 2016

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ABSTRACT

Introduction: In recent years, road accidents have been one of the leading causes of death in Iran, with the majority of victims being motorcyclists. Accurate knowledge of the pattern of injuries to those injured is a strategy to reduce the consequences of these fatal accidents. The aim of this study was to investigate the pattern of injuries to motorcyclists. **Methods:** The present study was a cross-sectional study that was performed in Rasoul Akram (PBUH) Educational and Medical Center in Tehran. The information was extracted from 500 hospital records of the patients admitted due to motorcycle accidents from September 2015 to September 2016, which was recorded in the data collection checklist. **Results:** About 67.9% of the injured did not have head injuries and 32.0% of the sample group suffered head injuries. Out of 160 people from the head injury group, 7.2% have Abbreviated Injury Scale (AIS) index = 1 and 93.8% have AIS \geq 2. A total of 82% of the injured had no neck injuries and 18.0% of the sample group had neck injuries. Of these, 72.2% had AIS = 1 and 17.8% had AIS \geq 2. About 65.0% of the injured did not have facial injuries and 35.0% of the sample group suffered facial injuries. **Conclusion:** An accurate knowledge of the pattern of injuries to this group of injured, providing pre-hospital services, timely diagnosis and treatment and the use of corrective and effective factors, has an effective role in reducing the incidence and consequences of this deadly accident.

Keywords: AIS index, injuries pattern, motorcyclists

Introduction

The characteristics of accidents and their associated injuries are not well-known to vehicle users. In recent years, road accidents have been one of the leading causes of death in Iran, with the majority of victims being motorcycle riders. According to statistics in the country, motorcycle accidents lead to injury

or death in 90% of the cases. The high prevalence of these events imposes costs and irreversible effects on production, the economy, and other aspects of social life. It seems that by accurately and up-to-date knowledge of the pattern of injuries to this group of injured, providing pre-hospital services, timely diagnosis and treatment and the use of corrective and effective factors, an effective step has been taken to reduce the severity and consequences of this deadly accident. The literature shows that in Iran, traffic accidents are known as the second leading cause of death and impose heavy costs on the health care system. Road accident injuries, with approximately 1.2 million deaths

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Received: 14-02-2021

Revised: 20-05-2021

Accepted: 30-07-2021

Published: 29-11-2021

Access this article online

Quick Response Code:



Website:
www.jfmpc.com

DOI:
10.4103/jfmpc.jfmpc_321_21

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How to cite this article: Memarian A, Aghakhani K, Rismantab Sani S, Abdolkarimi L, Soltani S. Pattern of inflicted injuries to motorcyclists referred to Hazrat-E-Rasoul Akram hospital in Tehran during 2015 – 2016. J Family Med Prim Care 2021;10:4212-7.

and 50 million injuries per year, are considered a global health problem.^[1] Recent studies in the United States have reported that for every mile travelled, the risk of death in a motorcycle accident is 34 times higher and the risk of injury is 8 times higher than in the people who use other types of vehicles.^[2-4] In the United Kingdom, one motorcyclist is killed or severely injured for every 665,894 km, compared to an estimated 18,661,626 km in cars.^[5] Also, the risk of injury or death in motorcyclists is 3.5 times higher than driving a vehicle with a belt, and in the summer months, the risk of injury or death increases up to seven times. Studies show that the majority of injuries to motorcyclists are treated in three areas of orthopaedic surgery (52%), general surgery (28%) and neurosurgery (20%), respectively.^[4] Modifiable factors such as helmet use, alcohol and other medications, lack of driving skills and training, vehicle ownership, driving speed and risky behaviours are considered as risk factors.

The motorcyclists in accidents often suffer multiple injuries. In the fatal accident of motorcyclists, the most common injury is to the head, as this case is involved in about half of the deaths of motorcyclists.^[4] Thoracic and abdominal injuries are the second most common cause of death, accounting for 7–25% of deaths in motorcyclists. Cervical spine injuries are more likely to occur than other areas of the spine.^[5-7] The lower limb is the most common area of injury in all motorcycle accidents. At the same time, riders with severe trunk injuries are more likely to be severely injured in other adjacent anatomical areas. Facial injuries have been diagnosed in a quarter of all motorcyclist injuries, which are associated with a risk of traumatic brain injury. However, head injuries are the leading cause of death in motorcycle accidents.^[3,8,9] Not wearing a helmet is associated with an increased risk of serious head injuries. It should be noted that head injuries are still a major cause of death even in helmeted drivers. Although protective clothing appears to reduce the risk of soft tissue injuries in motorcyclists, no noticeable effect has been reported in reducing the incidence of fractures. Haque *et al.*^[10] (2007) reported that motorcyclists were 2.63 times more likely to be injured than lightweight vehicles. Also, the rate of involvement of motorcyclists as victims is about 43%. Information obtained from the severity of injuries to motor vehicle users can help in planning for the consequences as well as preventing such injuries.^[11]

In general, road accident injuries are a public health issue with increasing risks. The use of two-wheeled vehicles, especially motorcycles, is highly welcomed due to its availability, cheapness, and ease of transportation, and accounts for a large part of the needs of the community in the field of transportation. Also, different age groups tend to use this device, which can create different forms of driving styles, and thus, diversify the patterns of injury. The previous studies have shown that the pattern of injuries includes head injury (67%), chest trauma (40%) and abdominal trauma (35%). Traumatic brain injury (67%) and hypovolemic shock (38%) were the most common causes of death.^[12] The most injured were motorcycle riders with a frequency of 79% and the highest frequency of injuries was

50% on the right side of the injured and the highest frequency of disability was between 0 and 5%.^[13] By conducting applied research and data analysis as well as accurately applying the obtained results, the process of education, prevention, and treatment can be advanced by better understanding the patterns of injuries caused by accidents and playing a more effective role in reducing the socioeconomic consequences. The aim of this study was to investigate the pattern of injuries to motorcyclists.

Materials and Methods

The present study was a descriptive-analytical cross-sectional study with regular random sampling. Information was extracted from 500 hospital records of patients admitted to the emergency department of the Hazrat Rasool Akram Hospital due to a motorcycle accident from September 2015 to September 2016 and was recorded in the data collection checklist. According to the theoretical study and literature review at the level of 99% confidence and study accuracy of 1% and with a standard deviation of 0.04 for the Injury Severity Score (ISS) index, 468 people were calculated as the sample for this study. In patients with multiple traumas, the ISS index was used to estimate the severity of the injury. The "ISS" is an anatomical scoring system based on the Abbreviated Injury Scale (AIS), which provides an overall score of a patient's life-threatening condition. In order to calculate the "ISS", each injury was assigned to one area of the body and was scored based on the "AIS" scale, then, only the highest score in each anatomical area of the body was determined. In the next step, three "AIS" scores with the highest number were selected and the "ISS" index was obtained by calculating the sum of their squares.^[14,15] The amount of AIS in each of the nine areas of the body is a number between 0 and 6, with a score of 6 for contrary to life injuries so that the presence of AIS is equal to the number 6 in an area brings the ISS index to 75. Thus, the maximum ISS value in a patient will be 3×52 or 75.^[16-18]

Data collection tools

Demographic characteristics including age, gender, poor marital status, occupation, and education of patients were recorded in the prepared form. Injuries to nine areas of the body include 1: Head, 2: Neck, 3: Face, 4: Chest, 5: Abdominal, 6: Pelvis, 7: Spine, 8: Upper limb, 9: Lower limb. They were examined and the characteristics of the injury such as superficial scratches, open wounds and tears, crushing, visceral injury, fractures, etc., were collected according to the checklist. Then, the data were analysed using the SPSS 20 statistical software. Significant levels were considered below 0.05.

Results

The results of the present study showed that the average age of the patients was 30.47 years with a standard deviation of 13.6 years; 438 (88.3%) were males and 58 (11.7%) were females, 217 (43.9%) were married and 277 (56.1%) were single, 314 (63.3%) were drivers and 182 (36.7%) were the pillion seats; 313 people (62.5%) were injured due to collision with another

vehicle, 89 (17.8%) were injured due to collision with a fixed obstacle or parked car, 51 (10.2%) of the injured had hypovolemic shock and 416 (83.0%) of the sample group did not have hypovolemic shock. A total of 340 (67.9%) of the injured did not have head injuries and 160 (32.0%) of the sample group suffered head injuries with varying severity. Out of 160 people from the head injury group: 36 people (7.2%) had Modified Injury Severity Scale (MISS) index = 1 and 124 people (93.8%) had MAIS \geq 2. Four hundred and ten (82%) of the injured had no neck injuries and 90 (18.0%) of the sample group had neck injuries of varying severity. Of these, 74 (72.2%) had AIS = 1 and 16 (17.8%) had AIS \geq 2. A total of 325 (65.0%) of the injured did not have facial injuries and 175 (35.0%) of the sample group suffered facial injuries of varying severity. Of these, 5 (2.9%) had AIS = 1 and 170 (97.1%) had AIS \geq 2. A total of 462 (92.2%) of the injured were not injured in the spine and 38 (7.8%) of the sample group were injured in the spine with different severity. Of these, all had an AIS \geq 2; 460 (92.0%) of the injured did not have chest injuries and 40 (8.0%) of the sample group had chest injuries of varying severity, all of which had an AIS index = 3. A total of 467 (93.4%) of the injured were not injured in the trunk and 33 (6.6%) of the sample were injured in the trunk with different severity. Of these, 17 (51.5%) had AIS = 1 and 16 (48.5%) had AIS \geq 2; 276 (55.2%) of the injured were not injured in the upper limb and 224 (44.8%) of the sample group were injured in the upper limb with different severity. Six people (2.7%) had AIS index = 1 and 218 people (97.3%) had AIS \geq 2. A total of 257 (51.4%) of the injured did not have lower limb injuries and 243 (48.6%) of the sample group had lower limb injuries with varying severity. One person (0.4%) had AIS index = 1 and 242 people (99.6%) had AIS \geq 2. A total of 442 (88.4%) of the injured did not have pelvic injuries and 58 (11.6%) of the sample group had pelvic injuries with varying severity. One person (0.2%) had AIS index = 1, 2 people (0.4%) had AIS index = 2 and 55 people (11.0%) had AIS index = 3.

The results of the present study showed that 240 (48.5%) of the injured had helmets, of which 216 were men and 24 were women. A total of 254 people (51.5%) of the sample group did not have helmets, of which 220 were men and 34 were women. It was found that 49.4% of the men wore helmets

during the accident while 41.4% of the women wore helmets. Also, in the case of six people, the status of wearing a helmet had not been determined. Twenty-two (40%) of the injured women in pillion seats had helmets and 33 (60%) of the sample group did not have helmets. Sixty-two (49%) of the injured men sitting on pillion seats had helmets and 65 (51%) of the sample group did not have helmets. Table 1 shows the frequency distribution according to the condition and severity of injuries to injured motorcyclists (driver) referred to the Hazrat Rasool Akram (PBUH) Hospital in Tehran.

The results of the above table show that the highest frequency of injury was in the lower limb area with a frequency of 152 people and the lowest frequency of injury was in the trunk area with a frequency of 15 people. The frequency distribution according to the condition and severity of the injuries to the injured motorcyclists (pillion seats) referred to the Hazrat Rasool Akram (PBUH) Hospital in Tehran are presented in Table 2.

The results of the above table show that the highest frequency of injury was observed in the lower limbs with a frequency of 90 people and the lowest frequency of injury was observed in the trunk with a frequency of 18 people. The results of the GCS investigation showed that 358 (72.2%) of the injured had Glasgow Coma Scale (GCS) status between 3 and 8, and 93 (18.8%) of the injured had GCS status between 9 and 12 and 45 (9.1%) had GCS status between 13 and 15. Table 3 shows the frequency distribution and percentage of the ISS index of injured motorcyclists by demographic status.

The results of Table 4 show that the "ISS" index varies between different demographic groups including the occupant status, marital status and accident history, but this difference is not significant. However, the "ISS" index has a significant difference between different demographic groups such as gender, type of accident, prognosis and helmet and hypovolemic shock at a 5% confidence level.

As can be seen in the table below [Table 5], the prognosis index varies significantly between different demographic groups such

Table 1: Frequency distribution according to the condition and severity of injuries to the injured motorcyclists (drivers)

Inflicted injuries to areas	Frequency								
	Head	Neck	Face	Spine	Chest	Trunk	Upper limbs	Lower limbs	Pelvis
No	212	269	201	294	288	299	180	162	282
Yes	102	45	112	20	26	15	134	152	32
Total	314	34	314	314	314	314	314	314	314
AIS index score									
1	27	37	5	0	0	6	6	1	0
2	29	1	31	6	0	3	55	96	2
3	0	7	76	10	26	6	73	55	30
4	46	0	0	4	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
Total number of injuries	102	45	112	20	26	15	134	152	32

Table 2: Frequency distribution according to the condition and severity of injuries to the injured motorcyclists (pillion seats)

Inflicted injuries to areas	Frequency								
	Head	Neck	Face	Spine	Chest	Trunk	Upper limbs	Lower limbs	Pelvis
No	125	138	121	164	168	164	93	92	156
Yes	57	44	61	18	14	18	89	90	26
Total	182	182	182	182	182	182	189	182	182
AIS index score									
1	9	37	0	0	0	11	0	0	1
2	14	0	14	4	0	0	40	41	0
3	0	7	47	10	14	7	49	49	25
4	34	0	0	4	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
Total number of injuries	57	44	61	18	14	18	89	90	26

Table 3: Frequency distribution and percentage of ISS index of injured motorcyclists by demographic status

ISS Index		Frequency	Mean	Standard Deviation	Mean Standard Error
In the whole sample		500	12.62	11.64	-
Gender	Male	438	12.04	11.091	0.53
	Female	58	15.84	13.169	1.729
Type of passenger	Driver	314	12.11	11.285	0.637
	Pillion seats	182	13.12	11.612	0.861
Marital status	Married	217	13.35	11.7091	0.795
	Single	277	11.71	11.119	0.688
Type of accident	Collision with another vehicle	313	13.39	11.987	0.678
	Collision with a fixed obstacle	89	10.09	9.635	1.021
	Overturning	94	11.72	10.655	0.512
Accident history	Yes	50	14.38	11.962	1.692
	No	444	12.30	11.352	0.539
Prognosis	Uncomplicated clearance	384	8.92	7.065	0.361
	Complicated discharge	57	16.53	9.103	1.206
	Discharge with disability	11	25.55	10.866	3.276
	Death	38	39.44	9.851	1.598
Helmet	Yes	241	8.43	5.366	0.346
	No	254	16.34	14.018	0.88
Hypovolemic shock	Yes	51	36.31	11.758	1.647
	No	416	9.61	7.533	0.369

Table 4: Difference of "ISS" index between demographic variables

Demographic variable	Levene's Test		ANOVA Test		t-Student Test	
	F	P	F	P	t	P
Gender	7.167	0.08	-	-	-2.106	0.039
Type of passenger	0.912	0.340	-	-	-0.943	0.346
Marital status	0.749	0.387	-	-	1.586	0.113
Type of accident	-	-	3.185	0.042	-	-
Accident history	0.844	0.359	-	-	1.174	0.245
Prognosis	-	-	199.329	0.00	-	-
Helmet	218.51	0.00	-	-	-8.213	0.00
Hypovolemic shock	16.366	0.00	-	-	22.238	0.00

as gender, type of accident, GCS, helmet and hypovolemic shock at a 5% confidence level. Table 6 presents the relative frequency distribution (percentage) of prognosis index, mean "ISS" index, mean age and mean hospitalisation time. The results of linear

regression analysis of the correlation between ISS index of demographic variables are presented in Table 7.

Discussion

The accident statistics in Singapore between 2001 and 2006 show that motorcyclist mortality was two times higher than the other motor vehicles. In Singapore, while motorcycles make up 19% of the total vehicle population, they account for 36% of all crashes. Although the number of accidents caused by heavy vehicles has decreased in the last 2 years, the number of accidents caused by motorcycles has remained stable. Haque *et al.* (2007)^[10] reported that the motorcyclists were 2.63 times more likely to be injured than lightweight vehicles. Also, the rate of motorcycle-rider involvement as a victim is about 43%. A study in India on the relationship between GCS and motorcyclists found that 77% of the injured had GCS between 13 and 15, 12% had GCS between

Table 5: Relative frequency distribution (percentage) of prognosis index in injured motorcyclists by demographic status

Prognosis index		1	2	3	4	Chi- square	P
In the whole sample		78.3	11.7	2.2	7.8		
Gender	Male	80.3	11.1	2.3	6.2	13.943	0.03
	Female	63.2	15.8	1.8	19.3		
Type of passenger	Driver	80.3	11.3	2.6	5.8	5.148	0.161
	Pillion seats	74.9	12.3	1.7	11.2		
Marital status	Married	73.7	14.6	3.8	8.0	7.39	0.06
	Single	81.8	9.5	1.1	7.7		
Type of accident	Collision with another vehicle	76.1	13.1	2.9	7.8	8.319	0.216
	Collision with a fixed obstacle	80.9	12.4	2.2	4.5		
	Overturning	83.0	6.4	0	10.6		
Accident history	Yes	67.3	18.4	4.1	10.2	4.294	0.231
	No	79.7	10.7	2.1	7.5		
GCS	3-8	89	9.3	1.7	0	4.16	0.00
	9-12	75	21.7	2.2	1.1		
	13-15	78.3	11.7	2.2	84.1		
Helmet	Yes	84.9	12.2	2.9	0	39.832	0.00
	No	72.0	11.2	1.6	15.2		
Hypovolemic shock	Yes	10	8.0	6.0	76.0	3.49	0.00
	No	86.1	11.9	1.9	0		

Table 6: The relative frequency distribution (percentage) of prognosis index, mean "ISS" index, mean age and mean hospitalisation time

Prognosis index	Frequency	Mean ISS index	Average age	Hospitalisation time
Uncomplicated clearance	384	8.92	30.15	2.79
Complicated discharge	57	16.53	30.18	7.12
Discharge with disability	11	25.55	30.60	10.80
Death	38	39.34	35	2.7
Total	500	-	30.47	3.62

Table 7: Linear regression analysis of the correlation between ISS index of demographic variables

Independent variables	Regression line slope (b)	Standard Deviation	β	P
Fixed coefficient	53.563	3.264	-	0.00
Gender	1.301	1.176	0.036	0.269
Type of accident	-1.008	0.481	-0.068	0.037
Helmet	3.898	0.759	0.168	0.00
Hypovolemic shock	24.750	1.225	-0.665	0.00

Dependent variable: ISS index

9 and 12 and 11% had GCS between 3 and 8. In a study, Patrica *et al.*(2006)^[19] examined the pattern and severity of injuries among older and younger people and stated that the pattern and severity of injuries varied at different ages. In terms of the type of collision, older people were more likely to crash into fixed obstacles and parked cars and were twice as likely to overturn. In terms of the severity of injury and helmet use, most injuries were in the "mild" group (52%) and moderate and severe injuries were 28 and 20%, respectively. The age differences in chest injuries were also associated with engines with volumes above 1,000 cc, most of which were used by the elderly. The older drivers showed

a significantly higher percentage of chest injuries, especially in the fractures of the ribs. While the younger people had three or more rib fractures in 21% of the cases, older people showed up in 44% of the cases. Instead, spinal cord injuries are more common in young drivers. This study showed that head and face injuries were less common in young drivers with helmets, compared to more injuries in older people with helmets.

Ankarath *et al.*, (2002)^[5] in a study of injured motorcyclists in the United Kingdom, found that after a head injury, abdominal and thoracic trauma, as well as pelvic ring fractures with long-bone injuries, played a major role in reducing survival. However, these studies have not addressed the role of motorcyclists' age. Kraus *et al.* (2002)^[9] examined the incidence of chest and abdominal injuries in injured motorcyclists in California and reported that multiple intrathoracic and intra-abdominal injuries were common and the number of rib fractures was associated with severe chest and abdominal injuries. In a cross-sectional analytical study, Masoud Ghadi Pasha *et al.*^[13] examined all the injured in traffic accidents referred to the Kerman Forensic Medicine Center during a solar year that resulted in lower limb injuries in terms of the pattern of injuries. Based on the findings of this study, the highest frequency of the injured was in the age group of 20–30 years and 79% of the injured had undergraduate education. The highest frequency of injured organs in the study population was the tibia trunk and then the upper tibia. The most injured were motorcycle riders with a frequency of 79% and the highest frequency of injuries was equal to 50% on the right side of the injured and the highest frequency of disability was between 0 and 5%.

Conclusion

Because of the high popularity of the use of two-wheeled vehicles, especially motorcycles, due to their availability,

cheapness and easier transportation, among different age groups, road accidents and injuries resulting from it as a public health issue is expanding, and thus, diversifying the patterns of damage. Accurate and up-to-date knowledge of the pattern of injuries to this group of injured, providing pre-hospital services, timely diagnosis and treatment and the use of corrective and effective factors, has an effective role in reducing the incidence and consequences of this deadly accident.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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