Print ISSN: 2321-6379
Online ISSN: 2321-595X

Original Article

Assessment of Magnitude of Head Injury Due to Motorized Two-wheeler Vehicle Road Traffic Accidents: A Prospective Observational Study

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Abstract

Introduction: Globally, injuries and fatalities occur in all forms of transportation but road traffic accidents (RTAs) accounts rank first among all causes. Head injuries are leading causes of death from motorized two wheeler accidents with significant mortality despite optimal use of the standard medical facilities.

Material and Method: This prospective observational study will be conducted in the Department of General Surgery, MGMMC, Indore, to see the magnitude of head injury due to motorized two wheelers RTAs.

Result: A total of 251 cases of head injuries due to motorized two wheeler accidents were reported for the study. Riders constituted (79.3%) and pillion riders (20.7%). Most victims were male (88.88%). Majority of victims were not wearing helmet. Linear fracture of vault (37.8%) was the most common pattern of fracture observed in two wheeler accidents. Intracerebral hemorrhage was also the commonest intracranial hemorrhage.

Conclusion: This study highlights that wearing helmets by the two wheeler riders are very essential in preventing injury and reducing the casualty during a RTA. There is need for increased helmet use among pillion rider in both rural and urban areas.

Key words: Motorized two wheelers, Pillion riders, Riders, Road traffic accidents

INTRODUCTION

India is undergoing major economic and demographic transformation coupled with increasing urbanization and motorization. Motorized two wheelers being inexpensive and very common mode of public transportation in Asian countries, India.[1] The number of mortality and morbidity due to motor vehicle collision is reported to be escalating day by day. According to "Road Accidents in India - 2016–2017" Ministry of road transport and highways transport Research Wing New Delhi. 147,913 persons were killed in road traffic accidents (RTAs) and out of those, 48,746 (33%) were killed while riding on motorized two wheelers.[2] The head and the abdomino-pelvic cavity have been looked on as the most vulnerable region. Mortalities and morbidities are more common in head injuries for both riders and pillion riders of two wheelers. Since the head contains brain, a very important vital organ, trauma to this region challenges the individual because of its anatomical position, size, and movements in all directions.[3] The mechanical forces such as shearing, strains, and biophysical motion that occurs during accidents to the top are liable for patterns of injuries. In spite of improvements in safety measures in vehicles and increased accessibility of emergency measures, head injuries have not declined.[4] Few reliable epidemiological data are available for the study of RTA involving two wheelers with and without wearing helmet. The aim of the present study is to find out the magnitude, patterns, and distribution of head

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www.ijss-sn.com

Month of Submission : 02-2021
Month of Peer Review : 03-2021
Month of Acceptance : 03-2021
Month of Publishing : 04-2021

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injuries in deaths due to RTA with or without helmet and other associated risk factors and to provide a feedback for controlling such injuries.

MATERIALS AND METHODS

A prospective observational study will be conducted to see the magnitude of head injury due to two wheelers RTAs. Informed consent will be taken from all the patients/guardians of the patients included in the study. 251 cases of head injuries due to motorized two wheeler RTA involving riders and pillion riders of two wheelers of both sexes, all age groups, treated and untreated, irrespective of duration of survival was included in the study. Cases of head injuries other than two wheeler RTAs reported at M.Y. Hospital, MGMMC, Indore, are not included in this study. All patients in the study will undergo a detailed history taking, general examination, and investigations. Patient outcome and complications will be recorded. Records will be maintained. Record analysis will be done at the end of study period. Patient's identity will be kept confidential.

OBSERVATIONS AND RESULTS

A total number of 251 cases of RTAs due to motorized two-wheeler were recorded. It was revealed that RTAs were more common in males (88.8%) than females (11.2%) [Table 1]. Most common involved age group were 21–30 years (36.7%), followed by 31–40 years (26.7%). There were 9.2% people who had been the sufferer of RTA in the age below 20 years [Table 2].

It was found that out of 144 riders from rural area majority were not wearing helmet (126 [87.5%]) whereas 18 (12.5%) were wearing helmet. Whereas out of 39 victims who were Pillion rider from rural area, all had not wear helmet (39 [100%]). Out of 55 riders from urban area, majority were not wearing helmet (36 [65.5%]) and 19 (34.5%) were wearing helmet whereas, out of 13 Pillion rider who's accident took place in urban area, majority were not wearing helmet (12 [92.3%]). The distribution was highly significant with $P < 0.001$ [Table 3].

It was found that most common accident mechanism in the present study was collision with either four wheeler (31.47%) or bike slip (27.9%), followed by collision with two wheeler (23.90%). Fall from bike was recorded in 13 (5.2%) people [Table 4].

It was observed that majority of the road accidents took place between 18 and 21 h (29.48%), followed by 15–18 h (19.92%), 21–24 h (17.53%), and 12–15 h (16.33%). There were early morning accidents where 27 (10.76%) took place between 9 and 12 h and seven took place between 6 and 9 h (2.79%) [Table 5].

It was found that out of 199 riders. Majority had (n = 73) linear fracture of vault, followed by linear fracture of vault and base in 42 riders. Whereas out of 52 Pillion rider, majority had linear fracture of vault [Table 6].

It was found that majority of the RTA victims had intracerebral hemorrhage (ICH) (52 [20.7%]) followed by extradural hemorrhage (EDH) (34 [13.4%]), subdural hemorrhage (SDH) (27 [10.8%]), combination of SDH + ICH (21 [8.4%]), and subarachnoid hemorrhage + ICH (11 [4.4%]) [Table 7].

DISCUSSION

Motorized two wheelers are economical and are common modes of public transportation in India and account for nearly three-fourths of the total registered vehicles.

RTAs are the leading cause of death by injury globally and now make up a significant portion of the worldwide burden of ill-health. A large number of people from all walks of life and of all age groups become sufferers from this disaster. According to WHO, approximately 1.35 million people die each year as a result of road traffic crashes.[5]

The aim of present study is to describe the distribution of magnitude of head injury due to motorized two-wheeler RTAs. In the present study, out of 251 people, RTA was more common in the age group of 21–30 years of age group people (36.7%), followed by 31–40 years (26.7%). It was also found that victims of both rural and urban area, majority had age between 21 and 40 years. There were 12.4% people who had been the victim of RTA in the age of 41–50 years. According to gender, most of the males were more commonly involved in RTAs (88.8%), followed by females (11.2%).

Similarly, in the study of Chourasia *et al.*, out of 237 RTAs cases, majority were males (82.5%) than females (17.5%). The maximum number of RTA fatalities was recorded in the age group of 21–30 72 years and the minimum no of RTA cases was noted in elderly above 80 years of age.[6] Bhoi *et al.* in their study recorded that highest number of cases (n = 120) were in the 21–30 years age group, followed by 31–40 age group (n = 68) and 11–20 age group (n = 63). Males were more commonly involved in road traffic injuries (n = 276) than female patients (n = 41).[7] Meyyappan *et al.* also noted that majority of individuals were in the age group of 21–40 years (56%). Among the victims, males were predominant (84.3%) than females (15.7%).[8]

Properly designed helmets might be effective in reducing the severity of head trauma. Only a few cities of India are actually following mandatory helmet law for drivers and pillion riders.[9] In the present study, it was observed that out of 251 two wheeler RTA victims, only 38 among them were wearing helmet and majority were riders (37 [97.4%]). It was found that out of 144 riders from rural area, majority were not wearing helmet (126 [87.5%]) whereas out of 55 rider from urban area, only 19 (34.5%) were wearing helmet. This highlight that people from rural area are lacking the information on the risk associated with not wearing the helmet. Out of 52, only 1 pillion rider from urban area were wearing helmet. In Bhoi *et al.* study, 49.8% of victims had used helmet at the time of accident.[7] In Tripathi *et al.* study, a very low rate (13.4%) of helmet use is reported in 74 two-wheeler riders (drivers: 16.5% and pillion riders: 3.7%) at the time of accident at $P < 0.001$.[10] Another study by Pathak *et al.* in Jaipur found that among motorized two-wheeled vehicles most of the victims (87.2%) were not wearing any protective helmet at the time of incidence.[11] Prasannan *et al.* study majority of the riders were wearing helmet as compared to pillion riders.[12] In Gupta *et al.* study, helmets were used by 301 victims in whom 292 were drivers and 9 pillion riders. Only 32.7% (292 out of 892) drivers were wearing helmet while driving.[13] Yadukul *et al.* in their study where people from rural area have the tendency to not wear helmet and results in maximum road accident related death.[14] Results of these studies were comparable to that of present study.

A large number of road users in India are pedestrians, two-wheeler riders and bicyclists who are known to be vulnerable road users.[15] In the present study, most common accident mechanism was collision with 4-wheeler (31.47%) or bike slip (27.9%), followed by collison with 2-wheeler (23.90%). Fall from bike was recorded in 13 (5.2%) people. In Meyyappan *et al.* study, two-wheeler accidents accounted for 66.4% of the RTAs and 21.6% were due to four-wheeler accidents.[8] According to Chourasia *et al.* study, the maximum number of vehicles involved in the accident was involving the two-wheeler (78.3%), followed by light motor vehicle (15.9%) and heavy motor vehicle (5.7%).[6] While in Singh *et al.* study the highest number of fatalities involved pedestrians (47.6%), followed by two-wheeler occupants (33.1%) and light motor vehicle occupants (10.4%). The pedestrians were most commonly involved probably 73 because children are usually less aware of traffic rules and regulations and try to cross the road while the traffic is moving.[16]

In the present study, majority of the road accidents took place between 18 and 21 h (29.48%), followed by 15–18 h (19.92%), 21–24 h (17.53%), and 12 to 15 h (16.33%). Early morning accidents were 27 (10.76%) took place between 9 and 12 h and seven took place between 6 and 9 h (2.79%). It was found that out of 74 road accidents that took place between 18 and 21 h, for them most common cause of accident was drunk and drive ($n = 36$) and negligent driving ($n = 14$). Out of 49 accidents that took place between 15 and 18 h, majority were due to over speeding ($n = 10$) and drunk and drive ($n = 10$). Out of 45 cases of road accident that took place between 21 and 24 h, majority were due to drunk and drive ($n = 28$) whereas out of 41 road accident that took place between 0 and 3 h, majority were due to over speeding ($n = 12$) and negligent driving ($n = 10$). These 75 findings are similar to many other studies by Singh *et al.* and Biswas *et al.* Singh *et al.* reported that most (40.15%) of the RTA's occurred in the evening (18–12 midnight).[17] Biswas *et al.* and Ghangale *et al.*

Table 1: Distribution of patients according to gender

Gender	Frequency	Percent
Female	28	11.2
Male	223	88.8
Total	251	100.0

Table 2: Distribution of patients according to age

Age group	Frequency	Percent
<20	23	9.2
21–30	92	36.7
31–40	67	26.7
41–50	31	12.4
51–60	19	7.6
61–70	15	6.0
>70	4	1.6
Total	251	100.0

Table 3: Comparing rider and pillion rider with wearing of helmet in rural/urban area

Helmet wearing	Rural		Urban		*P*-value
	Rider	Pillion rider	Rider	Pillion rider	
Yes	18 (12.5)	0 (0)	19 (34.5)	1 (7.7)	<0.001
No	126 (87.5)	39 (100)	36 (65.5)	12 (92.3)	
Total	144 (100)	39 (100)	55 (100)	13 (100)	

Table 4: Distribution of patients according to accident mechanism

Accident mechanism	Frequency	Percent
2-wheeler	60	23.90
3-wheeler	5	1.99
4-wheeler	79	31.47
Pedestrian	18	7.17
Fixed object	6	2.39
Bike slip	70	27.89
Fall from bike	13	5.18
Total	251	100.00

Table 5: Distribution of patients according to time of accident

Time of accident (24 h)	No of patients	Percentage
9:00–12:00	27	10.76
12:00–15:00	41	16.33
15:00–18:00	50	19.92
18:00–21:00	74	29.48
21:00–24:00	44	17.53
00:00–3:00	7	2.79
3:00–6:00	1	0.40
6:00–9:00	7	2.79
Total	251	100

Table 6: Relationship between injury to skull and rider and pillion rider

Injury to skull	Role of victim		Total
	Pillion rider	Rider	
Comminuted fracture of base	0	1	1
Comminuted fracture of vault	1	19	20
Comminuted fracture of base and vault	4	21	25
Linear fracture of base	5	7	12
Linear fracture of vault	22	73	95
Linear fracture of base and vault	8	42	50
No fracture	12	36	48
Grand total	52	199	251

noted that peak incidence of RTA found between 18 PM and 12 PM Midnight.[18] However, contrast to the observations made by Chourasia *et al*., where maximum numbers of RTA cases (43.7%) were reported to occur between 12 PM and 6 PM, followed by the period of 6 PM to 12 midnight (29.6%, $n = 78$). This is due to the fact that around this time many office goers in this city which is an IT hub begin their home journey. These findings are similar to many other studies.[6] Prasannan *et al*. in 2015 were majority of the road accident took place in night time where there is a less visibility.[12]

Head injuries are extremely common among the RTA victims. Craniocerebral injuries are the predominant and fatal injuries among the motor cyclists accounting for 80% of deaths. In adults, cranium varies in thickness and varies from place to place. Most common site of fracture is temporo-parietal region. In RTA, force is transmitted to a wider area and when sufficient to exceed the elasticity of the skull, fractures may commence from the site of impact or from the area remote to the site of impact, or commencing at a distance and run back to the site of impact. A heavy impact on the skull, fracture the vault of the skull running into the base of the skull usually the floor of the Middle Cranial Fossa, separating the floor into halves termed hinge fracture also termed as Motor Cyclists fracture.

The present study shows the relationship between injury to skull and rider and pillion rider. It was found that out of

Table 7: Distribution of patients according to ICH

ICH	Frequency	Percent
EDH	34	13.5
EDH+Pneumocephalus	4	1.6
EDH+SDH+ICH	4	1.6
EDH+ICH	10	4.0
EDH+SAH	1	0.4
EDH+SAH+ICH	3	1.2
EDH+SAH+SDH	2	0.8
EDH+SDH	3	1.2
EDH+SDH+SAH+ICH+IVH	1	0.4
ICH	52	20.7
ICH+IVH	2	0.8
ICH+Pnuemocephalus	4	1.6
ICH+SAH	3	1.2
ICH+SDH	1	0.4
IVH+SDH	1	0.4
No document available	2	0.8
Pneumocephalus	8	3.2
SAH	6	2.4
SAH+SDH	6	2.4
SAH+ICH+Pnuemocephalus	1	0.4
SAH+SDH+ICH	2	0.8
SAH+ICH	11	4.4
SAH+ICH+IVH	2	0.8
SAH+IVH	1	0.4
SDH	27	10.8
SDH+Pneumocephalus	5	2.0
SDH+ICH+Pneumocephalus	2	0.8
SDH+ICH	21	8.4
SDH+ICH+IVH	4	1.6
SDH+SAH+EDH+ICH	1	0.4
SDH+SAH+ICH	4	1.6
SDH+SAH+ICH+IVH	2	0.8
Within normal limit (WNL)	21	8.4
Total	251	100.0

EDH: Extradural hemorrhage, SDH: Subdural hemorrhage, ICH: Intracerebral hemorrhage, IVH: Intraventricular hemorrhage, SAH: Subarachnoid hemorrhage

199 riders. Majority had ($n = 73$) linear fracture of vault, followed by linear fracture of vault and base in 42 riders. Whereas out of 52 Pillion riders, majority had linear fracture of vault. Zhao *et al*. in 2011 found the difference in the distribution between the riders and the pillion riders regarding the superficial injuries. For drivers than passengers, the injuries in the hand and perineum region were comparatively in high fraction.[19] Fitzharris *et al*. 2009 reported in their study that fracture of the head and neck region was higher in female pillion riders (18%) and compared to male pillion riders (6.8%).[20] Another study by Prasannan *et al*., in skull fractures fissure fracture was present in 32.59% of cases. Pillion riders showed more incidence than drivers, may be due to the protection by 81 helmets. Incidence of skull base fissure fracture was almost same in both riders and pillion riders.[12]

In the present study, majority of the RTA victims had ICH 20.7%, followed by EDH 13.4%, SDH 10.8%, combination of SDH and ICH 8.4%, and combination of SDH and ICH 4.4%. In Ravikumar *et al*. study, sub-

dural hemorrhage was the common ICH.[21] In Fonesca *et al.* study, the second peak ICH was subdural/epidural hematomas, hemothorax/pneumothorax, pelvic fractures, and spleen/liver lacerations.[22] The most frequent injury type was contusion (28.3%), followed by ICH (18.9) and subdural hematoma (17.0%).[23]

CONCLUSION

Present study concludes that RTAs were more common in males of younger age group. Most common accident mechanism was collision with either 4-wheeler or bike slip. This study highlights that wearing helmets by the two wheeler riders are very essential for prevention of injuries and reducing the casualty during RTA. There is need for increased helmet use among pillion rider in both rural and urban areas. Majority of the road accidents happened between 18 and 21 h in rural area. Nearly 37.8% victims suffered from linear fracture of vault injury. Over speeding of 2-wheeled vehicles is one very important preventable etiological factor in RTAs. Understanding the pattern, important cause and risk factors for RTA provide very important information for controlling the event.

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How to cite this article: Kaushal M, Sheikh Z, Ghanghoria A, Gupt V, Yadav J, Parmar L. Assessment of Magnitude of Head Injury Due to Motorized Two-wheeler Vehicle Road Traffic Accidents: A Prospective Observational Study. Int J Sci Stud 2021;9(1):86-90.

Source of Support: Nil, **Conflicts of Interest:** None declared.