PATTERN OF INJURIES IN FATAL TWO WHEELER ACCIDENTS- AN AUTOPSY STUDY

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ABSTRACT**BACKGROUND**

Everyday around the world, more than 3000 people die from road traffic accidents.¹ It is estimated that by 2020, 8.4 million people will die every year of injuries from road traffic accidents. Over 90% of fatalities occur in low and middle income group countries. The majority of such deaths are among pedestrians, cyclists and motor cyclists.¹ The infrastructure has not kept pace with the number of vehicles and traffic resulting in the sharing of roads by vast number of vehicles and pedestrians. As a result, countries like India register higher fatality rate than western countries.

The objectives of this study are-

1. To study the pattern of injuries in drivers and pillion riders in fatal two wheeler accidents.
2. To compare the injuries of drivers and pillion riders with and without helmets.

MATERIALS AND METHODS

Baseline data was collected from the police requisition report and history was noted from the investigating officer and relatives. Post-mortem examination is conducted by the modified Rokitansky method. All the findings were noted in the proforma. The data collected is entered in MS Excel and analysed by the SPSS version 22.

RESULTS

In this study 34% of victims have died on the spot or died within 1 hour of accident, 27% survived for less than 24 hours, 26% survived for a week and 13% survived for more than 1 week. Out of the 100 cases skull fracture was detected in 68 cases, of which 'fissured type' of skull fracture was seen in 39 cases, 'comminuted fractures' in 20 cases and 'depressed comminuted fractures' in 9 cases. Subdural haemorrhage was the most frequent type (88%) followed by subarachnoid haemorrhage (86%).

CONCLUSION

A total of 100 cases of fatal two wheeler accident victims were autopsied in the Department of Forensic Medicine, Govt. Medical College, Kottayam from February 2012 to July 2013. The following conclusions were derived- Sex: There were 95 males and 5 females (all the females were pillion riders). Age: Maximum victims were in the age group of 20 - 29 years and the minimum age was 16 years and maximum age was 79 years. Month of occurrence: Maximum accidents occurred in the month of April (15%) and least accidents occurred in the month of January, March and August. Day of occurrence: Maximum accidents occurred on Sundays and Fridays (18 %) and least accidents occurred on Saturdays (6 cases). Time of Occurrence: Maximum accidents occurred at night time between 6 pm and 9 pm (23%) followed by day time 12 pm to 3 pm (17%) and 3 pm to 6 pm (17%) and least occurrence was between 3 am to 6 am (2%). Types of Vehicles involved: Two wheeler colliding with four wheeler accounted for the majority of accidents (40%), and least accidents happened between two wheeler and three wheeler (5%). Helmet among riders and pillion riders: Majority of victims (88%) were not wearing helmet at the time of accident and only 12% of victims were wearing helmets. All of them were riders.

Period of Survival- Maximum victims (34%) had either died on the spot or died within one hour of occurrence and 27% survived for less than 24 hours.

KEYWORDS

Two Wheeler, Pillion Rider, Fatal Injuries.

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BACKGROUND

In most regions of the world, the epidemic of road traffic accidents is increasing. According to World Health Organisation, each year road traffic accidents claim some 1.2 million lives and render about fifteen million to suffer morbidities.¹

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Two thirds of these victims are from third world countries.² The two wheeler accidents in Kerala are very high compared to other states of India. Injuries to the rider involve multi organ system and are more extensive and severe than those sustained by victims in other vehicular accidents.³ The number of vehicles has grown from 306,000 in 1951 to 58,863,000 by 2002 in India.⁴ In Kerala state in the year 2009, the number of vehicles involved accidents by two wheelers are 23,159.⁵ In a study conducted by the All India Institute of Medical Sciences, Delhi in 2007 - 08, 93.6% were males and the commonest age group was 20 - 30 years (44.7%). The most common cause of death was head injury. Most of the victims were riders, of which 54.5% were wearing a helmet. Only 6.4% were positive for alcohol.⁶ In Kerala, there is definite lack of scientific studies related to

accidents involving motor cyclists. This has affected the planning to reduce the mortality and morbidity of motor cycle riders.

Even in India, very few studies are conducted related to motor cycle accidents. There is urgent need for studies analysing the epidemiological factors pertaining to this particulate area and the injuries sustained by motor cyclists and formulate new strategies to counter them.

The present study is aimed to eliminate the pattern of injuries on the body and to compare the injury pattern of drivers and pillion riders and that of helmeted and non-helmeted riders of fatal two wheeler accident cases brought for autopsy at Govt. Medical College, Kottayam.

Objectives

1. To study the pattern of injuries in drivers and pillion riders in fatal two wheeler accidents.
2. To compare the injuries of drivers and pillion riders with and without helmets.

Everyday around the world, more than 3000 people die from road traffic accidents.¹ It is estimated that by 2020, 8.4 million people will die every year of injuries from road traffic accidents. Over 90% of fatalities occur in low and middle income group countries. The majority of such deaths are among pedestrians, cyclists and motor cyclists.¹ The infrastructure has not kept with pace with the number of vehicles and traffic, resulting in the sharing of roads by vast number of vehicles and pedestrians. As a result, countries like India register higher fatality rate than western countries.

Epidemiology of Two Wheeler Accidents

Pedestrians, cyclists and motor cyclists are the most vulnerable road users: They account for around 46% of global traffic deaths.⁶ The number of total accidents reported in India during 2010 was 499,628.⁴ The total number of accidents reported in the state of Kerala in the year 2011 was 35,216.⁷ Among this death occurred in 4145 cases, grievously injured 25,110 and minor injuries 16,269.

Age and Gender

Road traffic mortality rates are higher in men than in women in all regions regardless of income level and across all age groups.¹ In India this is partly due to low representation of women in Indian workforce and exposure on roads.⁸ Road traffic accidents are consistently one of the top three causes of death for people between 15 - 44 years.⁶ The age group between 21 - 30 years was the most vulnerable group (n=842, 34%) followed by 31 - 40 age group (n= 499, 20%) and 41 - 50 years' age group (n= 358, 15%) in a study conducted by Kumar Arvind et al.⁹

Risk Factors and Determinants

Driving at an excessive speed for the prevailing conditions is the most significant factor in most vehicular collisions, injuries and fatalities. The average travelling speed of motor vehicles has increased significantly. This change has occurred mainly from infrastructure and design improvements to the road network, leading to higher speeds on major roads and freeways. The crash frequency and crash severity increases as speed increases.¹⁰ Driving at speeds over the legal limit is a common behaviour of many drivers. The odds ratio for a

motor vehicle collision increases 40 times when travelling in excess of 84 km/hr as opposed to 60 km/hr.¹¹ Speed zones of 32 km/h can reduce crash risk and injury severity, and are recommended in areas where vulnerable road users are particularly at risk.¹² Speed cameras can catch drivers who are exceeding speed limits. Publicising the presence of speed cameras has found to increase compliance with speed laws and to reduce the incidence of crash and injury substantially.¹³ Long term placement of stationary police vehicles on each of three high-risk stretches of a rural road achieved an average 3.6 km/hr reduction of speed and a 58% reduction in death or serious injury.¹⁴

Drinking and Driving

The presence of alcohol in the blood of the driver causes an increase in the risk of collision, injury and death. Studies from India in recent years have shown the increasing link of alcohol with road traffic accidents, especially night time crashes.¹⁵ Random breath testing and police check points are important enforcement mechanisms that have been shown to reduce alcohol related crashes. Research has shown that the perceived risk of being caught is considerably more effective than the severity of penalty in discouraging driver, while under the influence of alcohol.¹⁶

Driving while Fatigued or Drowsy

Driver fatigue and drowsy driving covers a spectrum ranging from driving while clearly tired, up to episodes of "micro-sleeping" and finally to falling asleep at the wheel. Risk factors include lack of sleep, driving while intoxicated with alcohol or other drugs, under pressure, in extreme weather, monotonous roads, on unfamiliar roads, long periods of driving without rest, during periods of the day when the driver normally feels drowsy.¹⁷

Use of Motor Cycle Helmet

The use of helmets when compared to no use of helmets reduce the likelihood of head injuries. Helmet affords protection against head and facial injuries. Wearing a helmet can reduce the risk of death by almost 42% and the risk of severe injury by 69%.¹⁸ Whereas a study in the United States shows that the non-standard helmets used by half of all motor cyclists produced more frequent head injuries than not wearing a helmet at all.¹⁹

MATERIALS AND METHODS

Study Design

Descriptive study.

Study Setting

Department of Forensic Medicine, Govt. Medical College, Kottayam.

Study Sample

Study sample constituted 100 cases of riders and pillion riders of fatal two wheeler accidents brought for medico legal autopsy at Govt. Medical College, Kottayam.

Period of Study

February 2012 to July 2013.

Inclusion Criteria

All cases of fatal two wheeler accidents brought for autopsy.

Exclusion Criteria

Unknown bodies and accidents without proper history.

Method

Baseline data was collected from the police requisition report and history was noted from the investigating officer and relatives. Post-mortem examination is conducted by the modified Rokitansky method. All the findings were noted in the proforma. The data collected is entered in MS Excel and analysed by the SPSS version 22.

RESULTS

This study was conducted in the Department of Forensic Medicine at Government Medical College, Kottayam during the period 1.4.2011 to 31.3.2012. A total number of 100 cases brought for autopsy with history of two wheeler accidents were studied and their findings were recorded and analysed.

Gender Wise Distribution

Out of the 100 cases of fatal two wheeler accidents, 95 cases were males and 5 cases were females.

Age Wise Distribution

The maximum number of victims (25 cases) belonged to the age group of 20 - 29 years, followed by age group 40 - 49 (23 cases).

Age Group in Years	Victims	Percentage
<20	10	10.0
20-29	25	25.0
30-39	22	22.0
40-49	23	23.0
50-59	14	14.0
>60	6	6.0
Total	100	100.0

Table 1. Distribution according to Age (N= 100)

Distribution of Accidents according to the Month of Occurrence

Maximum number of accidents occurred during the month of April (15 cases), and least number of accidents occurred during the month of January, March and August.

Month of Occurrence	Frequency	Percentage
January	5	5.0
February	8	8.0
March	5	5.0
April	15	15.0
May	7	7.0
June	10	10.0
July	10	10.0
August	5	5.0
September	8	8.0
October	9	9.0
November	7	7.0
December	11	11.0
Total	100	100.0

Table 2. Distribution of Accidents according to the Month of Occurrence (N= 100)

Time of Occurrence of Accident

The maximum number of accidents were seen during night time between 6 pm and 9 pm (23%) followed by day time 12 pm to 3 pm (17%) and 3 pm to 6 pm (17%). Least occurrence was between 3 am and 6 am.

Time of Occurrence	Frequency	Percentage
6 am to 9 am	8	8.0
9 am to 12 pm	15	15.0
12 pm to 3 pm	17	17.0
3 pm to 6 pm	20	23.0
6 pm to 9 pm	23	23.0
9 pm to 12 am	12	12.0
12 am to 3 am	6	6.0
3 am to 6 am	2	2.0
Total	100	100

Table 3. Time of Occurrence of Accidents (N= 100)

Type of Vehicles Involved

With regard to the type of vehicle involved in two wheeler collisions, four wheeler accounted for the majority of accidents (40%) followed by two wheeler skid and fall (28%). The least accidents happened between two wheelers colliding with three wheelers (5%).

Type of Vehicle Involved	Frequency	Percentage
Two wheeler x four wheeler	40	40.0
Two wheeler x two wheeler	12	12.0
Two wheeler x three wheeler	5	5.0
Two wheeler x stationary object	15	15.0
Two wheeler skid and fall	28	28.0
Total	100	100.0

Table 4. Types of Vehicles Involved (N= 100)

Distribution of Helmet among Riders and Pillion Riders

Among the 100 cases of fatal two wheeler accidents, majority of victims (88%) were not wearing helmet at the time of accidents and 12% victims were wearing helmets, all of them were riders. None of the pillion riders were wearing the helmets.

Protective Gear	Frequency
Helmeted riders	12
Non-helmeted riders	57
Helmeted pillion riders	0
Non-helmeted pillion riders	31
Total	100

Table 5. Distribution of Helmeted and Non-Helmeted Riders and Pillion Riders (N= 100)

Period of Survival

In this study 34% of victims have died on the spot or died within 1 hour of accident, 27% survived for less than 24 hours, 26% survived for a week and 13% survived for more than 1 week.

Period of Survival	Frequency	Percentage
< 1 hour	34	34.0
1-24 hours	27	27.0
1 day to 1 week	26	26.0
> 1 week	13	13.0
Total	100	100.0

Table 6. Period of Survival (N=100)

Head Injuries/ Skull Fractures

Out of 100 cases skull fracture was detected in 68 cases, of which 'fissured type' of skull fracture was seen in 39 cases, 'comminuted fractures' in 20 cases and 'depressed comminuted fracture' in 9 cases.

Type of Skull Fracture	Frequency	Percentage
Fissured	39	57.3
Comminuted	20	29.4
Depressed Comminuted	9	13.2
Total	68	100.0

Table 7. Type of Skull Fracture (n= 68)

Intracranial haemorrhages: Subdural haemorrhage was the most frequent type (88%) followed by subarachnoid haemorrhage (86%). Extradural haemorrhage was seen in 11%. Brain stem haemorrhage was seen in 22%, intracerebral haemorrhage and intraventricular haemorrhage were seen in 6% each.

Type of Intracranial Haemorrhage	Frequency	Percentage
Extradural	11	11.0
Subdural	88	88.0
Subarachnoid	86	86.0
Intracerebral	6	6.0
Brain stem	22	22.0
Intraventricular	6	6.0

Table 8. Types of Intracranial Haemorrhages

Vertebral Column Injuries

There were 15 cases of vertebral column injury out of 100 cases. Cervical vertebrae fracture was seen in 8 cases and thoracic vertebrae fracture was seen in 4 cases. Combination of cervical and thoracic, thoracic and lumbar vertebral fracture was seen in 1 case each.

Vertebral Injury	Frequency	Percentage
Cervical	8	53.3
Thoracic	4	26.7
Cervical + thoracic	1	6.7
Thoracic + Lumbar	1	6.7
Cervical + Lumbar	1	6.7
Total	15	100

Table 9. Distribution of Vertebral Column Injuries (N=15)

Internal Chest Injury

Among the 91 cases of chest injury, there were 39 cases of rib fracture, fracture of sternum 6 cases, 31 cases of lung contusion, lung laceration in 5 cases, heart contusion in 5 cases and heart rupture in 5 cases.

Type of Chest Injury	Frequency	Percentage
Rib fracture	39	42.9
Fracture of sternum	6	6.6
Lung contusion	31	34.1
Lung laceration	5	5.5
Heart contusion	5	5.5
Heart rupture	5	5.5
Total	91	100.0

Table 10. Distribution of Chest Injury

Abdominal Injuries

Abdominal injuries were seen in 21 cases of fatal accident victims. Hemoperitoneum was found in 19 cases, liver laceration in 15, spleen rupture in 5, rupture of kidney 4, fracture of pelvis 4, intestinal perforation 2 and stomach perforation in 1 case.

Type of Abdominal Injury	Frequency	Percentage
Hemoperitoneum	19	90.5
Liver laceration	15	71.4
Spleen laceration	5	23.8
Kidney laceration	4	19.0
Fracture of pelvis	4	19.0
Intestinal perforation	2	9.5
Stomach perforation	1	4.8

Table 11. Abdominal Injury (N= 21)

Upper and Lower Limb Injuries

Among the 100 cases there were 6 cases of fracture clavicle and one case each of fracture of humerus and ulna. Long bone

fractures of lower limb included fracture of femur (4 cases), tibia 4 and 3 cases of fracture of fibula.

Type of Injury	Frequency	Percentage
Fracture Clavicle	6	6.0
Fracture Humerus	1	1.0
Fracture Ulna	1	1.0
Fracture Femur	4	4.0
Fracture Fibula	3	3.0

Table 12. Distribution of Injuries to Upper and Lower Limbs (N= 100)

Distribution of Fatal Injuries- Region Wise

Among the 100 victims of fatal two wheeler accidents, Head injury (91 cases) was the most frequent fatal injury followed by Chest injuries (34 cases), Abdominal injury (21 cases), Neck injury (10 cases), Pelvic fracture (4 cases) and Lower limb alone in one case.

Table 13. Distribution of fatal injuries in Two Wheeler Accidents (Region Wise).

Type of Fatal Injury	Frequency	Percentage
Head Injury	91	91.0
Chest Injury	34	34.0
Abdominal Injury	21	21.0
Neck Injury	10	10.0
Pelvic Injury	4	4.0
Lower Limb Injury	1	1.0

Table 13. Distribution of Fatal Injuries- Region Wise

Distribution of Head Injuries in Helmeted and Unhelmeted Victims

In helmeted group, fissured fracture of skull vault were 5, base of skull fracture were 13 (Anterior cranial fossa 5 and middle cranial fossa 8). In unhelmeted group skull vault fractures were 34, depressed fracture 9 and comminuted fracture 26. Among the base of skull fracture, anterior cranial fossa 30, middle cranial fossa 36 and posterior cranial fossa 18. In helmeted group, the most common type of intracranial haemorrhages were subdural and subarachnoid haemorrhages (9 cases each). Extradural haemorrhage (2 cases), Brain stem haemorrhage (4 cases), Coup and Contrecoup injury (4 cases each). In unhelmeted group the incidence of Subdural haemorrhage was (79 cases), Subarachnoid haemorrhage was (77 cases), Brain stem haemorrhage was (18 cases), Intraventricular haemorrhage was (6 cases), Coup injury was (41 cases) and Contrecoup injury was (32 cases).

Type of Head Injury	Helmeted Group (n=12)	%	Unhelmeted Group (n=88)	%
Fissured #	4	33.3	34	39.8
Depressed #	0	0.0	9	10.2
Comminuted #	3	25.0	26	29.5
ACF #	5	41.7	30	34.1
MCF #	7	58.3	37	42.0
PCF #	0	0	18	20.5
EDH	2	16.7	9	10.2
SDH	8	66.7	80	90.9
SAH	8	66.7	78	88.6
ICH	1	8.3	5	5.7
BSH	4	33.3	18	20.5
IVH	0	0	6	6.8
Coup Injury	4	33.3	41	46.6
Contrecoup Injury	4	33.3	32	36.3

Table 14. Distribution of Head Injuries in Helmeted and Unhelmeted Victims

Figure 9. Distribution of Head Injury in Helmeted and Unhelmeted Groups (Percentage)

Vertebral Column Injuries among Helmeted and Unhelmeted Victims

Among the 12 cases of helmeted victims, there were 4 cases of cervical vertebrae fracture (33.3%). Among the 88 cases of unhelmeted group, there were 4 cases of cervical and 4 cases of thoracic vertebrae fracture. There were 1 case each of lumbar, combined cervical and thoracic and thoracic and lumbar vertebral fracture.

Cause of Death in Fatal Two Wheeler Riders and Pillion Riders

There were 69 cases of riders and 31 cases of pillion riders. Head injury was the most common cause of death in riders 34 cases (49.3%) and pillion riders 20 cases (64.5%). Combined effect of Head and Chest accounted for 12 cases (17.4%) among the riders and 4 cases (12.9%) among pillion riders.

Cause of Death	Rider (n=69)	%	Pillion Rider (n=31)	%
Head Injury	34	49.3	20	64.5
Head + Chest	12	17.4	4	12.9
Head + Neck	5	7.2	0	0
Head + Neck + Chest	2	2.89	0	0
Head + Abdomen	1	1.4	1	3.2

Chest Injury	1	1.4	0	0
Abdominal Injury	2	2.9	2	6.5
Head + Chest + Abdomen	5	7.2	4	12.9
Chest + Abdomen	3	4.3	0	0
Lower Limbs	1	1.4	0	0
Head + Neck + Chest + Abdomen	3	4.3	0	0
Total	69	100	31	100

Table 15. Cause of Death among Riders (n= 69) and Pillion Riders (n= 31)

DISCUSSION

Motorised two wheelers are a major cause of accidental death in the developing and developed world. Motor cycle riders are more prone to fatal injuries, because of the full exposure of the body without protection. This study is based on the pattern of injuries in fatal two wheeler accidents and was conducted on 100 cases of autopsy done in the Department of Forensic Medicine, Govt. Medical College, Kottayam over a period of 17 months (01.02.2012 to 31.07.2013). The objective of the study was to find out the pattern of injuries in the victims of fatal two wheeler accidents including the rider and pillion riders. An attempt has also been made to compare the pattern of injuries in helmeted and unhelmeted motor cyclists.

Epidemiology of Fatal Two Wheeler Accidents

The analysis of 100 cases of fatal two wheeler accidents showed that there were 69 riders and 31 pillion riders. Majority of the victims were young adult males. There were no female riders and among the pillion riders there were 5 females. The mode of accident was varied, but the most common was collision with four wheelers (40%) followed by skid and fall (28%). Other modes of accidents were collision with other two wheelers and against stationary objects and against three wheelers. The study conducted by Nupur Pruthi et al observed results contradictory to the above findings, as it showed skid and fall as the most common mode of accident.²⁰ Harnam Singh et al observed that collision with motor cycles were mostly against heavy vehicles (36.6%) followed by light motor vehicles, cars and jeep (31%).²¹ This observation is in agreement with the present study. Out of 100 cases observed in the present study, only 12 cases were found to be wearing helmet.

Distribution based on Age and Sex

The maximum number of victims (25 cases) belonged to the age group of 20 - 29 years followed by age group of 40 - 49 (23 cases). There were 95 males and females constituted only 5 cases. All the 5 females were pillion riders.

Day of Occurrence in a Week

Maximum number of accidents occurred on Sundays and Fridays (18%) each.

Even though helmets were made compulsory for riders in Kerala, among the 100 cases of fatal two wheeler accidents only 12 people were found to be wearing helmets. Nupur et al study also revealed that only 12% of victims were wearing helmets at the time of accident.²⁰

Period of Survival

Maximum victims died within 1 hour (34%) following accident, while 27% died within 1 to 24 hours. Harnam Singh and Agarwal in their study found that majority of victims (32.7%) had only a survival period of 0 to 5 hours followed by death within 2 to 6 hours (14.4%).²¹

Head Injuries

Compared to occupant riders, pillion riders are prone to be thrown off the vehicle and sustain blunt injuries to the head. In the present study 39% of victims had fissured fracture, vault of skull and the most frequently fractured bone was temporal bone followed by parietal bone (10%). Depressed skull fracture and comminuted fracture was 11.6% and 3.2% among riders as against 3.2% and 12.9% among pillion riders respectively. In helmeted group, only 33.3% of victims showed fissured fracture as against 39.8% in unhelmeted victims. Comminuted fracture was 25% in helmeted victims, while it was 29.5% in unhelmeted group. There was no case of depressed fracture in helmeted persons, while it was 39.8% in unhelmeted victims. There was no significant difference in skull fractures between riders and pillion riders or between helmeted and unhelmeted victims (p value>0.05).

Intracranial Haemorrhages and Focal Brain Injuries

Out of 100 cases observed, subdural haemorrhage (88%) was the most frequent intracranial haemorrhage followed by subarachnoid haemorrhage (86%), brain stem haemorrhage (22%) and extradural haemorrhage (6%).

Vertebral Column Injury

In the present study cervical spine injury (8%), thoracic spine (2%), lumbar (1%), cervical with thoracic and thoracic with lumbar 1% each among the drivers. Among the pillion riders, only thoracic vertebral injury was seen (6.5%).

Other Injuries

Among the 100 cases in the present study, chest injury accounted for 34% followed by abdominal injury (21%), neck injury (10%) and lower limb injury (1%).

Cause of Death

Head injury alone was the cause of death in 54%; (34 cases among riders and 20 cases among the pillion riders). Followed by head + chest injury (16%), head + neck (5%), head + neck + chest (2.9%), head + abdomen (2%), abdominal injury alone (4%), head + chest + abdomen (9%), chest + abdomen (3%) and lower limb (1%).

CONCLUSION

A total of 100 cases of fatal two wheeler accident victims were autopsied in the Department of Forensic Medicine, Govt. Medical College, Kottayam from February 2012 to July 2013. The following conclusions were derived.

Sex

There were 95 males and 5 females (all the females were pillion riders).

Age

Maximum victims were in the age group of 20 - 29 years and the minimum age was 16 years and maximum age was 79 years.

Month of Occurrence

Maximum accidents occurred in the month of April (15%) and least accidents occurred in the month of January, March and August.

Day of Occurrence

Maximum accidents occurred on Sundays and Fridays (18%) and least accidents occurred on Saturdays (6 cases).

Time of Occurrence

Maximum accidents occurred at night time between 6 pm and 9 pm (23%) followed by day time 12 pm to 3 pm (17%) and 3 pm to 6 pm (17%) and least occurrence was between 3 am to 6 am (2%).

Types of Vehicles Involved

Two wheelers colliding with four wheeler accounted for the majority of accidents (40%) and least accidents happened between two wheeler and three wheeler (5%).

Helmet among Riders and Pillion Riders

Majority of victims (88%) were not wearing helmet at the time of accident and only 12% of victims were wearing helmets. All of them were riders.

Period of Survival

Maximum victims (34%) had either died on the spot or died within one hour of occurrence and 27% survived for less than 24 hours.

Head Injury

Most frequently seen head injuries were contusions (68%). There were no significant differences between helmeted and unhelmeted victims or among riders and pillion riders.

Base of Skull Fractures

Combination of anterior and middle cranial fossae fractures was the most frequent (17%) basal fractures followed by middle cranial fossa (15%).

Intracranial Haemorrhages

Subdural haemorrhage was the most common type of haemorrhage (88%) followed by subarachnoid haemorrhage (86%).

Coup and Contrecoup Injuries

Coup injuries were present in 45% of victims, whereas Contrecoup injuries were noted in 42% of victims.

Chest Injuries

Chest injury (34%) was the leading cause of death second only to Head injury.

Abdominal Injuries

Abdominal injuries were seen in 21% of victims.

Recommendations

There are many causative factors involved in two-wheeler accidents, which include interactions by road users; vehicle and road environment. So, a multi-dimensional approach is the need of the hour-

1. The use of properly designed helmet should be made compulsory for both riders and pillion riders.
2. Prompt and adequate ambulance service should be provided to the victims with the help of voluntary agencies.
3. Increase motor cycle rider safety awareness policies and practices.
4. Incorporate motor cycle friendly road way design, traffic control, construction and maintenance highways.
5. Improve motor cycle safety research, data and analysis.

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