

An autopsy study of 328 cases of fatal motor cycle accidents

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Abstract

Background: In India Fatalities due to Motor Cycle Accidents is not uncommon and remained a major reason of Public Health Issue despite Government Measures. **Aim:** **1)** To study the Pattern, Nature & Distribution of Injuries. **2)** To Identify the Fatal Injuries. **3)** The Age & Sex Distribution of the Victims. **4)** To study the Impact of Helmet Law on preventing Head Injuries. **Methodology:** This Prospective Study was an Autopsy based Study done during the period 2013 to November 2020 in Bangalore, India. A Total of 328 cases were Studied during this period. The data obtained during Autopsy was Registered in Autopsy Reports and The Autopsy report Data was recorded in a Register and Then analyzed on Yearly Basis. Information also retrieved from Police Records. Only the Motorcycle Rider Fatalities are Studied. The Pillion rider Fatalities are Excluded in the present study. **Results:** A total of 2368 Autopsy conducted during the period of Study, of which 1169 were Death due to Road Traffic Accidents. Fatal motor Cycle Accidents Accounted for 328 cases, 14% of Total Autopsies. Males Contributed to 84% of the Fatalities. Major number of Cases were reported from the age group 21-30years. Head Injuries accounted for 87% [n=285] of Injuries and were the major Fatal injury reported. Crush Injury to The Chest was least Reported. Majority of the Abdominal Injury resulted in Liver Lacerations in 42% of the Cases. Majority of the Injuries to the Extremities reported were Fractures involving the Upper Limbs in 39% [n=128] of the cases. Maximum Fatalities were reported from Motorcyclist without wearing the Helmet in 87.5% [n=287] of the cases despite the Legislation by the government. **Conclusion:** Head Injuries were the Major Cause of Fatality. Maximum Number of Fatalities reported due to Failure to Wearing Helmets. Males were Five times More Affected than Females. Major Fatalities reported between 21-30years.

Keywords: Head Injury, Fatal Motor Cycle Accidents, Helmet, Road Traffic Accidents, Autopsies, Fractures, Bangalore.

INTRODUCTION

The World Health Organization (WHO) in its Global status report on road safety 2013, states that 1.24 million people die annually on the world's roads. Compared with passengers on other types of vehicles, motorcyclists are 35 times more likely to die in a road traffic accident per distance travelled [1]. Motor Cyclist are most vulnerable Road Users in terms of Injuries & Fatalities due to Road Traffic Accidents, besides Pedestrians. With the increase of Motorcycles in India, the accident rates have also increased accordingly thereby contributing to increased Fatalities. Motorcycle riders have a 34-fold higher risk of crash-related death per vehicle mile traveled and are 8 times more likely to be injured [2]. however, per vehicle mile, motorcyclists are about 14 times as likely as passenger car occupants to die in a traffic crash [3]. The poor state of the roads in the country and the inefficiency of the public transportation system, as well as

worsening vehicular congestion and increasing unemployment, are major reasons for the thriving motorcycle transport industry [4]. Road traffic accidents is the Major Cause of Death and is projected to become the second leading cause in 2020 after Ischaemic Heart disease [5]. Among all RTAs involving motorcycles, frontal collision with other road users or stationary objects is the most common accident type, causing more severe injuries to the motorcyclists than other collision types [6-8]. Helmet Wearing, Alcohol & Drug Usage contributed to the High Fatalities in Motorcyclist, besides Inexperience and Driver Training & Lack of Licensure [9]. It is well known that motorcycle helmets are effective in preventing or reducing the severity of motorcycle-related head injuries [10-24]. new law reestablishing a helmet requirement for all motorcycle operators and passengers was enacted. One of the Aim of the present study is to determine the Usage of Helmet among motorcyclists Fatalities. The Increase in Number of Two Wheel Manufacturers and More and

More Types of Motorcycles released by different Companies due to increased Demand, The Fatalities are likely to increase, unless effective countermeasures are instituted. Besides safety programs, Public Awareness Campaign & many Preventive Measures, by the Government, it is essential to investigate the Fatalities due to Motorcycle Accidents. Hence The Present Study has been initiated.

MATERIAL AND METHODS

This Prospective Study was Based on The Autopsy conducted during the period 2013 to November 2020 in Bangalore, India. A Total of 328 cases were Studied during this period. The data obtained during Autopsy was Registered in Autopsy Reports and the same was recorded in a prescribed format in the Register and then analyzed by the Year End. Information regarding the Helmet were retrieved from Police Records and Photographs of the Accident Scene. Only the Motorcycle Rider Fatalities were Studied. The Pillion rider Fatalities were Excluded in the present study. The Pattern, Nature & Distribution of Injuries were studied on Categorizing it as Head injuries, Chest Injuries, Abdominal injuries & Injuries to Extremities. The age related fatalities were analyzed on Decade Basis of both Sexes. Fatal Injuries were Analyzed per se in comparison to the Total Number of Fatalities.

RESULTS

Figure no 01-Describes the Total Number of Autopsies Conducted between 2013 to November 2020. A total of 2968 Autopsies were conducted during the period of Study. Road Traffic Fatalities contributed to 1168 [39.35%] of the cases. Of the 1169 Road Traffic Fatalities Fatal Motor Cycle Accidents contributed to 328 Cases [11.05%] of Autopsies and 28.08% of Road Traffic Fatalities.

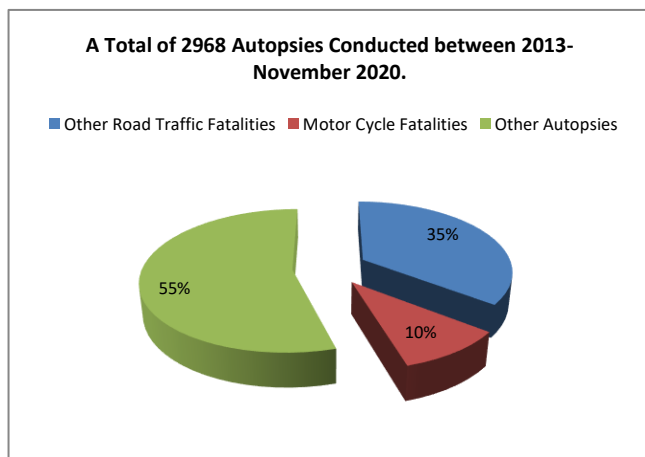


Figure 1: Describes the Total number of Autopsied conducted During the Period of Study.

Figure no 02- Describes the Sex Distribution of Victims in a Fatal Motor Cycle Accidents. Majority of the Victims were Males-276 [84%] & Females contributed to only-52 cases [16%].

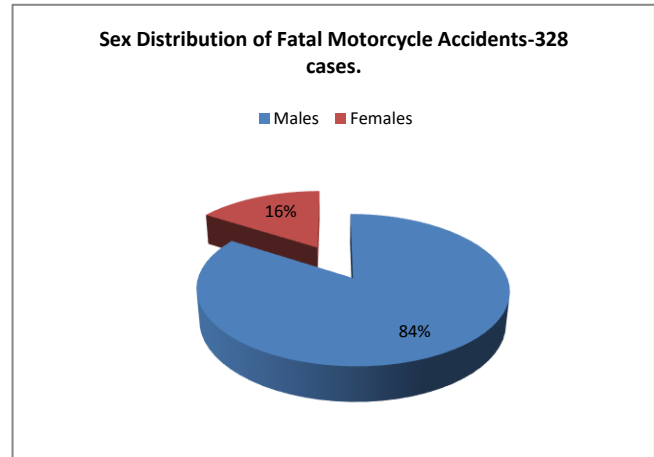


Figure 2: Describes the Sex Distribution of Victims in a Fatal Motor Cycle Accidents.

Table no 01-Showing Age & Sex Wise Distribution of the Victims. Major Age Group Involved were individuals between 21-30years contributing to 55% [n-179] of Cases. The Male & Female Sex Showed Major Involvement in this Age Group with 152 and 27 cases respectively. The Individuals above 70years and Below 10 years were never Affected. The other Age Group which reported more cases were between 31-40years contributing to 19% [n-62] of the Fatalities. Individuals in the age group 11-20 contributed to 09% [n-30] of Fatalities. Least age group affected were between 61-70years accounting to 1% [n-04] of the cases.

Table 1: Showing Age & Sex Wise Distribution of the Victims.

S No	Age Distribution	Male	Females	Total
01	0-10	00	00	00
02	11-20	18	12	30 [09%]
03	21-30	152	27	179 [55%]
04	31-40	54	08	62 [19%]
05	41-50	32	04	36 [11%]
06	51-60	16	01	17 [05%]
07	61-70	04	00	04 [01%]
08	71-80	00	00	00

Table no 02-showing Pattern, Nature & Distribution of Head Injuries. A total of 285 cases [87%] Sustained Head Injuries, of which 239 cases [72%] were Open Head Injuries and 46 Closed Head Injury 241 developed Fracture. A total of 241 Individuals [73%] Developed Fracture. Only 228 Individuals developed Intracranial Hemorrhage. Brain Lacerations seen in 218 cases. Cervical Spine Fractures seen in 84 cases. Crush Injury to Head seen in [05%] 18 cases.

Table 2: Showing Pattern, Nature & Distribution of Head Injuries.

S No	Head Injuries	Total -285/87% of Cases	Total Percentage
01	Open Head Injuries	239	72%
02	Closed Head Injuries	46	14%
03	Skull Fractures	241	73%
04	Intracranial Hemorrhage	228	79%
05	Brain contusion	48	15%
06	Brain Laceration	218	70%
07	Facial Bone Fractures	116	35%
08	Jaw Bone Fracture	28	08%
09	Cervical Spine Fracture	84	26%
10	Neck tissue Injuries	27	08%
11	Crush Injury to Head	18	05%

Table no 03-showing Pattern, Nature & Distribution of Chest Injuries. A total of 179 Individuals [55%] sustained Chest Injuries, of which Lung Contusions/Laceration seen in 84 cases and Heart Laceration/Contusion seen in only [26%] 26 individuals. Crushing injury to Chest was seen in only [04%] 14 individuals. Rib Fractures were found in [23%] 76 cases. The Chest Wall Injuries like Abrasion, Contusion & Laceration were seen in 165,114 & 99 cases respectively. Large vessel Injuries were seen in 12% [n-38] cases.

Table 3: Showing Pattern, Nature & Distribution of Chest Injuries.

SI no	Chest Injuries	Total -179/55% of Cases	Total Percentage
01	Wall Lacerations	99	30%
02	Wall Contusions	114	35%
03	Wall Abrasions	165	50%
04	Rib Fractures	76	23%
05	Lung Contusion/Laceration	84	26%
06	Heart Laceration /Contusion	26	08%
07	Crush Injury	14	04%
08	Large Vessel Laceration	38	12%

Table no 04-showing Pattern, Nature & Distribution of Abdominal Injuries. A Total 186 [57%] individuals Sustained Abdominal Injuries. Almost all 186 cases developed Abrasions and only 164 individuals sustained Contusions and Lacerations of the Wall was reported in only 48 cases. Liver Lacerations/Contusion was noted in [42%]138 cases. Whereas Spleen & Kidney Injuries were reported in 24 & 26 cases only.

Vertebral Fracture was noted in [03%] 11 cases whereas Fracture Pelvis Reported in [09%] 29 cases. Gastrointestinal Injuries were present in 43 Cases.

Table 4: Showing Pattern, Nature & Distribution of Abdominal Injuries.

S No	Abdominal Injuries	Total-186/57% of Cases	Total Percentage
01	Abdominal Wall Abrasions	186	57%
02	Abdominal Wall Contusions	164	50%
03	Abdominal Laceration s	48	15%
04	Vertebral Fracture	11	03%
05	Pelvis Fracture	29	09%
06	Liver Contusion/Laceration	138	42%
07	Spleen Contusion/Laceration	24	07%
08	Kidney Contusion/Laceration	26	08%
09	GIT laceration/Contusion/Perforation	43	13%

Table no 05- showing Nature, Pattern & Distribution of Injuries to Extremities. In 319 cases involving Upper Limbs & 303 cases involving Lower Limbs, Abrasions were Present, but only 298 cases and 165 cases contusions were present respectively. Whereas 216 cases Lacerations were Present in Upper Limbs & 134 Cases Lacerations were present in the Lower Limbs. Fractures of the Upper Limbs were reported in only [39%] 128cases and in Lower Limbs 29% cases[n-96] reported Fractures.

Table 5: Showing Nature, Pattern & Distribution of Injuries to Extremities

SI no	Injury Pattern	Upper Limb	Lower Limb
01	Abrasion	319 [97%]	303[92%]
02	Contusion	298 [91%]	165 [50%]
03	Laceration	216 [66%]	134 [41%]
04	Fractures	128 [39%]	96 [29%]

Table no 06-showing Description of Fatal injuries Reported in Fatal Motor Cycle Accidents. Majority of the Fatal Injuries were due to Head Injury in [87%] 285 cases. Liver Lacerations in 138 cases [42%] added up to the Fatalities. But only 08 cases Crush Injuries involving Abdomen were the causative Factors. Lung and Diaphragm injuries contributed to [26%] 84 Fatalities. Fracture Ribs in [23%] 76 cases added up to the Fatalities. Spleen Laceration in [07%] 24 cases contributed to the Fatality, whereas Kidney Lacerations [04%] contributed to only 12 cases Fatalities. Heart and Large Vessels Lacerations contributed to 26[08%] & 38 [12%] Fatalities. Spinal injuries in [28%] 94 cases added up to the Fatalities. Crushing injury to the Head & chest Added up to [05%] 18 & 14 [04%] Fatalities.

Table 6: Showing Description of Fatal injuries Reported in Fatal Motor Cycle Accidents.

SI no	Fatal Injuries	n-328	Percentage
01	Head Injury	285	87%
02	Lung/Diaphragm Laceration	84	26%
03	Heart Laceration/Contusion	26	08%
04	Large Vessels Laceration	38	12%
05	Fracture Ribs	76	23%
06	Liver Laceration	138	42%
07	Spleen Laceration	24	07%
08	Kidney Laceration	12	04%
09	Spinal Injuries	94	28%
10	Crush Injury to Head	18	05%
11	Crush Injury to Chest	14	04%
12	Crush Injury to Abdomen	08	02%

Table no 07-showing Age Wise Usage of Helmet reported in Fatal Motor cycle Accidents. Majority of the Victims [n-155] in the age group 21-30, Were Helmetless at the time of the Accident. Only in 24 cases the Individuals died wearing Helmet. In 56 cases Individuals belonging to the age group 31-40, failed to wear Helment, whereas Only 06 fatalities were reported in the similar Age group with Helmet. In the age group 41-50, 33 individual fatalities showed failure to use the Helmet, whereas 03 Fatalities showed presence of Helmets at the time of the Accident. In individuals below 10 years and above 70years No Fatalities Reported. In the age group 11-20, Fatalities without Helmet were reported in 27 cases and with helmet on 03 cases. Over all 87.5% of the Fatalities [n-287] the Victims failed to Wear Helmet during the time of Accident, whereas in only 12.5% cases [n-41], the Victims used Helmets.

Table 7: Showing Age Wise Usage of Helmet reported in Fatal Motor cycle Accidents.

SI no	Age Distribution	Helmet	No Helmet
01	0-10	00	00
02	11-20	03	27
03	21-30	24	155
04	31-40	06	56
05	41-50	03	33
06	51-60	03	14
07	61-70	00	04
08	71-80	00	00
Total		41 [12.5%]	287 [87.5%]

DISCUSSION

In the present Study a Total of a total of 2968 Autopsied were Performed during the period of Study of which Road Traffic Accidents contributed to 39.35% [n-1168] of the cases. Of the 1168 cases of Road Traffic Accident cases, Fatal Motor Cycle Accidents Contributed to 28.05% [n-328] of cases, whereas Fatal Motor Cycle Accidents Contributed to 11.05% of the Total Autopsies Conducted During the Period of Study. This is in Sharp contrast to that of the Study conducted by Francis *et al* [25], he had reported that Road Traffic accident fatalities

contributed only 18.4% of Fatalities and Fatal motor Cycle Accidents contributed to only 2.8% of the Fatalities. This clearly demonstrates the Regional Variations of Motor Cycle Accidents and reason for Public Health concern due to High Number of Fatalities Involving Road Traffic Accidents. This Variations is possibly due to Increase in Road Congestion as a result of Increased Number of Motorcycle Plying in a given Area of population. In the Present Study the Maximum number of Victims belonged to Male Sex, contributing to 84% [n-276] of the Cases. These observations were close to that of Francis *et al* [25], & Yashar Moharamzad *et al* [26], In their study Males Contributed to 86%, and 80.5% respectively. In another Study conducted by Kimberly *et al* [27], Males contributed to 94.7% of the cases. This increase in Male Fatalities indicates the That Motor Cycles are Identified with Male Sex in its usage, also reflects the Male Dominant Society. In the present Study the Major Age group affected were between 21-30years, contributing to 55% of the cases, of which 152 were Male victims and 27 were Female Victims. This observations are close to that of the Study conducted by Kimberly *et al* [27], but contrary to that of others [25, 26], who concluded in their study that majority of the individuals belonged to 31-40years. This Variations in the Age Group indicates the Influence of Regional Changes and Working Class. In India, The Increase Number of Victims [56%] in the age group 21-30 indicates the Active Young Group, Middle Class Working group and Student Group preferring Motor Cycle as a Means of Travel. The Unaffected Age group below 10years & above 70years further reaffirms the Earlier statement pertaining to Students and Middle-Class Working group. The Major Part of the Body Involved in Fatal Motor Cycle accidents was Head Injury, accounting to 87% [n-285] of the Cases, This results are similar to the observations made by ZHAO Hui *et al* [28], wherein he had concluded that 84% of his cases developed Head injury. But all this observations are Contrary to those made by Francis & Nwadiaro *et al* [25, 29], Who, concluded that 41.4% & 40.1% of the Victims had Developed Head injuries. This Wide Variations is due to different Age Group, Usage of Helmets, Traffic Laws, Collision Factors like Impact & Tumbling. In the Present Study Chest and Abdominal Injury were reported in 55%[n-179] &57%[n-186] of the victims, this results are close to those made by Zhao *et al* [28] wherein 74% of his Victims had accounted for Chest injuries & 49% Abdominal injuries. In the Present Study Head & Facial Injuries in association with Chest, Abdominal & Extremities injuries also contributed to the High Mortality, similar were the observation made in the studies conducted elsewhere [29, 30]. In the present Study the Upper Limb injuries accounted for 97% & lower limb injuries accounted for 92% of cases of which majority were Abrasions, contusions & Lacerations but Fracture accounted for 39% of Upper Limb injuries and the Lower Limb Fractures Accounted for only 29% of the Cases. This is close to the observations made by Solagberu *et al* [31]. Wherein he had concluded that 70.3% of his cases had accounted for Lower Extremity injuries. However in the study conducted by Sharma *et al* [32] 9.7% of his victims accounted for Fracture of Humeri. However in a study Conducted by Heydari *et al*. [33] Upper Extremity injuries contributed to 9.8%. This variations highlights the possibility of Regional Factors, Economic Factors, Traffic Regulations & Infrastructure related factors, as the possible contributing Factors. Analysis of the Chest Injuries revealed the most common Chest Injury was Rib Fracture in 29% and Lung contusion/Laceration in 21% of the cases & the least common was Heart Laceration in 08% of the cases. This is in contrast to the observation made by Sharma and Kraus *et al* [32, 34], in USA wherein they had concluded that 40.3% and 45.9% of their Victims had Sustained Rib Fractures. In the present Study of the 57% of abdominal injuries Majority were abrasions & contusions. Liver laceration accounted for 42% [n-138], Spleen & kidney Laceration accounted for 07% [n-24] & 8%[n-26] respectively. This results are similar to those made

by Kraus *et al* [34], in the U.S, who reported that liver laceration was the commonest type of intra-abdominal injury in a fatal motorcycle accident, representing 31.8% [34] & Kidney 9.1%, however it differed from the Observations on the Splenic Injuries which constituted to 21.8%. The susceptibility of the liver, spleen and kidney to injuries is possible due to the Fixed Organs against the Bony resistance & External Impact by Protruding part of the Vehicle like Handle, Petrol tank, Head light, Front Guard. The Deceleration force of Impact Flexes the Abdominal Region thereby coming in contact to the Structures Close to it during the Impact making the Abdominal Organs Vulnerable for Damage. Hence this results highlights the importance of protective gears to the Chest, Abdomen & Extremities and also at the same time impresses upon the Legislation to check the Vehicle movement and Manufacturing Rider Friendly Motor Cycle. In the Present study Majority of the Fatal Injury reported were due to Head Injury in 87% [n-285] of the cases, followed by Liver Lacerations in 42% [n-138] of the cases. These results are contrary to those made by Francis *et al* [25] wherein 50.7% of his victims died of Craniocerebral injuries. However, the present Study results Varied from similar such studies carried across the world in the range 33.3% to 87.8% [33, 35, 36]. This is because it is well understood that the Head is the most vulnerable site of fatal injury in the event of a motorcycle accident, especially in the setting of poor compliance with helmet use, because of the easy, Weight of the head and the Eccentric position of the Head to the Spine. In a study conducted by Nzegwu *et al.* in Benin City, he observed that none of the dead victims in his study wore a crash helmet at the time of the accident [37].

With the Major number of Victims Sustaining Fatal Head Injuries it is essential to do more research in this regard to understand the Mechanism of Injury due to Impact and also evaluate a Standard Protective Gear so as to prevent further Morbidity & Mortality. Similar were the views of Kimberly *et al* [27], wherein he observed that motorcyclists wearing helmets were significantly less likely to suffer a Traumatic Brain Injury than were motorcyclists not wearing helmets. Furthermore, the fatality rate per 10000 registered motorcycles decreased by 56% over a 5-year period after enactment of the helmet law. However, Injuries noted to the Vital Structures always contributed or associated with the Fatal Injury. In the present Study highlighted the Importance of Helmet and the importance of Stringent Imposition of Helmet Law. In the Present Study 87.5% [n-287] of the Victims failed to use the Helmet at the time of the Accident. Only 41 [12.5%] of the Victims had used the Helmet. As discussed earlier, other Fatal injuries contributing to the Death cannot be ignored. But the study highlights the importance of the Usage of Helmet. Hence Mandatory Helmet Laws is the need of the hour, other studies have observed 100% compliance in the presence of Mandatory Helmet Law [38-41]. Apart from Preventing Head injuries, helmet use is associated with shorter hospital stays [42, 40, 41, 45, 46], Lesser readmissions [45, 46], Less Fatal injuries [38, 42, 43, 44], and lower total hospital costs [42, 45, 39, 40].

CONCLUSION

The present study highlights the fact that Motor Cycle Accidents is a serious public Health Issue which the Government cannot afford to ignore. Apart from the Stringent Imposition of Helmet Law, Manufacturing of Rider Friendly Vehicle with Strict Safety Measures are important. above all it is important for the government to also consider Encouraging training and research in Advanced Trauma Car and Life Support and Establishing & Equipping Emergency units so as to prevent Fatalities.

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