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Original Research Article

An analysis of deaths in two wheeler accidents among autopsied cases: Five year retrospective study

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ABSTRACT

Background: Road traffic accidents have become a major public health issue causing fatality and disabilities affecting and impacting the socio-economic development, an examination of the profiles of two-wheeler road traffic accidental injuries and a detailed forensic analysis is needed to reduce fatality and life altering disabilities.

Materials and Methods: In our present study done during a study period of 5 years from 2015 to 2019 the total number of autopsies reported to the mortuary was 930 cases, of which 233 deaths were due to two wheeler accidents. Male victims predominated (217) amounting to 93.1% when compared with female victims in a ratio of 13.5 : 1 and 70.0% (163) of the victims were from rural areas.

Results: The cause of death in majority of cases was head injury in 157 (67.4%) cases. Fatal injuries were confined to a single region in 168 (72.1%) cases and to multiple regions in 65 (27.9%) cases. Skull fractures were noted in 148 cases with 70 cases of fissure fracture on calvaria alone and 30 cases of comminuted fracture. Haemorrhages were predominantly of subdural type in 160 cases, and subarachnoid type in 152 cases. About, 56.7% victims died in collision with 4 wheelers, 13.3% in collision with two wheelers, 15.0% due to collision with pedestrian, 2.1% victims died due to collision with 3 wheelers.

Conclusion: Driver clothes with fluorescent marks, day-time running lights for two wheelers and helmets in white or mild colors are suggested for easy noticability and to prevent collisions.

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1. Introduction

Rapid motorisation,¹ population explosion² and a mismatch between road design, infrastructure and the increase in magnitude of motorised vehicle users has lead to a major public health issue and it is the major cause of road traffic injuries and its related mortality. World statistics reveal that of the total 1.3 million people deceased every year in road traffic accidents 93% of the fatalities occur in low and middle-income countries.³ Road traffic crashes cost 3% of the country's gross domestic product. The WHO and the national data report mention road traffic accidents as a major

cause of death in India.⁴ Fatalities in union territories are higher as compared to the other states in India.

Piantini et al.⁵ in his study has noted that injury to the head and thorax were common with scalp contusions externally and injury to cerebrum internally. While Arjun P et al.⁶ has noted injuries to head, face and neck. Fractures of the head and neck were common in a study by Seethalakshmi et al.⁷ with fatal injuries being meningeal haemorrhages. Deaths in two wheelers were noted between 18 – 44 years⁸ from Mangalore, while it was 18 to 23 years⁶ in a study from Coimbatore and 20 to 30 years^{5,7} in other studies. Two wheeler and car collisions were noted by Piantini et al.⁵ in 97% of accidents. Arjun P et al.⁶

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in his study has noted 72% cases with collisions between two wheeler and heavy vehicle or cars. Most studies have recorded high death rates in males,⁵⁻¹² as they are the bread winner in most families, and coupled with risky behaviors like over speeding, they are commonly involved in road traffic accidents. In our hospital, road traffic accidents are very commonly reported to the casualty and this analysis is undertaken to evaluate the characteristics of two wheeler accidents autopsied. In this backdrop, the present study was conducted to determine the fatal injuries causing death, its relationship to demographic factors and the type of vehicles involved with two wheelers.

2. Materials and Methods

The international classification of disease defines, a motor cycle as a two wheeler with one or two riding saddles and sometimes with a third wheel for the support of a sidecar.¹¹ This was a retrospective descriptive study conducted on 930 cases of road traffic accidents autopsied during the period between January 2015 to December 2019 and among these 239 cases of deaths were due to two wheeler. Any two wheeler road traffic accident cases with incomplete history, partially healed injuries or decomposing bodies were excluded from the study (6 numbers). Data on injuries and cause of death were collected from post mortem records. Details of victims such as rider or pillion occupant, time, information of collisions between two wheeler and other types of vehicles, were noted from first information report and postmortem requisition of police. Such data collected was separated & entered in excel. Descriptive statistics such as mean and standard deviation for continuous variables, number and percentage for categorical variables was calculated. Chi square test / Fisher's exact test to find association between variables was done and $p < 0.05$ was considered statistically significant. This study has been approved by the Institutional and ethics committee (RC/2021/10).

3. Results

Of the total 930 cases of road traffic accidents autopsied during the study period, data on 233 cases of two wheeler accidental deaths were collected. On analysis of data male victims predominated and were 217 in number amounting to 93.1%. Majority of the victims were from (163, 70.0%) rural areas (Table 1). Analysis of victims position at the time of accident on two wheeler 191 (82.0%), were riders and 42 (18.0%) pillion occupants. Victims age ranged between 3 months to 84 years and the mean age was 39.1 ± 16.6 years. On analyzing the age groups, majority of victims (72 numbers, 30.9%) belonged to the 20 to 29 years, followed by equal distribution of victims in the 30 to 39, 40 to 49 and 50 to 59 years group. Within the 20 to 29 year age group, 54 (70.0%) cases died due to fatal injury to single region

and 18 (25.0%) cases died due to fatal injuries to multiple regions (Table 2).

The cause of death in majority of 157 (67.4%) cases in collisional and non-collisional deaths was due to head injury, followed by thoracic and limb injuries. On analyzing the injured regions, fatal injuries confined to single region was noted in 168 (72.1%) cases and fatal injuries in multiple regions was noted in 65 (27.9%) cases. On analyzing head injuries, skull fractures were noted in a total of 148 cases with 70 cases of calvaria fracture alone and 30 cases of comminuted fracture. Intracranial hemorrhages were noted in 160 cases (subdural haemorrhage), 152 cases (subarachnoid hemorrhage).

On analyzing the injuries sustained by the victim on two wheelers, lacerations predominated in 175 cases followed by abrasions in 128 cases and contusions in 82 cases. On analyzing the number of deaths in collisions between two wheelers and other vehicles, maximum number of 132 victims (56.7%) were involved in collisions with 4 wheelers, 31 (13.3%) victims in collision with other 2 wheelers and 5 victims (2.1%) in collision with 3 wheelers. 35 victims (15.0%) were involved in collision with pedestrian and 30 (12.9%) victims died after self fall from two wheelers. Majority of accidents (92 cases, 39.5%) occurred between 6 pm to 12 am and 82 cases (35.2%) occurring between 12 to 6 pm (Table 2). There was no significant association between anatomical region of fatal injuries with age group, place of residence, and time of accident. However, significant association ($p=0.001$) between manner of collision and multiple injuries was observed (Table 3). Single injury was more common when collision with 2 wheeler or self falls while multiple injuries were common when collision against 4 wheeler.

Table 1: Demographic profile of victims

Characteristics	Number	Percentage (%)
Age (Years)		
0-9	4	1.7
10-19	14	6
20-29	72	30.9
30-39	37	15.9
40-49	37	15.9
50-59	37	15.9
60-69	25	10.7
≥70	7	3
Gender		
Male	217	93.1
Female	16	6.9
Place of Residence		
Rural	163	70
Urban	70	30

Table 2: Manner of collision, type of injuries and time of accident

Characteristics	Number	Percentage (%)
Collision against		
Pedestrian	35	15
2 wheeler	31	13.3
3 wheeler	5	2.1
4 wheeler	132	56.7
Slip	30	12.9
Anatomical region of fatal injuries		
Single Region	168	72.1
Multiple Region	65	27.9
Type of injuries		
Skull fractures	148	63.5
Intra cranial hemorrhages	-	
Lacerations	175	75.1
Abrasions	128	54.9
Contusions	82	35.2
Time of accident		
0.0-5.59AM	11	4.7
6.0-11.59AM	48	20.6
12.0-5.59AM	82	35.2
6.0-11.59PM	92	39.6

Table 3: Anatomical region of fatal injuries with age group, Place of residence, manner of collision, and time of accident

Characteristics	Single Injury n (%)	Multiple Injuries n (%)	P value
Age (Years)			
≤14	4 (2.4)	0(-)	0.478
15-34	76 (45.2)	26(40)	
35-59	64 (38.1)	31(47.7)	
≥60	24 (14.3)	8 (12.3)	
Place of Region			
Rural	119 (70.8)	44(67.6)	0.639
Urban	49(29.2)	21(32.3)	
Collision against			
Pedestrian	23 (13.7)	12 (18.5)	0.001
2 wheeler	29(17.3)	2 (3.1)	
3 wheeler	3 (1.8)	2 (3.1)	
4 wheeler	86(51.2)	46 (70.8)	
Slip	27(16.1)	3 (4.6)	
Time of accident			
0.0-5.59AM	6 (3.6)	5 (7.7)	0.567
6.0-11.59AM	34 (20.2)	14 (21.5)	
12.0-5.59AM	61(36.3)	21 (32.3)	
6.0-11.59PM	67(39.9)	25(38.5)	

4. Discussion

4.1. Frequency of two wheeler accidents

In our study, a total of 930 cases autopsied during the study period 2015 to 2019, out of which 386 were road traffic accident cases (41.5%) and of which 233 cases (60.4%) were two wheeler accidental deaths. Markogiannakis et al. from Greece also reported 60.8% motorcyclist deaths.¹³ Sahu et al.¹⁴ has noted 24.6% of two wheelers. In many other studies conducted world-wide the two wheeler

accident cases among road traffic accidents vary between 10 to 30%.⁹ In a developing country like India, two wheeler usage as primary mode of transit has started to increase steadily from financial year 1991 and reached up to 73.8% in financial year 2017⁹ and this fact is reflected in our study also with two wheeler accidents contributing about 60% of total road traffic accidental cases. Our center is located off to East Coast Road (ECR).

4.2. Sex distribution of cases

The male to female ratio in our study is 13.5:1 with 217 cases (93.1%) of male and 16 cases (6.9%) of female. This male preponderance is similar to most of the two wheeler accident studies conducted elsewhere.^{5-13,15-18} Being the bread winner of family, and coupled with the fact of risky behavior like over speeding, driving with over confidence and thrill seeking behavior of males makes them as most commonly involved gender in road traffic accidents.

4.3. Age distribution of cases

The age group commonly involved in our study is young adult age group of 20 to 29 years of age contributing to 30.9% (72 cases) of total cases (Table-1). This finding of involvement of young adult population is similar to various other studies conducted.^{5-7,9,15,18} Aslam et al. from Karachi¹⁹ claims 41% of victims 16 to 30 years age. In experience when combined with false assumption of better driving capabilities makes the young drivers to indulge in risky behavior like speeding, overtaking, frequent lane changing, and in attentiveness which often turns to be life threatening behavior for them.

4.4. Regional distribution of cases

On comparing the demographic profile of victims, it was found that majority (70.0%) of them was from rural background and only 30.0% of victims belong to urban area (Table 1). This finding shows that the urban two wheeler drivers have better vehicle handling ability and driving capability when compared with counterparts of rural population owing to constant exposure to driving in extreme traffic congestions present in urban regions. But Wells et al. from New Zealand suggests crashes more in urban population (66%).²⁰

4.5. Frequency of Riders vs pillion riders

In our study 82.0% (191 cases) were drivers and 18.0% (42 cases) were pillion riders. Similarly Hui Zhao et al. in his comparative study noted 79 deaths of drivers against 19 deaths of pillion riders.²¹ This observation is similar to most of the studies conducted on two wheeler accidental cases.^{7,10} As most of the two wheelers are operated alone and logically the rider's over confidence is unchecked when driving alone and this fact is very well seen in the above observation

4.6. Manner of collision

In our study, majority of the accidents 132 (56.7%) happen due to collisions between two wheeler and 4 wheeler (Table 2). This is followed by accidents due to collision between two wheeler with pedestrian - 35 persons (15.0%) and accidents due to collision between two wheelers - 31

individuals (13.3%). Almost equal number of people died due to slip/fall from two wheeler - 30 (12.9%). Only 5 persons (2.1%) died of collision deaths of two wheelers with 3 wheelers. Studies by Jakhar et al. from Haryana¹⁸ (71.7%), Zargar et al from Iran²² (64.6%), Arjun P et al.⁶ (36%) and George et al²³ claim that majority of victims were in collisions between four wheelers with two wheelers. Marak et al.²⁴ in his study has noted motorcyclists as the common vehicles involved and pedestrians being the highest number of casualties.^{16,24} These observations show that mortality is increased whenever two wheeler collisions happen with vehicles of higher size and capacity. George et al has noted skid and fall as common among two wheelers.²³

4.7. Anatomical distribution of fatal injuries

On analyzing the anatomical region of fatal injuries, it was found that 168 cases (72.1%) had injuries in single anatomical region and 65 cases (27.9%) had fatal injuries in multiple anatomical regions (Table 2). Among the various anatomical regions involved anatomical region Head is most affected among cases with injuries confined to single region^{5-12,18,25} (159 cases, 94.6%) and among cases with fatal injuries in multiple regions.^{25,26} (45 cases, 69.2%). The anatomical region head had fatal injuries in most of cases across all manners of collision, hit against pedestrian (60.1%), and hit against two wheeler (90%), hit against three wheelers (60%), and hit against four wheelers (59%) and also in self falls from two wheelers (90.01%). The head is most affected anatomical region in many other studies conducted at various places.¹⁰ This indirectly reflects the non usage of helmets in the study region. Because of various reasons the average two wheeler riders wearing helmet observed in India is around 30%¹⁰ and as on January 2019, 47.28% of deaths were recorded in Tamil Nadu as due to non-wearing of helmets.²⁷ This fact of non usage of helmet is also reflected in our study. Other causes like motorcyclists not being visible due to dull clothing or inadequate headlights, hit on guard-rails and trees were noted in similar studies.²⁵ Dischinger et al in his study noted multiple thoracic injuries in individuals above 40 years of age.²⁸ Asa et al. has noted fatal injuries in lower extremity and abdominal regions²⁹ in turn crashes.

4.8. Types of Injuries

In our present study, skull fractures were noted in 148 (63.5%) cases. This includes 70 cases of fissure fracture of calvaria and 31 cases of comminuted fracture and 47 cases with base of skull fractures (Table-2). Similar findings in a study by Sahu et al.^{7,14} with 108 cases of fissure fracture, 28 cases of comminuted fracture, 47 cases of isolated base of skull fracture was noted. Among intra cranial hemorrhages, our study showed 160 cases with

subdural haemorrhage and 152 cases with subarachnoid hemorrhage (Table-2). In the study by Sahu et al.^{7,14} 266 cases of subdural haemorrhage, 158 cases of subarachnoid haemorrhage noted. On analysis of the injuries sustained by the victim on two wheeler, lacerations predominated in 175 cases followed by abrasions in 128 cases and contusions in 82 cases (Table-2). Study by Sahu et al.^{7,14} shows abrasion (37.8%) as predominant injuries in two wheeler accidents. This denotes the severity of the injury mechanism causing fractures and intracranial hemorrhages as these injuries have penetrated the skull and reached the meninges.

4.9. Time of accidents

In our study majority of accidents (92 cases, 39.2%) occurred between 6 pm to 12 am and 82 cases (35.2%) occurred between 12 to 6 pm (Table-2). Similar finding was noted by Seethalakshmi et al.⁷ But a Study by Chourasia et al.³⁰ has showed most cases between 12 pm to 6 pm (115, 43.7%) followed by 6 pm and 12 am (78, 29.6%). Also in our study more number of accidents happened in the hours between 7 to 8 pm, 25 (10.7%), and 6 to 7 pm, 19 (8.2%). This shows that most accidents are happening when people are returning from their workplace and moving around with their family and friends. Urgent Measures to decongest the roads during work hours are required.

The WHO mentions risk factors for vulnerability in road traffic accidents – 2021 as socio economic status of countries, age, speeding with and without alcohol consumption, correct helmet use, distracted driving by mobile and hands free usage, inadequate post-crash care, and inadequate traffic laws.³¹

5. Conclusion

The study on 233 autopsied cases of two wheeler accidental deaths revealed predominance of male victims, who were riders on two wheelers from rural areas, belonging to the 20 to 29 years age group. Fatal injuries in 54 cases confined to single region, with frequent accidents between 6 pm and 12 am.

Head injury was the cause of death in majority of collisional and non-collisional deaths followed by Thoracic and limb injuries. In cases of head injuries, skull fractures were noted in a total of 148 cases with intracranial hemorrhages in 160 cases.

In injuries sustained by the victims, lacerations predominated followed by abrasions and contusions. Most deaths happened in collisions between two wheelers and four wheeler followed by two wheeler collision with pedestrians.

Effective law enforcement includes establishing, regularly updating and enforcing laws and clear definition of appropriate penalties. Other facts such as absent electronic stability control in vehicles, designing footpaths and safe crossing points to be implemented. Under aged

drivers and driving without licenses should be looked into. From the information obtained, strategies can be developed to prevent mortality and implement public education measures aimed towards particular age groups. Further a multi-sectorial approach by transport, police, health, education can improve the safety of roads, vehicles and road users.

6. Limitations

It is not possible to predict the incidence of accidents in the local area as the road traffic accident cases brought to the casualty can be from near areas or referred from other places. Amongst the cases of road traffic accidents, few cases may be taken to other hospitals. More data regarding issues like wearing of helmets are unavailable and maybe looked into in further studies.

7. Source of Funding

None.

8. Conflict of Interest

The authors declare that there is no conflict of interest.

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