

## A Cross-Sectional Epidemiological Evaluation of Injury Patterns Seen in Pedestrians Who Have Died as a Result of Road Traffic Accidents

Ranjit Yadav<sup>1</sup>, Pappu Kumar<sup>2</sup>, Mukti Nath Singh<sup>3</sup>

<sup>1</sup>Assistant Professor, Department of FMT, Narayan Medical College and Hospital, Jamuhar, Sasaram, Bihar, India

<sup>2</sup>Assistant Professor, Department of FMT, Gouri Devi Institute of Medical Science and Hospital, Durgapur, West Bengal, India

<sup>3</sup>Professor and HOD, Department of FMT, Narayan Medical College and Hospital, Jamuhar, Sasaram, Bihar, India

Received: 10-03-2024 / Revised: 20-04-2024 / Accepted: 26-05-2024

Corresponding Author: Dr. Pappu Kumar

Conflict of interest: Nil

### Abstract

**Aim:** To investigate the injury patterns seen in pedestrians who have died as a result of road traffic accidents.

**Materials and Methods:** A Cross-sectional study was conducted in department of FMT, Narayan Medical College and Hospital, Jamuhar, Sasaram, Bihar, India, on the pattern of injuries among pedestrian deaths autopsied. Information about the pattern of injuries sustained by the deceased was obtained from hospital case records (in admitted cases) and post mortem findings. The socio demographic profile of the deceased was obtained from police records and from the relatives of the deceased.

**Results:** Among the pattern of injuries sustained by the pedestrians, 83% (68) cases had head injuries, 25 cases had abdominal injuries, 41 cases had chest injuries and in 42 cases injuries were seen in extremities. Abrasion was the most common external injury seen in 76 cases. Head injury was the commonest cause of death seen in about 54% of cases followed by shock and haemorrhage involving multiple vital organs was the cause of death in 30.5% cases. The most common offending vehicle resulting in pedestrian death in the present study was a two-wheeler with 18 cases (22%), followed by car with 16 cases (19.5%), heavy four wheelers (bus, truck, minivan, tractor) accounting for 19 cases (23.2%). Hit and run cases where the offending vehicle could not be traced amounts for 34.1% (28 cases). Among 82 pedestrian deaths, maximum deaths 38 (46.3%) happened in the outskirts (Belgaum rural area with kaccha roads), followed by 25 deaths (30.5%) on highways and 19 deaths (23.2%) occurring on intra city roads. During the study period of one and half yrs., 2670 cases of road traffic accident were admitted to BIMS hospital, out of which 255 cases expired, thus mortality rate being 9.6%. This data shows that timely medical aid saved 90% of lives in road traffic accidents.

**Conclusion:** As the study clearly shows, timely medical help can prevent mortality to the extent of 90%, thus making fast and prompt accessibility of medical aid for the victims of road traffic accidents goes in a long way in preventing both morbidity and mortality. It is in the best interest of the pedestrians to construct over bridges or under pass for movements at all major junctions of the city. Foot paths which already exist in the city should be widened and strictly be meant only for pedestrians, not for parking vehicles or street vendors.

**Keywords:** Road traffic accidents

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

### Introduction

Road traffic accidents (RTAs) are a significant global public health concern, contributing to a substantial proportion of injury-related deaths and disabilities. Pedestrians, as vulnerable road users, are particularly at risk, often suffering severe and fatal injuries in such incidents. According to the World Health Organization (WHO), approximately 1.35 million people die each year as a result of road traffic crashes, with pedestrians comprising 22% of these fatalities. The pattern of injuries sustained by

pedestrians in road traffic accidents is influenced by several factors, including the speed and type of the vehicle, the point of impact, and the pedestrian's age and physical condition. [1,2] Common injury patterns include head trauma, lower limb fractures, and thoracoabdominal injuries. Head injuries are particularly prevalent and severe, often resulting in long-term cognitive and functional impairments or death. Lower limb injuries are also frequent among pedestrian victims of RTAs, typically occurring

when the vehicle impacts the legs. This can lead to fractures, soft tissue damage, and, in severe cases, amputations. [3,4] The biomechanics of pedestrian injuries indicate that children and the elderly are especially vulnerable to lower extremity injuries due to their body proportions and fragility. Thoracoabdominal injuries, including rib fractures, lung contusions, and internal organ damage, are common when pedestrians are thrown onto the hood or windshield of a vehicle. Several studies have highlighted the importance of vehicle speed in determining the severity of pedestrian injuries. Higher vehicle speeds not only increase the likelihood of accidents but also significantly escalate the risk of fatal injuries. Environmental and situational factors also play a critical role in pedestrian injury patterns. Poor visibility, inadequate pedestrian infrastructure, and driver behaviour, such as distracted or impaired driving, contribute to the frequency and severity of pedestrian injuries in RTAs. Urbanization and the growing number of vehicles on the roads further exacerbate these risks, making pedestrian safety a pressing concern for city planners and policymakers. Efforts to mitigate pedestrian injuries in road traffic accidents require a multifaceted approach, including improved traffic regulations, better urban planning, and public awareness campaigns. Implementing pedestrian-friendly infrastructure, such as crosswalks, pedestrian overpasses, and traffic calming measures, can significantly reduce the incidence and severity of pedestrian injuries. Additionally, advancements in vehicle safety technologies, such as pedestrian detection systems and automatic emergency braking, hold promise in enhancing pedestrian safety. [5,6]

### Materials and Methods

A Cross-sectional study was conducted in department of FMT, Narayan Medical College and Hospital, Jamuhar, Sasaram, Bihar, India for 3 months on the pattern of injuries among pedestrian deaths autopsied.

### Inclusion Criteria

All cases of pedestrian deaths due to road traffic accidents autopsied

### Exclusion Criteria

Other road traffic accidents cases autopsied.

### Methodology

Information about the pattern of injuries sustained by the deceased was obtained from hospital case records (in admitted cases) and post mortem findings. The socio demographic profile of the deceased was obtained from police records and from the relatives of the deceased.

### Results

During the study period 1172 cases were autopsied out of which 255 cases (21.75%) Table 1, were due to road traffic accidents and out of the 255 cases of road traffic accident deaths, 32.1% (82 cases) table 2, were pedestrians. Among the 255 cases of road traffic accident deaths that were autopsied, 82 cases were pedestrians, constituting 32.1% of pedestrian deaths, 76 were occupants of 2 wheelers (29.8%), 66 (25.9%) were 4-wheeler

occupants and 31 (12.2%) 3 wheelers (table 2). The male- female ratio among pedestrian deaths was 3:1 (table 3) and majority of the victims among the 82 cases of pedestrian deaths were in the age group of 40-60 yrs. (46% table 4). Among the pattern of injuries sustained by the pedestrians, 83% (68) cases had head injuries, 25 cases had abdominal injuries, 41 cases had chest injuries and in 42 cases injuries were seen in extremities (table 5). Abrasion was the most common external injury seen in 76 cases (table 6). Head injury was the commonest cause of death seen in about 54% of cases followed by shock and hemorrhage involving multiple vital organs was the cause of death in 30.5% cases (table 7). The most common offending vehicle resulting in pedestrian death in the present study was a two-wheeler with 18 cases (22%), followed by car with 16 cases (19.5%), heavy four wheelers (bus, truck, minivan, tractor) accounting for 19 cases (23.2%). Hit and run cases where the offending vehicle could not be traced amounts for 34.1% (28 cases) (table 8).

Among 82 pedestrian deaths, maximum deaths 38 (46.3%) happened in the outskirts (Belgaum rural area with kaccha roads), followed by 25 deaths (30.5%) on highways and 19 deaths (23.2%) occurring on intra city roads (table 9). During the study period of one and half yrs., 2670 cases of road traffic accident were admitted to BIMS hospital, out of which 255 cases expired, thus mortality rate being 9.6%. This data shows that timely medical aid saved 90% of lives in road traffic accidents.

**Table 1: Showing profile of medico legal autopsies conducted during the study**

Type of case	No.	Percentage
Road traffic accidents	255	21.75%
Others (asphyxia, burns, poisoning, assault etc.)	917	78.25%
Total	1172	100

**Table 2: Showing profile of deaths among victim of road traffic accidents**

Type of victim	No.	Percentage
Pedestrian	82	32.10%
2-wheeler	76	29.80%
4-wheeler	66	25.88%
3-wheeler	31	12.15%
	255	100

**Table 3: Showing sex wise distribution of pedestrian deaths**

Sex	No	Percentage
Male	62	75.6%
Female	20	24.4%
Total	82	100

**Table 4: Showing age wise distribution of pedestrian deaths**

Age of pedestrian	No. of cases	Percentage
0-10 yrs.	3	3.7%
10-20 yrs.	0	0.0%
20-30 yrs.	10	12.2%
30-40 yrs.	12	14.6%
40-50 yrs.	17	20.7%
50-60 yrs.	21	25.6%
60-70 yrs.	15	18.3%
70-80 yrs.	3	3.7%
80-90 yrs.	1	1.2%
Total	82	100

**Table 5: 68 cases of head injury**

Type of head injury	No. of cases	Percentage
Intra cranial hemorrhage + fracture of skull	42	61.8%
Intra cranial hemorrhage	26	38.2%
Total cases of head injury	68	100

**Table 6: 25 cases of abdominal injuries**

Type of abdominal viscera injured	No. of cases	Percentage
Only liver	9	36%
Only spleen	4	16%
Liver + spleen	5	20%
Liver + spleen + mesenteric vessels + intestine (crush)	7	28%
Total	25	100

**Table 7: 41 cases of thoracic injuries**

Type of thoracic viscera injured	No. of cases	Percentage
Lungs + fracture ribs	30	73.2
Lungs only (contusions)	7	17.2
Lungs + ribs + heart(crush)	4	9.6
Total	41	100

**Table 8: 42 cases of skeletal injuries**

Skeletal injury to extremities	No. of cases	Percentage
Upper limb	13	31%
Lower limb	29	69%
Total	42	100

**Table 9: External injuries**

External injuries	No. of cases	Percentage
No external injuries	3	3.7
Only abrasion	16	19.5
Abrasion + contusion	7	8.5
Abrasion + laceration	35	41.4
Contusion + laceration	3	3.7
Abrasion + contusion + laceration	11	13.4

**Table 10: Cause of death**

Cause of death	No. of cases	Percentage
ICH (Only intra cranial hemorrhage)	16	19.51
CCI: (Intra cranial hemorrhage + skull fractures)	28	34.15
SH (Where more than one vital organ is involved)	25	30.49
NS (Crush injury involving viscera of all three vital systems)	08	9.76
RF(Fracture ribs & injury to lungs)	04	4.88
Septicemia	01	1.21
Total	82	100

**Table 11: Showing offending vehicle wise distribution of pedestrian deaths**

Type of vehicle	No. of cases	Percent
Two-wheeler	18	22.0
Car	16	19.5
Heavy four wheelers	19	23.2
Three-wheeler	1	1.2
Hit and run	28	34.1
Total	82	100

**Table 12: Showing distribution based on type of road on which pedestrian deaths occurred**

Type of road	No. of cases	Percentage
Out skirts of city	38	46.34
Highways	25	30.49
Intra city	19	23.17
Total	82	100

## Discussion

A prospective study conducted on pattern of pedestrian injuries among autopsied revealed that among 255 cases of road traffic accidents, most common victims were pedestrians 82 cases (32.1%) followed by occupants of two wheelers 76 cases (29.8%), then occupants of 4 wheelers (car, van, bus, truck) 66 cases (25.9%) and 31 cases of 3-wheeler occupants. This data shows the vulnerability of pedestrian was high in road traffic accidents, mainly due to not following existing traffic rules by both pedestrians and drivers of vehicles. This data was similar to the prospective studies conducted by Khubchandani et al. [4] and by Farooqui JM et al. [5] at Loni. However, a retrospective study conducted at KMC Manipal, by Kanchan T et al. [6] showed most common victims (43%) were 2 wheelers riders followed by pedestrians (33%).

Among 82 cases of pedestrian deaths, male: female ratio is 3:1 which shows almost 3/4th victims of pedestrian deaths are males. This is mainly because males are by and large more ambulant than females. The majority of the victims are in the age group 40-60 yrs. age group constitutes about 46%. This age group which is laden with immense stress of managing the full-fledged family, and thus are more ambulant and susceptible. The findings in this regard were similar studies conducted by Harnam Singh et al. [7] & Khubchandani et al. [4] and contrasting results were noted in studies conducted by Vestrup et al [8]. Our studies show that more than 80% of victims had head injuries and was also the contributing factor for the cause of death in the pedestrians, the reason being, irrespective of the site of primary impact by any vehicle, as the pedestrian is suddenly and unexpectedly thrown on to hard ground (hard stones on the kaccha road or hard surface of the high way) there is more susceptibility

to sustain head injuries. The outcome of our study was similar to studies conducted by Umaru H et al. [9], and Harnam Singh et al. [7] & Khubchandani et al. [8]. The studies conducted in European countries by Vestrup et al. [8] & Carlos et al.<sup>10</sup> showed thoracic & spinal injuries to be the commonest. Among the offending vehicles which have led to death of 82 pedestrians, in about 1/3rd of the cases (34.1%) the offending vehicle was not traced as they were hit and run cases. Among the vehicles that could be traced, heavy 4 wheelers (bus, truck, tractor) were main culprits in 19 cases, closely followed by 2 wheelers and car in 18 and 16 cases respectively. [8,9] This data shows that 4 wheelers in general have contributed for about 43% of deaths. The outcome of the study was similar to most of the study results by, Harnam Singh et al. [7] and Khubchandani et al. [4]. Majority of deaths due to 4 wheelers had happened on highways which show that the highway crossing by the pedestrians is extremely dangerous as specific rules are not followed while crossing. Among 82 pedestrian deaths, majority of deaths have happened on the kaccha roads on the outskirts of the city 38 cases (46.34%), followed by highways 25 cases (30.5%) and 19 cases within the city (23.2%). [10,11]

### Conclusion

As the study clearly shows, timely medical help can prevent mortality to the extent of 90%, thus making fast and prompt accessibility of medical aid for the victims of road traffic accidents goes in a long way in preventing both morbidity and mortality. It is in the best interest of the pedestrians to construct over bridges or under pass for movements at all major junctions of the city. Foot paths which already exist in the city should be widened and strictly be meant only for pedestrians, not for parking vehicles or street vendors. As the present study shows that hit and run cases are in majority, this fact emphasizes on the moral and conscious effort of the offender in providing the minimal medical assistance to the victim. Barring which the law has to have tight clutches in finding such offenders which will be possible by installing long range CC TV cameras all along the highway hotspots as eye witnesses in such

cases are very less and those who have witnessed will never come forward to give evidence.

### References

1. World Health Organization. Global status report on road safety 2018. Geneva: World Health Organization; 2018.
2. World Health Organization. Pedestrian safety: a road safety manual for decision-makers and practitioners. Geneva: World Health Organization; 2013.
3. Leaf WA, Preusser DF. Literature review on vehicle travel speeds and pedestrian injuries. Washington, DC: National Highway Traffic Safety Administration; 1999.
4. Khubchandani HT, Kothari GG, Jadav JC. Profile of pedestrian deaths in road traffic accidents. *NJIRM* 2013;4(3):103-105.
5. Farooqui JM, Chavan KD, Bangal RS et al. Pattern of injury in fatal road traffic accidents in a rural area of western Maharashtra, India. *Australas med J* 2013;6(9):476-82.
6. Kanchan T, Kulkarni V, Bakkannavar SM. Analysis of fatal road traffic accidents in a coastal town ship of south India. *Journal of forensic and legal medicine* 2012;19(8):448-451.
7. Harnam Singh, Agarwal, Gaurav Sharma. A review of pedestrian traffic fatalities. *Journal of Indian academy of Forensic Medicine* 2007;29(4):55-57.
8. Umaru H, Ahidjo A, Dogo Niger H. Pedestrian injuries resulting from road traffic accidents: The Azare experience *J Med* 2007;16(2):169-72.
9. Vestrup, Judith A, Reid MD. A profile of urban adult pedestrian trauma *Journal of trauma – injury infection and critical care* 1989;29(6).
10. Carlos AD, Francisco JL, Maria SG. Pedestrian injuries in 8 European countries. An analysis of hospital discharge data. *Accident analysis and prevention* 2010;42(4):1164-1171.
11. Mahanta P. Road Traffic injuries. In *Modern text book of Forensic Medicine and toxicology*. 1st ed. New Delhi: Jaypee Brothers medical Publishers 2014, P297.