Section: FMT

Original Research Article

PATTERN OF HEAD INJURY IN FATAL ROAD TRAFFIC ACCIDENTS: PROSPECTIVE STUDY

Agatha Gangmei[1], Rajkumari Reena Devi[2], Konsam Suken Singh[3]

[1]Assistant Professor, Department of Forensic Medicine & Toxicology, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur, India.
[2]Assistant Professor, Department of Forensic Medicine & Toxicology, Shija Academy of Health Sciences, Imphal, Manipur, India.
[3]Assistant Professor, Department of Forensic Medicine & Toxicology, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur, India.

Received : 12/04/2026
Received in revised form : 02/06/2026
Accepted : 17/06/2026

Keywords:
Head injury, Road traffic accidents, skull fracture.

Corresponding Author:
Dr. Rajkumari Reena Devi,
Email: reenark2016@gmail.com

DOI: 10.47009/jamp.2026.8.3.244

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (3); 1383-1387

ABSTRACT

Background: Head injury has been defined as **"**a morbid state, resulting from gross or subtle structural changes in the scalp, skull, and /or the contents of skull, produced by mechanical forces". It has also been defined as physical damage to the scalp, skull or brain produced by an external force. Road traffic accidents are one of the major causes of death and illness which is preventable. **Aims and objectives:** To study the incidence of head injury in relation to age, gender and to determine the pattern of head injury in fatal road traffic accident. **Materials and Methods:** A prospective Cross-Sectional study of all cases of fatal road traffic accidents which was conducted at JNIMS, Imphal, Manipur between the period of August 2017 to July 2019. **Results:** Fatal road traffic accidents were 126 of total autopsies conducted during the period. Highest incidence of 38 (30%) cases was noticed among the age group of 15 to 30 years, followed by the age group of 30 to 45 years constituting 32(25%) cases. Male (84%) victims outnumbered females (16%). **Conclusion:** Road traffic accidents result in tremendous loss of lives and prolonged morbidity besides causing suffering to relatives and friends. A road traffic injury is a fatal or non –fatal injury incurred as a result of a collision on a public road involving at least one moving vehicle. Road traffic accidents are one of the major causes of death and illness which is preventable.

INTRODUCTION

Road traffic accidents result in tremendous loss of lives and prolonged morbidity besides causing suffering to relatives and friends. A road traffic injury is a fatal or non –fatal injury incurred as a result of a collision on a public road involving at least one moving vehicle.[1] Road traffic accidents are one of the major causes of death and illness which is preventable.

Over 1.25 million people die each year on the world's road, with millions more sustaining serious injuries and living with long term adverse health consequences. Globally, road traffic accidents are a leading cause of death among young people, the main cause of death among those aged 15 – 29 yrs. Road traffic accidents are estimated to be the ninth leading cause of death across all aged groups globally and are predicted to become the 7th leading cause of death by 2030. Half of those dying are vulnerable road users: pedestrians, cyclist and motor cyclists. India has just 1% of the total vehicles in the world but it contributes to 6% of the global road traffic accident cases.[2] Head injury has been defined as **"**a morbid state, resulting from gross or subtle structural changes in the scalp, skull, and /or the contents of skull, produced by mechanical forces". It has also been defined as physical damage to the scalp, skull or brain produced by an external force. However, such force/impact, responsible for the injury need not be applied directly to the head.[3] In India, the motor vehicle population is growing at a faster rate than the economic and population growth. These increase in motorization coupled with expansion of the road network has brought with it an increase in road accidents.[4]

The present study is contemplated to determine the pattern of head injury sustained by different types of road users and identify the relationship with type of victim, age and sex distribution, the findings of which can be used in evaluating the methods of prevention of head injuries in road traffic accidents.

Aim and Objectives

1. To study the incidence of head injury in relation to age and gender.
2. To determine the pattern of head injury in fatal road traffic accident

ISSN (O): 2687-5365; ISSN (P): 2753-6556

MATERIALS AND METHODS

A prospective cross-sectional study was conducted at the Department of Forensic Medicine & Toxicology, JNIMS, Imphal, Manipur from August 2017- July 2019.

Inclusion and Exclusion Criteria

Cases of fatal head injuries due to vehicular accidents and cases of head injuries associated with fatal injuries in other parts of the body due to vehicular accidents were included.

Putrefied bodies were excluded. Prior to the study approval of Institutional Ethical Committee was taken.

Confidentiality was maintained.

Statistical Analysis: Data was analyzed using various descriptive statistical methods.

RESULTS

During the study period of 2 years from August 2017 to July 2019, there were total 434 Medicolegal autopsies conducted in the mortuary of Forensic Medicine and Toxicology Department of Jawaharlal Nehru Institute of Medical Sciences, Imphal. Out of these, 177 cases were of fatal road traffic accidents and of which 126 cases had head injuries.

Age Incidence

Age of incidence among the individual were broadly grouped into 15 years range and the youngest age noticed was 9 months old and the oldest case noted was 82 years old. Highest incidence of 38 (30%)cases were noticed among the age group of 15 to 30 years, followed by the age group of 30 to 45 years constituting 32(25%) cases and then by 45 to 60 years consisting of 30(24%) cases. [Table 1]

Sex Incidence

On considering the sex profile among victims of head injuries in fatal road traffic accident, 106 (84%) cases were that of male and 20(16%) deaths were in female. [Table 2]

Type of Victim

When data was analyzed among the type of road users, the maximum victims of fatal road traffic accidents having head injuries were found in equal number of cases in motorcyclist and four wheeler occupants consisting of 45(35.7%)cases each. It was followed by pedestrian and cyclist constituting 24(19%) and 7(5.6%) of the cases respectively. Least were the occupants of 3 wheeler observed in 5(4%) cases. [Figure 1]

Scalp Injuries

In this study the most common single type of injuries on the scalp were contusion seen in 41(32.5%) cases followed by laceration seen in 21(16.7%) cases and hematoma seen in 16(12.7%). Varying degree of combination of abrasion, contusion, laceration and hematoma were seen in 17(13.5%) cases of which contusion and laceration was the commonest, seen 8(6.3%) cases. No obvious lesion of scalp was seen in 25(19.8%) cases. [Table 3]

Fracture of Skull:

Out of 126 cases, fracture of skull was seen in 71(56%) cases either in the vault or base or in both. No fracture was observed in 55(44%) cases. Fracture of both vault and base was seen in 38(30%) cases. [Figure 2]

Fracture of Vault

On considering the fracture of skull vault, out of 126cases, 62cases showed fracture in the vault of skull. Temporal bone was the most common single bone involved seen in 10(16%) of cases followed by occipital bone in 7(11.3%) cases. In 37 (59.9%) cases more than one bone were fractured, more commonly combination of fronto-parietal, seen in 7(11.3%) cases and followed by parieto-temporal bones and fronto-parieto-temporal bones seen in 5(8%) cases each. Table 16. Out of 45 motorcyclists, 28(62%) of cases had fracture of the skull vault, of which temporal bone was the most common single bone fractured, followed by occipital bone constituting 5(11.1%) and 4(9%) of the cases respectively. [Table 4]

Intracranial Hemorrhage

A total of 102 cases showed different types of intracranial hemorrhage. The most frequent intracranial hemorrhage was a combination of subdural hemorrhage (SDH) and subarachnoid hemorrhage (SAH) seen in 47(46%) victims. Subarachnoid hemorrhage (SAH) alone was seen in 23(22%) victims and 20(20%) victims had subdural hemorrhage alone. A combination of EDH with SDH and SAH were seen in 1(1%) case. Intracerebral hemorrhage alone was seen in 1(1%) case and intracerebral hemorrhage with other intracranial hemorrhage was seen in 3(3%) cases. [Table 5]

Table 1: Distribution of cases according to age

Age- Categories	No. of cases	Percentage
Below 15	15	12
15-30	38	30
30-45	32	25
45-60	30	24
Above 60	11	9
Total	126	100

Table 2: Gender-wise distribution according to type of cases

Type of Cases	Male		Fem	ale	Total
	No of Cases	%	No of Cases	%	No of Cases
Head injury alone	48	77.4	14	22.6	62

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 3: Types of injuries in scalp

Scalp injuries	No. of cases	Percentage
Abrasion	0	0
Contusion	41	32.5
Hematoma	16	12.7
Laceration	21	16.7
Abrasion + laceration	1	0.8
Abrasion + contusion	3	2.4
Contusion + laceration	8	6.3
Contusion + hematoma	3	2.4
Laceration + hematoma	1	0.8
Abrasion + contusion + hematoma	1	0.8
Crush	6	4.8
No obvious lesion	25	19.8
Total	126	100

Table 4: Frequency of site of fracture in vault

Sites	No. cases	Percentage
Frontal bone	4	6.4
Parietal bone	4	6.4
Temporal bone	10	16
Occipital bone	7	11.3
Fronto-parietal	7	11.3
Fronto-temporal	4	6.4
Parieto-temporal	5	8
Parieto- occipital	4	6.4
Temporo-occipital	1	1.6
Fronto-parieto-temporal	5	8
Parieto-temporo-occipital	2	3.2
Fronto-parieto-temporo-occipital	3	5
Crush	6	10
Total	62	100

Head injury with other injury	58	90.6	6	9.4	64
Total	106	84	20	16	126

Table 5: Types of intracranial hemorrhage (ICH)

Types of ICH	No. of cases	Percentage
EDH only	1	1
SDH only	20	20
SAH only	23	22
EDH + SDH	5	5
SDH + SAH	47	46
EDH + SDH + SAH	1	1
Intracerebral Hemorrhage	1	1
Intracerebral hemorrhage + SDH	2	2
Intracerebral hemorrhage + SAH	1	1
Intracerebral hemorrhage + SDH + SAH	1	1
Total	102	100

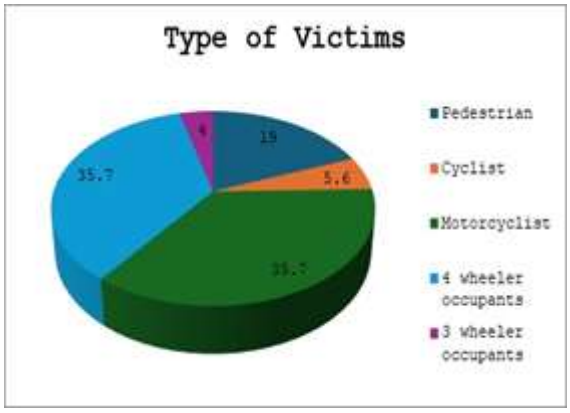

Figure 1: Distribution of cases by type of victim

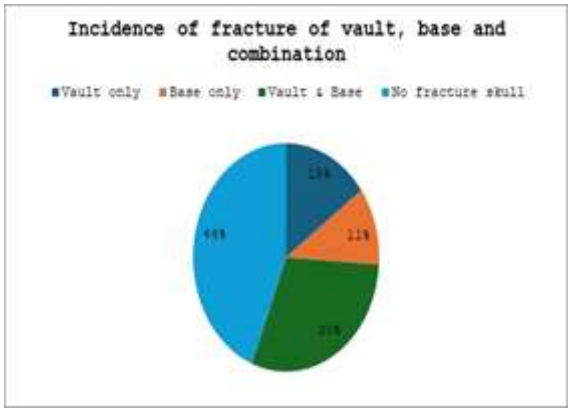

Figure 2: Incidence of fracture of vault, base and combination

ISSN (O): 2687-5365; ISSN (P): 2753-6556

DISCUSSION

The present study was undertaken to study the pattern of head injuries in fatal road traffic accident brought for Medico-Legal Postmortem Examination in the Mortuary of Department of Forensic Medicine & Toxicology, JNIMS, Imphal and compare these data with the data available in the literatures of different workers elsewhere.

In the present study, a total of 126 cases of fatal RTA of all age groups and both sexes were studied for duration of two years. Highest incidence of fatalities occurred in the age group of 15 to 30 years (30%) followed by 30 to 45 years (25%). Since the age group of 15 to 45 years is the most active phase of life – physically and socially, and outnumbers the other road users, they therefore accounted for the maximum number of accidental deaths. Also, individuals of this age group were either students or working people in various jobs who usually travel by either own vehicles, buses or walk for work. Children below 15 years of age were least involved, so also, were in the case with person beyond 60 years of age. This could be explained as the persons in extremes of the age usually remain indoors, whereas children are confined to the residential premises most of the time other than going to school. This corresponds with those of other workers in the field who also reported maximum fatality in the age group 21 to 40 years.[5,8,12]

Males are largely involved in the accidents with M/F ratio 5.3:1, probably due to the fact that males lead a more active role in life and keep themselves active outdoors most of the time. They are more involved in activities such as driving and travelling. These findings in general are well supported by other workers.[5,10,12,17] Deaths in road traffic accidents were more among married persons (66%). Similar finding was reported by Sonawane S et al.[5] Two wheeler occupants (motorcyclist, pillion rider) and four wheeler occupants constituted the majority of the victims seen in 45(35.7%) of cases each. This is followed by pedestrian (19%) and cyclist (5.6%). This may be explained by the fact that two wheelers being cheaper than cars are affordable for a larger number of people. The increasing numbers of two wheelers on the roads without strict enforcement of safety helmet wear among the occupants are probably one of the main reasons for increased two wheeler accidents. Safety helmets were not strictly enforced in Imphal during the study period. The increasing trend of driving two wheelers by college students, who have the tendency to drive fast, is probably the reason for increased two wheeler accidents. Overcrowding of passengers in vehicles is another feature of Indian roads. Accordingly, when such a vehicle is involved in an accident, the toll is usually higher. Drunken driving is a known factor which increases the risk of causing accidents. Other workers in the field also reported similar findings where two wheeler users constitute the largest group in road traffic accident.[6,9,10] Some other authors reported that the pedestrians were the major victims, followed by motorcyclist.[7,16] This shows the erratic pedestrian behavior and reckless driving of vehicles on the roads.

Out of total 126 cases, injuries to scalp were seen in 80.2% and no obvious lesion was seen in 19.8%. The scalp revealed contusion, laceration and hematoma alone in the diminishing order of frequency of 41%, 21% and 16% respectively. Contusion and laceration in combination was seen in 6.3%. The above distribution of the injuries point out to the great force of the impacts in automobile accidents. This can be explained by the heavy blunt force, loose areolar space available for blood accumulation beneath scalp, minimal musculature of the scalp and the velocity of victim of fall on the ground. These findings is in contrast to that of Jha S et al,[3] where laceration is the commonest injuries found on scalp(59%), followed by contusion(27.3%) and abrasion(23.4%). Other workers,[4,15] in the field also found that contusion was the commonest scalp injury seen.

In this study, fracture of the skull was noted in 71(56%) victims. This shows that fatalities are more common in head injuries associated with skull fractures than those without fractures. Most cases showed fracture of both vault and base of the skull in 38(30%) cases. Fracture in the skull vault alone was noticed in 19(15%) cases. Fractures in the base of skull were noted in 14(11%) of the victims. These findings correspond with the studies done by Nair SS and Lakshmanan N,[11] and Murugesa BO et al,[12] In analyzing the skull vault fracture, temporal bone(16%), the thinnest of all the skull bones fractured the most and fissure fracture was found in 39% of cases followed by comminuted fracture (27%). Similar findings were observed by Kumar S et al.[13] This is in contradiction to Honnunger RS et al,[14] who revealed that the frontal bone fracture was the most common bone fractured in the head (69%). Singha YN et al,[15] in their study observed that the parietal bone was the commonest (42%) followed by frontal bone (20%). Common type of fracture was fissure fracture (30%) followed by comminuted fracture (24.4%). In the present study, solitary subarachnoid hemorrhage and subdural hemorrhage were observed in 23% and 20% of cases respectively. Solitary extradural hemorrhage and intracerebral hemorrhage was observed in significantly less number of cases. These findings are in contradiction to other workers who reported that subdural hemorrhage was the most common type of intracranial hemorrhage followed by subarachnoid hemorrhage.[8,10,18]

CONCLUSION

This study analyses patterns of head injury in road traffic accidents, focusing on the primary factors causing victim fatalities for future prevention and

ISSN (O): 2687-5365; ISSN (P): 2753-6556

mitigation strategies. While both human and mechanical failures contribute to these incidents, human error is significantly more prominent. Helmet usage substantially lowers the risk of severe head trauma and death, highlighting the need for enhanced public traffic safety education alongside stricter enforcement of protective measures—including seat belts, headrests, and helmets for both riders and pillion riders. Furthermore, because substance abuse and speed miscalculations remain major contributors to road traffic accidents, discouraging drunk driving requires consistent highway Breathalyzer checks, harsher penalties, and more rigorous driver training before licensing. As most fatalities occur within six hours of impact, establishing robust emergency medical services, swift ambulance deployments, and well-equipped trauma facilities will be vital to saving lives.

REFERENCES

1. Sonawane S, Jambure M. Patterns of head injuries in road traffic accidents: an autopsy study. Int J Cur Res. 2015 Dec;7(12):23733-37.
2. Biswas G, Verma SK, Sharma J, et al. Pattern of Road traffic accidents in North East Delhi. Journal of Forensic Medicine and Toxicology.2003;(20): 27-32.
3. Vij. K. Textbook of forensic medicine and toxicology. 2nd ed. India: Churchil livingstone; 2002. p. 521.
4. Aggarwal KK, Oberoi SS, Kumar R. Sharma M.Pattern and distribution of injuries in fatal road traffic accident cases. J Punjab Acad Forensic Med Toxicol. 2009;9(1):71-5.
5. Sonawane S, Jambure M. Patterns of head injuries in road traffic accidents: an autopsy study. Int J Cur Res. 2015 Dec;7(12):23733-37.
6. Sirathranont J and Kasantikul V. Mortality and injury from motorcycle collisions in Phetchaburi province. J Med Assoc Thai. 2003;86(2):97-102.
7. Kaul A, Sinha US, Pathal YK, Singh A, Kapoor AK, Sharma S et al. Fatal road traffic accidents, study of distribution, nature and type of injury.
8. Menon A, Nagesh KR. Pattern of fatal head injuries due to vehicular accidents in Manipal. JIAFM. 2005;27(1):19-22.
9. Kumar A, Lalwani S, Agrawal D, Rautji R, Dogra TD. Fatal road traffic accidents and their relationship with head injuries: An epidemiological survey of five years. Indian J Neurotrauma. 2008;5(2):63-7.
10. Menon A, Pai VK, Rajeev A. Pattern of fatal head injuries due to vehicular accidents in Mangalore. J Forensic Leg Med.2008;15:75-7.
11. Drake RL, Vogl W, Mitchell AWM. Gray's anatomy for students. 1st ed. Philadelphia(PA): Churchill Livingstone; 2005. p. 763-78.
12. Bernard knight. Forensic pathology. 1st ed. Great Britain: Edward Arnold; 1992. p. 253.
13. Cameron JM. Wounds and trauma. Gradwohl's legal medicine. 3rd ed. Britol: John Wright and Sons; 1976. p. 25599.
14. Nandy A. Communication and transport injuries. Principles of forensic medicine. 3rd ed. India: New Central Book Agency; 1995. p. 465-77.
15. Rao NG. Transportation injuries.Textbook of forensic medicine and toxicology. 1st ed. India: Jaypee Brothers Medical publishers; 2000. p. 207-11.
16. Singh YN, Das G, Phukon S. Pattern of head injuries in fatal RTAs in tertiary care hospital, Assam. Medpulse Int Med J. 2014;1(4):149-52.
17. Raza S, Pandey SK, Kaulaskar SV, Kumar A. Epidemiological study of fatal head injury in road traffic accident in Varanasi district. The Pharma Innovation Journal. 2018;7(3):65-8.
18. Kumar A, Lalwani S, Agrawal D, Rautji R, Dogra TD. Fatal road traffic accidents and their relationship with head injuries: An epidemiological survey of five years. Indian J Neurotrauma. 2008;5(2):63-7.

ISSN (O): 2687-5365; ISSN (P): 2753-6556