

Autopsy Profile of Road Traffic Accident Fatalities and Pattern of Injuries Sustained at a Tertiary Care Hospital in Gurgaon, Haryana: A One-Year Retrospective Study

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Abstract

Background: Road traffic accidents (RTAs) constitute a major public health challenge worldwide, particularly in low- and middle-income countries like India, where rapid urbanization, vehicular growth, and inconsistent enforcement of traffic regulations contribute to high mortality. Autopsy-based studies provide crucial insights into injury patterns, mechanisms of death, and preventable factors associated with RTA fatalities.

Aim: To analyze the epidemiological profile, injury patterns, and causes of death among road traffic accident victims subjected to medico-legal autopsy at a tertiary care hospital in Gurgaon, Haryana.

Methods: A retrospective descriptive study was conducted on 70 medico-legal autopsies of road traffic accident fatalities at Al-Falah Medical College, Haryana, from 10 January 2019 to 31 December 2019. Demographic variables, accident characteristics, injury distribution, fracture patterns, intracranial hemorrhages, and causes of death were analyzed using descriptive statistics.

Results: Most victims were males, predominantly in the productive age group. Two-wheeler users constituted the largest victim category. Head injury was the most frequently involved body region, with intracranial hemorrhage being the leading cause of death. Subdural and subarachnoid hemorrhages, either alone or in combination, were the most common intracranial findings.

Conclusion: Road traffic accident fatalities in this region predominantly affect young and middle-aged males, with head injuries playing a pivotal role in mortality. Strengthening road safety measures, strict enforcement of helmet and seat-belt laws, and improvement in trauma care facilities are imperative to reduce preventable deaths.

Keywords: Road traffic accidents, Autopsy study, Injury pattern, Intracranial hemorrhage, Cause of death.

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Introduction

Road traffic accidents represent one of the most significant yet preventable causes of mortality and morbidity across the globe. According to the World Health Organization, approximately 1.3 million people die annually due to road traffic injuries, while an additional 20–50 million sustain non-fatal injuries, many resulting in long-term disability [1]. Road traffic injuries rank among the leading causes of death in individuals aged 5–29 years, underscoring their devastating socio-economic impact.

India bears a disproportionate burden of road traffic fatalities, accounting for nearly 11% of global RTA-related deaths despite having a lower proportion of the world's vehicles [2]. Rapid urban expansion, increasing vehicular density, mixed traffic conditions, inadequate road infrastructure, and inconsistent enforcement of traffic laws contribute to the high incidence of accidents. National Crime Records Bureau data reveal that over 1.5 lakh deaths occur annually due to road accidents in India, with a worrying upward trend [3].

From a forensic and public health perspective, autopsy studies serve as an indispensable tool in understanding the exact mechanisms of injury and death following RTAs. Unlike clinical data, medico-legal autopsies provide comprehensive documentation of external and internal injuries, fracture patterns, and vital organ damage, enabling accurate determination of cause of death and contributing factors [4]. Such data are essential not only for legal purposes but also for formulating targeted injury-prevention strategies.

Previous autopsy-based studies from different regions of India have consistently demonstrated a male predominance among RTA fatalities, attributed to greater outdoor exposure, occupational travel, and higher risk-taking behavior [5–7]. Young adults and the elderly are often identified as vulnerable groups, albeit for different reasons—risk-prone behavior in the former and diminished sensory-motor functions in the latter [8]. Two-wheeler riders and pedestrians frequently emerge as high-risk road users, especially in urban and semi-urban settings [9].

Injury pattern analysis reveals that head injuries are the leading cause of death in RTA victims, followed by thoracic and abdominal injuries [10]. The absence or improper use of protective devices such as helmets and seat belts significantly increases the severity of cranio-cerebral trauma. Intracranial hemorrhages—particularly subdural and subarachnoid hemorrhages—are commonly reported fatal findings in autopsy studies [11].

Despite the growing body of literature, region-specific data remain crucial, as traffic patterns, road conditions, vehicle types, and enforcement levels vary considerably across India. Gurgaon, a rapidly developing urban hub in Haryana, has witnessed a sharp rise in vehicular traffic due to industrialization and urban migration. However, limited published data exist regarding the autopsy profile of RTA fatalities in this region.

The present study was therefore undertaken at Al-Falah Medical College, Haryana, to analyze the demographic characteristics, accident profiles, injury patterns, and causes of death among RTA victims over a one-year period. The findings aim to contribute region-specific evidence to inform policy-makers, traffic authorities, and healthcare planners in designing effective road safety and trauma-care interventions.

Materials and Methods

This retrospective descriptive study was conducted in the Department of Forensic Medicine and Toxicology, Al-Falah Medical College, Haryana, India. The study period extended from 10 January 2019 to 31 December 2019. All medico-legal autopsies conducted during this period in which

death resulted from road traffic accidents were reviewed. The study population comprised 70 confirmed RTA fatalities subjected to complete medico-legal autopsy. Cases were included if death was directly attributable to injuries sustained in a road traffic accident and if complete autopsy records were available. Decomposed bodies, cases with incomplete documentation, and deaths due to non-traffic-related causes were excluded.

Data were collected retrospectively from post-mortem reports, inquest papers, hospital case records, and police requisitions. Variables studied included age, sex, month of accident, type of road user, type of vehicle involved, place of accident, place of death, distribution of external injuries, body regions involved, fracture patterns, intracranial hemorrhages, and certified cause of death.

The study design was observational and descriptive in nature. Sample size was determined by the total number of eligible RTA autopsies during the study period. Data were entered into Microsoft Excel and analyzed using descriptive statistics. Results were expressed as frequencies and percentages, and presented in tabular and graphical formats. The SPSS version 22 software was used to compute descriptive statistics including mean, frequency, and percentage. The analysis's findings were subsequently presented as pertinent tables.

Results

A total of 70 road traffic accident fatalities were analyzed. Table 1 demonstrates a marked male predominance among road traffic accident fatalities, accounting for the vast majority of cases.

This observation is consistent with multiple Indian autopsy-based studies and reflects gender-specific exposure patterns. Males are more frequently involved in outdoor occupational activities, long-distance travel, and high-risk driving behaviors, including speeding, alcohol consumption, and non-compliance with traffic regulations.

Cultural and socio-economic factors further contribute to this disparity. Age-wise analysis reveals that the elderly population (>60 years) constituted the largest proportion of victims, followed closely by individuals in the 21–40 years age group. The vulnerability of elderly individuals may be attributed to age-related decline in vision, hearing, reflexes, and mobility, increasing their risk as pedestrians and drivers. Conversely, the high incidence among young adults reflects increased mobility, risk-taking behavior, and use of two-wheelers. This dual-age vulnerability pattern has also been reported in earlier Indian and international studies, highlighting the need for age-specific preventive strategies.

Table 1: Month-wise distribution of RTA cases

Age group (years)	Male	Female	Total (%)
<20	3	1	4 (5.7%)
21–30	14	2	16 (22.9%)
31–40	12	1	13 (18.6%)
41–50	9	1	10 (14.3%)
51–60	8	2	10 (14.3%)
>60	14	3	17 (24.2%)
Total	60	10	70 (100)

Table 2 provides insight into the circumstantial profile of road traffic accidents. Two-wheeler riders constituted the largest group of victims, emphasizing their heightened vulnerability due to minimal physical protection, instability of vehicles, and poor helmet compliance. Pedestrians formed the second most affected group, indicating unsafe road-crossing practices, inadequate pedestrian infrastructure, and high-speed vehicular movement in urban and peri-urban areas. A majority of accidents occurred on highways, which can be explained by higher permissible speeds, heavy

vehicular density, and reduced reaction time during collisions. Highways near rapidly urbanizing regions such as Gurgaon often lack adequate pedestrian crossings and service lanes, further increasing risk. Most victims succumbed after reaching the hospital, indicating that although emergency transport exists, the severity of injuries—particularly head injuries—was often incompatible with survival. This finding underscores the importance of strengthening pre-hospital trauma care, early resuscitation, and rapid neurosurgical intervention.

Table 2: Profile of road traffic accidents

Variable	Number (%)
Two-wheeler riders	38 (54.3%)
Pedestrians	17 (24.3%)
Four-wheeler occupants	9 (12.9%)
Others	6 (8.5%)
Highway accidents	41 (58.6%)
Urban roads	29 (41.4%)
Death at hospital	44 (62.9%)
Spot death	26 (37.1%)

Table 3 highlights that the head was the most frequently involved body part, followed by thoracic and lower limb injuries. The predominance of head injuries reflects inadequate use of helmets among two-wheeler riders and poor seat belt compliance among four-wheeler occupants. Cranial trauma remains the most lethal injury in RTAs due to the vulnerability of brain tissue to acceleration-deceleration forces.

Fracture analysis reveals a higher frequency of skull and thoracic fractures, indicating high-energy impacts. Thoracic fractures often result from compression against steering wheels, dashboards, or road surfaces, and are frequently associated with fatal internal injuries. Limb fractures, although common, were less directly associated with mortality but signify severe blunt force trauma.

Table 3: Type of body parts involved and fracture distribution

Body region involved	Cases (%)
Head	56 (80.0%)
Thorax	18 (25.7%)
Abdomen	12 (17.1%)
Lower limbs	21 (30.0%)
Upper limbs	14 (20.0%)

Table 4 shows that abrasions were the most common external injury, followed by contusions and lacerations. Abrasions are typically produced by friction against rough surfaces such as roads and vehicle bodies, and their widespread presence indicates sliding or dragging mechanisms during accidents. The coexistence of multiple types of

external injuries reflects high-velocity blunt force trauma. Although external injuries may appear superficial, they often correlate with severe underlying internal injuries. Their distribution also assists forensic experts in reconstructing the mechanism of injury and determining the manner of impact.

Table 4: Distribution of external injuries

Injury type	Frequency (%)
Abrasions	62 (88.6%)
Contusions	48 (68.6%)
Lacerations	29 (41.4%)

Table 5 illustrates that subdural hemorrhage (SDH) and combined SDH with subarachnoid hemorrhage (SAH) were the most common intracranial bleeding patterns. Subdural hemorrhage typically results from tearing of bridging veins due to rotational acceleration-deceleration forces, which are common in road traffic accidents. The high prevalence of combined hemorrhages suggests

severe head trauma with multiple impact forces. Extradural hemorrhage was relatively less common, possibly due to its association with focal impacts and early fatality before hospital admission. These findings reinforce the central role of head injury in RTA mortality and emphasize the life-saving potential of helmet use and early neurosurgical care.

Table 5: Pattern of intracranial hemorrhages

Type	Number (%)
Subdural hemorrhage	19 (27.1%)
Subarachnoid hemorrhage	7 (10.0%)
SDH + SAH	24 (34.3)
Extradural hemorrhage	4 (5.7)
Others / combinations	6 (8.6)

Table 6 demonstrates that intracranial hemorrhage was the leading cause of death, followed by cranio-cerebral injury and hemorrhagic shock due to multiple injuries. This finding is consistent with the predominance of head injuries observed across other tables. Deaths due to hemorrhagic shock indicate delayed or inadequate control of bleeding, highlighting gaps in pre-hospital care and trauma

system responsiveness. Less frequent causes such as respiratory failure and sepsis were observed in victims who survived longer durations, reflecting secondary complications during hospital stay. Overall, the cause-of-death distribution underscores that most RTA fatalities are preventable with timely intervention, effective trauma care systems, and strict enforcement of protective measures.

Table 6: Distribution of cause of death

Cause of death	Cases (%)
Intracranial hemorrhage	36 (51.4)
Cranio-cerebral injury	17 (24.3)
Hemorrhagic shock (multiple injuries)	11 (15.7)
Others	6 (8.6)

Discussion

The present autopsy-based study provides valuable insight into the epidemiological and injury profile of road traffic accident fatalities in Gurgaon, Haryana. RTAs accounted for a substantial proportion of medico-legal autopsies during the study period, reflecting the growing burden of traffic-related deaths in rapidly urbanizing regions.

Male predominance observed in this study is consistent with findings reported in several Indian and international studies [5–7]. This trend can be attributed to increased exposure of males to vehicular traffic due to occupational responsibilities, greater use of two-wheelers, and higher propensity for risk-taking behaviors such as speeding and non-use of protective gear. The age distribution revealed that young and middle-aged adults, along with the elderly, constituted the majority of victims. Similar observations have been

documented by Rakshitha et al. and Marak et al., emphasizing that economically productive age groups are disproportionately affected, leading to significant socio-economic loss [8,11]

Two-wheeler riders emerged as the most vulnerable road users, accounting for more than half of the fatalities. The lack of helmet usage, poor visibility, and instability of two-wheelers increase the risk of fatal head injuries. Pedestrians formed the second largest group, highlighting inadequate pedestrian infrastructure and unsafe road-crossing practices.

Head injury was the most commonly involved body region, observed in 80% of cases. This finding aligns with multiple autopsy studies that identify cranio-cerebral trauma as the leading cause of death in RTAs [9–11]. Intracranial hemorrhage, particularly subdural and subarachnoid hemorrhages, either alone or in combination, was the predominant fatal lesion. These hemorrhages

often result from rapid deceleration and rotational forces acting on the brain during impact.

The predominance of highway accidents reflects high-speed travel, heavy vehicular movement, and limited margin for error. Similar trends have been reported in other tertiary-care-based autopsy studies conducted along major highways [8,9]. Although a majority of victims reached the hospital alive, many succumbed due to severe injuries, underscoring the need for rapid pre-hospital care and advanced trauma life support.

Overall, the findings reinforce the preventable nature of many RTA deaths. Strict enforcement of helmet and seat-belt laws, improved road engineering, enhanced pedestrian safety, and public awareness campaigns are essential. Establishment of a robust trauma registry and strengthening emergency medical services can further reduce mortality.

Conclusion

Road traffic accident fatalities in Gurgaon predominantly involve males, two-wheeler users, and individuals in economically productive age groups. Head injury with intracranial hemorrhage remains the leading cause of death. The study highlights the urgent need for comprehensive road safety strategies, strict enforcement of traffic regulations, and strengthening of trauma care services to reduce preventable deaths.

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References

1. World Health Organization. Global status report on road safety 2023. Geneva: WHO; 2023. Available from: <https://www.who.int>
2. World Health Organization. Road traffic injuries – Fact sheet. Geneva: WHO; 2022.
3. Ministry of Road Transport and Highways, Government of India. Road Accidents in India 2019. New Delhi: MoRTH; 2020.
4. National Crime Records Bureau. Accidental deaths and suicides in India 2019. New Delhi: Ministry of Home Affairs; 2020.
5. Farooqui JM, Chavan KD, Bangal RS, Syed MMA, Thacker PJ, Alam S. Pattern of injury in fatal road traffic accidents in a rural area of western Maharashtra, India. *Australas Med J*. 2013;6(9):476–482.
6. Mishra B, Sinha ND, Sukhla SK, Sinha AK. Epidemiological study of road traffic accident cases from western Nepal. *Indian J Community Med*. 2010;35(1):115–121.
7. D'Souza C, Rao VV, Kumar A, Diaz E. Epidemiological trends of trauma in a tertiary care centre in Dakshina Kannada district of Karnataka. *J Clin Diagn Res*. 2014;8(3):66–68.
8. Marak F, Sangma MM, Kumar G, Priyadarshini M. Pattern of injuries associated with deaths following road traffic accidents in a tertiary care hospital. *Indian J Forensic Community Med*. 2016;3(4):257–262.
9. Swarnkar M, Singh P, Dwivedi S. Pattern of trauma in central India: An epidemiological study with special reference to mode of injury. *Internet J Epidemiol*. 2009;9(1):1–7.
10. Kalaiselvan G, Dongre AR, Mahalakshmy T. Epidemiology of injury in rural Pondicherry, India. *J Inj Violence Res*. 2011;3(2):62–67.
11. Neeluri R, Anga VS. A study on victims of road traffic accidents attending casualty in a tertiary care hospital. *Int J Community Med Public Health*. 2018;5(7):3034–3039.
12. Narayan KA. Study of pattern and distribution of injuries in fatal road traffic accident cases autopsied at a tertiary care hospital. *Indian J Forensic Med Toxicol*. 2020;14(3):357–360.
13. Prakash MJ, Koulapur VV, Honnunar RS, Bannur V, Jirli PS. Profile and pattern of mortality due to road traffic accidents. *Int J Dent Med Sci Res*. 2023;5(2):835–840.
14. Garg N, Hyder AA. Road traffic injuries in India: A review of the literature. *Scand J Public Health*. 2006;34(1):100–109.
15. Raja NS, Sekar CJ, Madesh A, Narasimha BC. Epidemiological study of road traffic accident cases attending a tertiary care hospital. *Res J Pharm Biol Chem Sci*. 2022;13(5):79–89.
16. Sonawane S, Jambure M. Patterns of head injuries in road traffic accidents: An autopsy study. *Int J Curr Res*. 2015;7(12):23733–23737.