RESEARCH PAPER

Pattern of Injuries Among Victims of Fatal Accidents Brought for Medico-Legal Autopsy at a Tertiary Care Teaching Hospital in Haryana: A Retrospective Study

Dr Sonal Raman[1] ,Dr Parveen Kumar[2] , Dr Shivam Sharma[3] , Dr kanika kohl[4], Dr K. k. Aggarwal[5]

[1] Junior Resident Maharishi Markandeshwar Institute of Medical Sciences and Research, Ambala University: Maharishi Markandeshwar university,Mullana, Ambala Email sonalkraman@gmail.com
[2]Junior Resident Maharishi Markandeshwar Institute of Medical Sciences and Research, Ambala University: Maharishi Markandeshwar university,Mullana, Ambala Email pcpchahal@gmail.com
[3]Junior Resident Maharishi Markandeshwar Institute of Medical Sciences and Research, Ambala University: Maharishi Markandeshwar university,Mullana, Ambala Email drshivam.3188@gmail.com
[4]Professor Maharishi Markandeshwar Institute of Medical Sciences and Research, Ambala University: Maharishi Markandeshwar university,Mullana, Ambala Email kanikaghotra86@gmail.com
[5]Professor and head Maharishi Markandeshwar Institute of Medical Sciences and Research, Ambala University: Mahari

Abstract

Background: Accidental deaths are a leading cause of medico-legal autopsy referrals in India. Region-specific autopsy data on fatal injury patterns from Haryana are limited. This study aimed to characterize the pattern and distribution of injuries in fatal accident victims to inform forensic practice and preventive policy.

Methods: A retrospective record-based observational autopsy study was conducted at the Department of Forensic Medicine and Toxicology, MMIMSR, Mullana-Ambala, Haryana over 12 months (December-January 2025). One hundred and twenty medico-legal autopsy cases of fatal accident victims were analyzed for demographic profile, type of accident, external injury pattern, body regions injured, bone fractures, internal organ injuries, survival period, and cause of death.

Results: Of 120 cases, males predominated (83.3%) and the 21–40-year age group was most affected (60.8%). Road traffic accidents accounted for 79.2% of cases. Hemorrhagic shock was the leading cause of death (48.3%), followed by septicemia (22.5%) and multiple organ failure (MOF) (18.3%).

Conclusion: Fatal accidental injuries predominantly affect young working-age males involved in RTAs. The abdomen is the most vulnerable body region and hemorrhagic shock the leading cause of death. Strengthening pre-hospital emergency care, road safety enforcement, and emergency surgical capacity are critical to reducing accidental mortality.

Keywords: accidental injury; autopsy; fatal accidents; injury pattern; road traffic accidents; polytrauma; hemorrhagic shock; forensic medicine

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Introduction

Injuries resulting from accidents represent a leading cause of mortality and disability worldwide, constituting a major public health challenge in developing nations such as India. Trauma arising from road traffic accidents (RTAs), falls from height, physical assault, and occupational hazards accounts for a substantial proportion of all medico-legal autopsy referrals. [1,2]

Accurate documentation of injury patterns at autopsy is indispensable for determining the cause and manner of death, reconstructing accident events, and assisting judicial proceedings. [3,4] Under the Bharatiya Nyaya Sanhita (BNS), 2023, hurt is classified as either simple or grievous, with statutory criteria — including hurt that endangers life — determining whether an injury qualifies as grievous, making precise injury characterization central to medico-legal testimony. [5]

India bears one of the world's highest burdens of road traffic fatalities. The WHO Global Status Report on Road Safety (2023) identified RTAs as a major preventable cause of death, with young working-age males disproportionately affected. [6] Rapid urbanization, increased vehicular density, poor road design, and non-compliance with traffic safety regulations contribute to and compound this burden. [6]

Autopsy-based studies uniquely capture the true spectrum of fatal injuries — including external wounds, body region involvement, skeletal fractures, and internal organ damage — that may be underestimated or missed in clinical settings. Such data inform surgical trauma protocols, emergency response planning, and targeted preventive strategies. Despite their importance, region-specific forensic autopsy data from Haryana remain scarce. [7-11]

The present study was conducted with the aim of analyzing the pattern and distribution of physical injuries among victims of fatal accidents brought for medico-legal autopsy at a tertiary care teaching hospital in Haryana.

Materials and Methods

Study Design and Setting

A retrospective, record-based, observational autopsy study was conducted in the Department of Forensic Medicine and Toxicology at Maharishi Markandeshwar Institute of Medical Sciences and Research (MMIMSR), Mullana-Ambala, Haryana, India, from January 2025 to December 2025 (12 months).

Study Population

All victims of fatal accidents brought for medico-legal autopsy during the study period were eligible. A total of 120 cases meeting the inclusion criteria were included by complete enumeration.

Eligibility Criteria

Inclusion: Deaths due to accidental trauma (RTAs, falls from height, occupational accidents); victims dying on the spot or after hospital admission; complete and legible autopsy and inquest records available.

Exclusion: Deaths due to homicidal or suicidal causes; decomposed bodies where reliable injury assessment was not possible; cases with incomplete medico-legal documentation.

Autopsy Protocol and Data Collection

All autopsies were performed by forensic medicine specialists following standardized medico-legal protocols. External examination documented injury type (abrasions, contusions, lacerations, incised wounds, burns) and body region distribution. Internal examination recorded organ injuries, fractures, and pathological findings. Cause of death was determined from integrated autopsy, inquest, and clinical data. Variables recorded included: age, sex, type of accident, survival period, external injury pattern, body region injured, major bone fractures, internal organ injuries, and cause of death.

Ethical Approval

The study was approved by the Institutional Ethics Committee of MMIMSR (Approval No. MMIMSR/IEC/2024/FMT/3826). Informed consent was waived by the committee for this retrospective post-mortem record-based study.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using IBM SPSS Statistics version 23.0 (IBM Corp., Armonk, NY, USA). Categorical variables are presented as frequency and percentage.

Results

Of 120 cases, 100 were male (83.3%) and 20 were female (16.7%). The majority of cases (73 out of 120, 60.8%) were in the 21–40 years age group. (Figure 1 & 2)

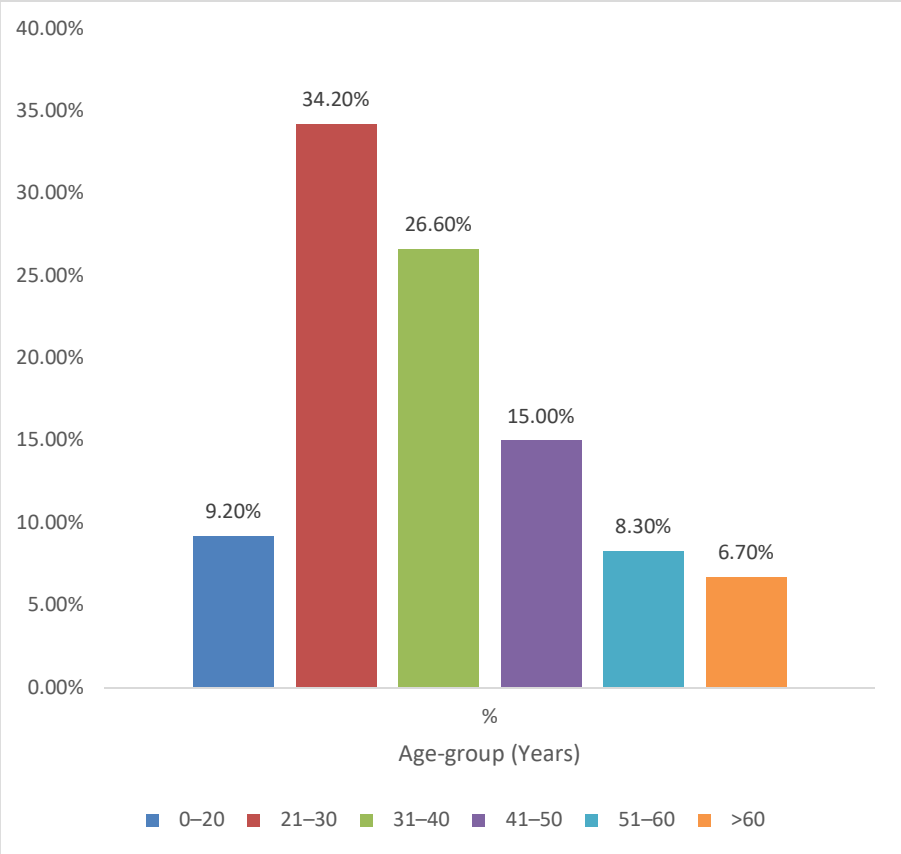

Figure 1. Age group distribution of study participants

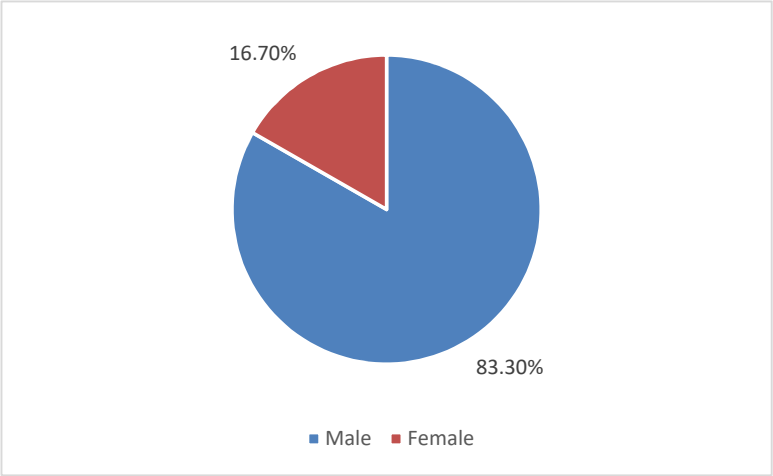

Figure 2. Sex distribution of study participants

Table 1. Accident characteristics of study participants (n = 120)

Type of accident	n	%
Road traffic accident (RTA)	95	79.2
Fall from height	21	17.5
Occupational injury	4	3.3
Total	120	100

RTA = road traffic accident

Table 1 shows that RTAs were the most common mechanism of fatal injury (79.2%), followed by falls from height (17.5%) and occupational injuries (3.3%).

Table 2. Pattern of injuries among study participants (n = 120)

Injury Parameter	n	%
External Injuries		
Abrasions	89	74.2
Contusions	82	68.3
Lacerations	74	61.7
Incised wounds	18	15.0
Burns	6	5.0
Body Regions Injured		
Abdomen	91	75.8
Chest	79	65.8
Head and neck	68	56.7
Lower limbs	53	44.2
Upper limbs	47	39.2
Spine/back	22	18.3
Bone Fractures		

Injury Parameter	n	%
Ribs	63	52.5
Skull	44	36.7
Femur	31	25.8
Pelvis	27	22.5
Tibia/fibula	24	20.0
Vertebrae	14	11.7
Humerus	11	9.2
No fracture	19	15.8
Internal Organ Injuries		
Liver	73	60.8
Small intestine	65	54.2
Spleen	49	40.8
Lung	39	32.5
Large intestine	30	25.0
Kidney	25	20.8
Brain/intracranial	14	11.7
Urinary bladder	13	10.8
Cause of Death		
Hemorrhagic shock	58	48.3
Septicemia	27	22.5
Multiple organ failure (MOF)	22	18.3
Head injury complications	9	7.5
Pulmonary complications	4	3.3

MOF = multiple organ failure.

Table 2 presents the complete injury profile. Among external injuries, abrasions were most frequent (74.2%), followed by contusions (68.3%) and lacerations (61.7%), reflecting the frictional and blunt-force mechanisms of vehicular trauma. The abdomen was the most commonly injured body region (75.8%), followed by the chest (65.8%) and head and neck (56.7%). Rib fractures (52.5%) and skull fractures (36.7%) were the predominant skeletal injuries, while the liver (60.8%) and small intestine (54.2%) were the most frequently injured internal organs. Hemorrhagic shock was the leading cause of death (48.3%), with septicemia (22.5%) and multiple organ failure (MOF) (18.3%) accounting for the majority of delayed deaths.

Table 3. Survival period by type of accident (n = 120)

Type of Accident	<24 h n (%)	24–72 h n (%)	3–7 days n (%)	>7 days n (%)	Total n (%)
RTA	41 (43.2)	31 (32.6)	16 (16.8)	7 (7.4)	95 (79.2)
Fall from height	13 (61.9)	6 (28.6)	2 (9.5)	0 (0.0)	21 (17.5)
Occupational	1 (25.0)	1 (25.0)	0 (0.0)	2 (50.0)	4 (3.3)
Total	55 (45.8)	38 (31.7)	18 (15.0)	9 (7.5)	120 (100)

RTA = road traffic accident.

Table 3 illustrates survival period stratified by type of accident. Overall, 45.8% of victims died within 24 hours of injury, highlighting the lethal severity of the trauma sustained. Falls from height demonstrated the highest early

mortality, with 61.9% of victims dying within 24 hours, compared with 43.2% for RTA victims. Occupational accident victims showed a distinct pattern, with 50.0% surviving beyond seven days, consistent with the relatively lower-energy mechanisms typically involved. Among RTA victims, 75.8% died within 72 hours, underscoring the critical importance of the first three days in determining outcome.

Table 4. Cause of death by type of accident (n = 120)

Cause of Death	RTA (n = 95) n (%)	Fall from Height (n = 21) n (%)	Occupational (n = 4) n (%)	Total n (%)
Hemorrhagic shock	46 (48.4)	10 (47.6)	2 (50.0)	58 (48.3)
Septicemia	21 (22.1)	5 (23.8)	1 (25.0)	27 (22.5)
Multiple organ failure (MOF)	17 (17.9)	4 (19.0)	1 (25.0)	22 (18.3)
Head inj. comp.	7 (7.4)	2 (9.5)	0 (0.0)	9 (7.5)
Pulm. comp.	4 (4.2)	0 (0.0)	0 (0.0)	4 (3.3)

RTA = road traffic accident; Head inj. comp. = head injury complications; Pulm. comp. = pulmonary complications.

Table 4 shows that the distribution of cause of death was remarkably consistent across all three accident types. Hemorrhagic shock was the leading cause regardless of mechanism: 48.4% in RTAs, 47.6% in falls from height, and 50.0% in occupational injuries. Septicemia and MOF were the second and third most common causes across all groups. Pulmonary complications were recorded exclusively in RTA victims (4.2%), possibly reflecting the higher-energy thoracic trauma associated with vehicular collisions. The uniformity of the cause-of-death distribution across accident types suggests that the terminal pathophysiology of fatal accidental trauma is largely mechanism-independent, dominated by hemorrhage and its sequelae.

Discussion

The present autopsy-based study documented the pattern and distribution of injuries among 120 fatal accident victims in Haryana. Male predominance (83.3%) was consistently observed, in agreement with Marak et al. (85.7%) [3], Prasad et al. (87.40%) [12], Sengupta et al., (75.33%) [1], and Rao et al. (83.04%) [13]. This male preponderance reflected greater outdoor exposure, occupational mobility, and higher utilization of two-wheelers among males in the region.

The predominance of fatalities in the 21–40-year age group (60.8%) carried substantial socioeconomic implications, as this represented the most economically productive segment of the population. Comparable findings were reported by Yadav et al. (26.7% in the 21–30-year group) [14], Manoranjan et al. (24.2% in the 21–30-year group) [6], and Prasad et al. (52.59% in the 21–40-year group) [12], all of whom similarly identified young adults as the most vulnerable demographic in fatal road traffic accidents (Table 1).

Road traffic accidents accounted for 79.2% of fatal accidental deaths in the present study (Table 1). Kumar et al. identified RTAs as the leading cause of medico-legal autopsy referrals (38.64%) [10], and Marri et al. reported RTAs as the predominant mode of accidental death in their cohort (47.89%) [15]. Survival period analysis (Table 3) revealed that 45.8% of victims died within 24 hours, underscoring the severity of injuries sustained. Falls from height showed the highest early mortality (61.9% within 24 hours), while occupational injuries were more frequently associated with prolonged survival, with 50.0% surviving beyond seven days. Patel et al. reported an even higher immediate mortality with 80.4% of victims dying at the scene [9], while Manoranjan et al. found 60% of victims died within 0–1 day [7].

Abrasions were the most frequent external injury (74.2%), followed by contusions (68.3%) and lacerations (61.7%) (Table 2). This pattern was consistent with findings reported Prasad et al. (89.62%) [12], and Rao et al., who documented abrasions in all RTA victims [13]. The ubiquity of abrasions reflected the frictional mechanisms inherent in vehicular collisions, including sliding contact with road surfaces and vehicle bodies.

The abdomen was the most frequently injured body region (75.8%), followed by the chest (65.8%) and head and neck (56.7%) (Table 2). This diverged from Ambade et al. [2], Manoranjan et al. [7], and Rao et al. [13], where head and neck injuries predominated, possibly reflecting a higher proportion of two-wheeler victims in those cohorts. The high frequency of injury across multiple body regions (Table 2) is consistent with the polytraumatic nature of fatal RTAs.

Rib fractures (52.5%) and skull fractures (36.7%) were the predominant bony injuries (Table 2). Patel et al. reported a substantially higher rate of skull fractures (87%) [9], a difference that may reflect greater representation of unhelmeted two-wheeler riders in that cohort. Yadav et al. found rib fractures in 41.3% [14] and Jiwane et al. documented rib fractures in 76.7% of victims [11], bracketing the present findings. The liver (60.8%) and small intestine (54.2%) were the most commonly injured internal organs (Table 2). Pati et al. similarly identified the liver as the most frequently affected organ in fatal RTAs [8], and Marak et al. documented liver involvement as the highest among abdominal injury cases [3].

Hemorrhagic shock was the leading cause of death (48.3%), and its distribution was consistent across all accident types (Table 4). Late deaths from septicemia (22.5%) and MOF (18.3%) were associated with hollow viscus perforations and prolonged hospitalization, a pattern also documented by Patel and Asawa [9] and Rao et al. [13]. These findings underscore the need for pre-hospital emergency care, rapid damage-control surgery, and targeted road safety enforcement in Haryana.

Limitations

The single-centre retrospective design limits generalizability. Selection bias is inherent, as the study captured only fatal cases and did not include survivors of comparable trauma for comparison.

Conclusion

Fatal accidental injuries in Haryana predominantly affected young working-age males, with road traffic accidents accounting for the vast majority of cases. The abdomen, chest, and head and neck were the most commonly injured body regions. Rib and skull fractures were the predominant bony injuries. The liver and small intestine were the most frequently injured internal organs. Hemorrhagic shock was the leading cause of death. These findings underscore the critical need for strengthened pre-hospital emergency response, early hemorrhage control, damage-control surgery, and robust road safety enforcement in the region.

Conflict of Interest: None declared.
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