

ORIGINAL ARTICLE

Comprehensive Analysis of Fatal Road Accidents: Patterns and Characteristics of Injuries in a Forensic Medicine Setting

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Abstract:

An accident is an occurrence that takes place suddenly, unexpectedly and unintentionally, often arising from unforeseen circumstances. Road traffic injuries (RTA/RTI) resulting in death, especially Motor Vehicle Traffic Accidents (MVTA), have been recognized as a concealed epidemic with global impact, affecting every segment of society. This study has been conducted at a tertiary care hospital, aimed to identify different patterns and distributions of injuries, with the goal of devising preventive measures for the future.

Keywords: Fatal injury; pattern of injury; RTA.

Introduction:

An accident is an event that occurs suddenly, unexpectedly and inadvertently under unforeseen circumstances. Death resulting from road traffic injuries (RTA/RTI), specifically Motor Vehicle Traffic Accidents (MVTA), has been globally characterized as a hidden epidemic that affects all sectors of society. The definition of a road traffic accident (RTA) entails "an accident which took place on road between two or more objects, one of which must be any kind of a moving vehicle."¹⁻³

William Haddon, the Head of the Road Safety Agency in the USA, has highlighted the complex nature of road accidents, emphasizing that they are linked to multiple issues that require individual attention, encompassing pre-event factors, post-event factors and those factors occurring during the event related to humans, vehicles and the environment, all of which interplay and influence the occurrence and outcome of traumatic events.

Furthermore, the process of globalization has contributed to an improvement in the socio-economic status of people all over the world. This, in turn, has led to significant changes in the lifestyle of individuals. However, along with these positive changes, there has also been an emergence of non-communicable diseases and accidents as prominent concerns within the healthcare delivery system. The broader impact of these changes has brought attention to the need for comprehensive strategies in managing road safety, encompassing preventive measures, post-accident care and addressing the overall health and well-being of individuals.^{3,4}

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This study was conducted at a tertiary care hospital with the aim of thoroughly examining and understanding the causative factors, patterns and distribution of injuries resulting from road accidents. The primary objective was to gather comprehensive data that would enable the formulation of effective measures to prevent such incidents in the future.

Aims & Objectives:

- To identify patterns of injuries arising out of fatal road traffic accidents.
- To interpret different causes of death found in different patterns of injury.

Material and methods:

To accomplish the aims, the researchers meticulously analyzed a wide range of variables associated with fatal road accidents presenting to the Department of Forensic Medicine and Toxicology, in MKCG Medical College, at Brahmapur. These variables included descriptions of human injuries, such as site (head, upper limb, lower limb, abdomen, pelvis, etc.), type of injury (like abrasion, laceration, contusion, crush etc.) during a 2 year period from August 2019 to July 2021.

By examining these factors in detail, the researchers sought to identify commonalities and trends among accident cases. This involved analyzing the types and severity of injuries sustained by the individuals involved, as well as the locations on body where the injuries occurred.

Observation:

During the study period, a total of 2,664 autopsies were conducted, with 350 of them (13.1%) attributed to road traffic accident (RTA) deaths. Table 1 provides an overview of the injury distribution among these 350 RTA deaths. Out of the 1,449 sites examined, the lower limb was the most frequently involved, accounting for 270 cases (77.14%), followed by the head in 262

Table 1. Site of injuries in fatal road traffic accident.

Site of injury	Total Count (1449)	Percentage out of 350	% out of 1449
Head	262	74.85%	18%
Maxilo-facial	200	57.14%	14%
Neck	40	11.42%	3%
Chest	134	38.28%	9%
Abdomen	137	39.14%	9%
Pelvic	38	10.85%	3%
Perineum	21	6.00%	1%
Upper limb	249	71.14%	17%
Lower limb	270	77.14%	19%
Back	98	28.00%	7%

a single system, with 176 males and 26 females. The head (including face) was the most frequently involved region, accounting for 78.21% of cases followed by the abdomen (10.89%), lower limb (6.43%), chest (2.47%) and spinal cord (1.53%) as shown in Table 2.

Table 3 reveals the most common organs involved in fatal road traffic accidents out of 350 cases. The liver (28.28%), lungs (24.57%) and brain (22.28%) were the top three involved organs. Spleen (10.28%), intestine (7.4%) and heart (6.57%) were also commonly affected. Spinal cord (6.00%), kidney (4.5%) and bladder (0.57%) were less frequently involved.

Among the 350 deaths, 262 individuals had head injuries, with contusion of the scalp observed in 253 cases (95.56%) and intracranial hematoma in 91.58% of those cases, as shown in Table 4. Skull fractures were present in 82.82% of the cases, while brain lacerations were found in 29.77% of cases. Interestingly, scalp abrasions were the least common, occurring in only 17 cases (6.48%). This highlights that internal injuries within the head are more prevalent than surface abrasions, with lacerations and contusions being common in the scalp region.

Table 5 shows that out of the total 350 deaths, chest injuries were observed in 134 cases. Internal injuries, including chest wall contusion and associated rib fractures, were present in 79.85% and 70.89% of cases, respectively. Fatal chest injuries involved lung contusion or laceration in 64.17% of cases and heart contusion or laceration in 17.16% of cases. External injuries primarily consisted of abrasions, present in 54.44% of cases, followed by grazed abrasions in 17.16% of cases.

Abdominal and pelvic injuries were present in 175 of 350 deaths, i.e., 50 %, as shown in Table 6. In internal injuries, damage to liver was most common (99 cases) i.e. 56.57%, following injury to spleen i.e., in 35 cases or 20.57 %. Following which the 35 cases of pelvic fracture i.e., 20.57 % and 26 cases of intestinal loop injury i.e., 14.85 % and 22 cases of injury to mesentery i.e., 22 cases or 12.57%. Injury to kidney was present in 16 cases i.e., 9.14%.

In external injuries, abrasion was most commonly evident, a simple abrasion being present in 49 cases i.e, 28.0 % followed by grazed abrasions in 26 cases or 14.85%, injury to perineum was present in 18 cases i.e., 10.27%.

In Table 7, the analysis of 860 cases reveals the distribution of extremity injuries. The most common type of injury observed was abrasion, accounting for 31.51% of cases, followed by grazed abrasions (8.25%), contusions (3.48%) and lacerations (18.72%). Severe injuries included fracture dislocations, with the ankle joint being involved in 1.74% of cases, followed by the knee joint (2.55%), hip joint (2.44%), wrist joint (1.27%), elbow joint (0.81%) and shoulder joint (1.97%). Fractures were also observed in specific bones, including the hand (1.27%), forearm (3.13%), arm (3.13%), foot (1.80%), leg (7.44%) and thigh (7.20%). Additionally, 3.13% of cases involved crush injuries.

Discussion:

Distribution of injuries : Out of the total 350 deaths resulting from road traffic accidents (RTA), 1449 injury sites were observed on the deceased bodies, including both fatal and non-

Table 2. Sites of fatal injuries in fatal mono-trauma road traffic accident.

Site of fatal injury	Total count (202)	Percentage	Female (26)	Male (176)
Head	158	78.21%	20	138
only abdominal injury	22	10.89%	3	19
only lower limb	13	6.43%	-	5
only chest injury	5	2.47%	3	10
only pelvic injury	3	1.48%	-	3
only spinal cord injury	1	1.53%	-	1

Table 3. Distribution of visceral injury in fatal road traffic accident.

Type of viscera	Total count (350)	Percentage (%)
Liver injury	99	28.28
Contusion/laceration of lungs	86	24.57
Contusion/laceration of brain	78	22.28
Spleen injury	36	10.28
Intestine loop injury	26	7.4
Contusion/laceration of heart	23	6.57
Contusion/laceration of Spinal Cord	21	6.00
Kidney injury	16	4.5
Bladder injury	2	0.57

Table 4. Pattern of injury on head in fatal road traffic accident.

Pattern of head injury	Total count 262	Percentage (%)
Abrasion of scalp	17	6.48
Contusion of scalp	253	96.56
Laceration of scalp	143	54.58
Intracranial hematoma	240	91.06
Brain laceration	78	29.77
Skull fracture	217	82.82
Crush injury	24	9.16

Table 5. Pattern of injury in chest (thorax) in fatal road traffic accident.

Pattern of chest injury		Total Count 134	Percentage (%)
Abrasion	External injury	73	54.44
Grazed abrasion		23	17.16
Laceration		17	12.68
Crush injury	Internal injury	12	8.95
Contusion of chest wall		107	79.85
Rib fracture		95	70.89
Sternum fracture		42	31.34
Clavicle fracture		19	14.17
Contusion or laceration of lungs		86	64.17
Contusion or laceration of heart		23	17.16

cases (74.85%), the upper limb in 249 cases (71.14%) and the maxillofacial region in 200 cases (57.14%). Chest and abdomen injuries were observed in 38.28% and 39.14% of cases respectively. Neck injuries were present in only 40 cases (11.42%), pelvic injuries in 38 cases (10.85%) and injuries to the perineum were the least common, occurring in 21 cases (6%).

Among the 350 RTA deaths, 202 were attributed to fatal injury to

Table 6. Pattern of injury on abdomen & pelvis in fatal road traffic accident.

Pattern of abdominal and pelvic injury	Category	Total count (175)	Percentage (%)
Abrasion	External Injury	49	28.00
Grazed abrasion		26	14.85
Contusion		15	8.57
Laceration		25	14.28
Crush injury	Crush Injury	12	6.85
Intestine loop injury	Internal Injury	26	14.85
Mesentery injury		22	12.57
Kidney injury		16	9.14
Liver injury		99	56.57
Spleen injury		36	20.57
Pelvic fracture		35	20
Bladder injury		2	1.14
Perineum		Miscellaneous	18

fatal injuries. The lower limbs were involved in 270 cases (77.14%), making it the most frequently affected body part. The head was involved in 262 cases (74.85%), followed by the upper limbs in 249 cases (71.14%), and the maxillofacial region in 200 cases (57.14%). The chest and abdomen were affected in 38.28% and 39.14% of cases, respectively. The neck was involved in 40 cases (11.42%) and the pelvis in 38 cases (10.85%). The perineum was the least affected region, with only 21 cases (6%).

Distribution of injuries in fatal "mono-trauma": Among the 202 deaths caused by fatal injuries to a single body system, the head (including face) was the most frequently affected region, accounting for 78.21% of cases (158 cases). The abdomen was involved in 22 cases (10.89%), while the lower limbs were affected in 13 cases (6.43%). Chest injuries were observed in 5 cases (2.47%) and only 1 case (0.49%) involved the spinal cord. These findings are consistent with similar studies, where the head was most commonly affected (60%), followed by the abdomen (18%) and the chest (6%).⁵ Another study reported the highest number of injuries in the head and face region (71.69%), with lower extremity injuries accounting for only 3.77% and chest injuries at 1.88%.⁶

Distribution of visceral injury: According to this study, the most commonly involved organ in fatal road traffic accidents out of 350 cases was the liver, accounting for 28.28% (99 cases). This was followed by the lungs at 24.57% (86 cases), the brain at 22.28% (78 cases), the spleen at 10.28% (36 cases), the intestine at 7.4% (26 cases), the heart at 6.57% (23 cases), the spinal cord at 6.00% (21 cases), the kidneys at 4.5% (16 cases), and the bladder at 0.57% (2 cases).

In a study conducted by Farooqui et al.(2013), it was found that the highest organ involvement was in the brain at 38.61%, followed by the lungs at 12.37%, the liver at 11.88%, the heart at 7.92%, and the spleen at 5.94%.⁷ These findings differ from my study, which may be due to the fact that their study focused only on rural areas, whereas my study included both urban and rural areas.

Pattern of head injury: In this study, head injuries were identified in 262 out of a total of 350 deaths. Contusions of the scalp were present in 253 cases, accounting for 95.56% of the head injury

Table 7. Pattern of injury to extremities in fatal road traffic accident.

Pattern of extremities injury	Total count (860)	Percentage
Abrasion	271	31.51
Grazed abrasion	71	8.25
Contusion	30	3.48
Laceration	161	18.72
Fracture dislocation of ankle joint	15	1.74
Fracture dislocation of knee joint	22	2.55
Fracture dislocation of hip joint	21	2.44
Fracture dislocation of wrist joint	11	1.27
Fracture dislocation of elbow joint	7	0.81
Fracture dislocation of shoulder joint	17	1.97
Fracture of hand bone	11	1.27
Fracture of forearm bone	27	3.13
Fracture of arm bone	27	3.13
Fracture of foot bone	16	1.8
Fracture of leg bone	64	7.44
Fracture of thigh bone	62	7.20
Crush injury	27	3.13

cases. Intracranial hematomas were found in 240 cases (91.58%), while skull fractures were observed in 217 cases (82.82%). Lacerations in the brain were present in 78 cases (29.77%). The lowest incidence was recorded for scalp abrasions, which were found in only 17 cases (6.48%).

In a study by Kumar et al. (2008), the most common type of intracranial hemorrhage was subdural hemorrhage (89.11%), followed by subarachnoid hemorrhage (72.98%). Extradural hemorrhage was present in 20.25% of cases.⁸ Additionally, skull fractures were found in 69.63% of head injury cases, which is similar to the findings of this study.

Pattern of chest injury: In this study, out of the total 350 deaths, 134 cases involved chest injuries. External injuries were predominantly abrasions (54.44%), followed by grazed abrasions (17.16%) and lacerations (12.68%). Fractures were most commonly observed in the ribs (70.89%), followed by the sternum (31.34%) and clavicle (14.17%). These findings align with a study by Patil et al. (2017), where similar proportions of abrasions (52.50%), lacerations (16.25%), rib fractures (64.71%), sternum fractures (21.85%) and clavicle fractures (9.24%) were reported.⁹

Regarding internal injuries, contusions or lacerations of the lungs (64.17%) and the heart (17.16%) were frequently observed. The study by Patil et al. (2017) also found lung injuries in 53.40% of cases and heart injuries in 30.10%, which aligns with the findings of this study.⁹

Pattern of abdominal injury: In this study, abdominal and pelvic injuries were identified in 175 out of a total of 350 deaths. Among the internal injuries, the most common organ affected was the liver (56.57%), followed by the spleen (20.57%), intestinal loops (14.85%), mesentery (12.57%) and kidneys (9.14%). In contrast, a study by Patil et al. (2007) reported different percentages for organ injuries, with the liver affected in 31.45% of cases, the spleen in 11.27%, intestinal loops in 5.15%, mesentery in 7.51%, and the kidney in 21.13%. The variation in findings could be attributed to the fact that in the study by Patil et al. (2007), the percentages were calculated based on the total number of injuries,

while in our study, the percentages were calculated based on the total number of deaths.⁹ However, the order of organs involved, from most common to less common, is generally similar between the two studies.

Conclusion:

The study analyzed 350 deaths from road traffic accidents, with 202 deaths attributed to fatal injury to a single system. The head was the most frequently involved region, consistent with previous studies. The liver was the most commonly affected organ in abdominal and pelvic injuries, followed by the spleen, intestinal loops, mesentery and kidneys. Findings related to head and chest injuries align with previous studies, highlighting consistent patterns. Understanding these injury patterns can inform preventive measures and medical interventions to reduce the severity and fatality of road traffic accidents.

Conflict of interest : Nil.

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Ethical clearance: Yes.

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