

Sociodemographic Characteristics and Injury Patterns in Fatal Road Traffic Accidents: An Autopsy Study from Traffic Light Free City of Southeast Rajasthan

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Abstract: ***Background:** Road traffic accidents (RTAs) constitute a major public health problem in India, causing significant morbidity, mortality, and economic loss, particularly among the working-age population. **Aim:** To study the injury patterns and sociodemographic characteristics of victims of fatal RTAs in Southeast Rajasthan. **Methodology:** This cross-sectional autopsy-based study included 90 cases of fatal road traffic accidents brought for medico-legal autopsy at Government Medical College, Kota. Data regarding demographic profile, injury characteristics, and circumstances of accidents were collected using a structured proforma and analyzed using descriptive statistics. **Results:** The majority of victims were male (88.9%), with the highest proportion in the 31-40-year age group (21.1%). Two-wheeler riders constituted the most affected group (58.9%). Head injury was the leading cause of death (57.8%). Most deaths occurred within 1-3 days of hospitalization. **Conclusion:** Fatal RTAs predominantly affect economically productive age groups, with two-wheeler users being particularly vulnerable. Strengthening traffic safety measures and improving trauma care services may reduce mortality.*

Keywords: Road traffic accidents, injury pattern, autopsy, fatality, sociodemographic factors

1. Introduction

Road traffic accidents (RTAs) in India constitute a significant public health and societal issue, leading to substantial human suffering and economic detriment. These incidents result in untimely fatalities, injuries, and diminished earning potential, thereby impacting individuals, families, and the broader economy, especially the working-age demographic (1, 2).

According to the Fatality Analysis Reporting System (FARS), fatal traffic collisions are characterized as occurrences involving a motor vehicle on a public roadway that culminate in the death of an occupant or non-occupant within 30 days following the incident (3).

India, a country experiencing swift development and economic advancement, encounters considerable challenges associated with adverse traffic conditions. The rapid increase in motorization and urbanization has contributed to a surge in road traffic accidents, traffic-related injuries, and fatalities (4). In 2022, States and Union Territories in India documented nearly 4.61 lakh road accidents, leading to approximately 1.68 lakh deaths and injuries to around 4.43 lakh individuals (5).

While the phrase “road traffic accident” implies an unforeseen occurrence, many of these incidents are preventable and frequently linked to human error, non-adherence to traffic regulations, driver distraction or fatigue, substandard road conditions, the presence of stray animals, insufficient lighting, and driving under the influence of alcohol or drugs (6-9). As a result, a significant portion of

these accidents can be averted through suitable interventions.

Thus, the current study aimed to investigate the injury patterns associated with fatal road traffic accidents to identify the most prevalent and severe types of injuries. The research also intended to analyze the sociodemographic characteristics of victims to enhance the understanding of risk factors and vulnerable groups. The outcomes are designed to aid in the allocation of medical resources, enhance emergency response strategies, and inform the creation of targeted prevention initiatives.

This research holds significant importance in Southeast Rajasthan, an area where traffic management systems are scarce and adherence to traffic laws is insufficient. The findings produced may aid in the formulation of better safety policies, the advancement of infrastructure, and the increase of public awareness, ultimately contributing to a decrease in fatal road traffic accidents.

2. Aim and Objectives

Aim

To study the pattern of injuries sustained in fatal road traffic accidents in the southeast region of Rajasthan, an area with limited traffic control systems and a rapidly growing population. The study also aimed to generate evidence to support preventive measures for reducing fatalities and improving road safety.

Objectives

- 1) To systematically examine the injury patterns resulting from fatal road traffic accidents (RTAs).
- 2) To analyze the sociodemographic characteristics of victims and identify vulnerable groups.
- 3) To determine the most prevalent and severe types of injuries in fatal RTAs.

3. Methodology

The present cross-sectional study was conducted after obtaining prior approval from the Institutional Ethics Committee. Consent from the closest relatives of the deceased individuals was obtained before inclusion in the study.

Sample of study

The study included 90 cases of fatal road traffic accidents brought for medico-legal post-mortem examination. Cases were selected based on predefined inclusion and exclusion criteria.

Inclusion criteria

- Cases involving alleged road traffic accidents brought to the mortuary for post-mortem examination.
- Cases must have no indication of suspected foul play, with the cause of death solely attributed to road traffic accidents as per police reports.
- Cases where informed consent is obtained.

Exclusion criteria

- Cases other than road traffic accidents brought to the mortuary for post-mortem examination.
- Cases with decomposed corpses of road traffic accident victims.
- Cases with any indication of suspected foul play, or where the cause of death is attributed to factors other than road traffic accidents as per police reports.
- Cases involving unknown dead bodies.
- Cases where informed consent is not obtained.

Method of study

Step 1. Before starting the study approval of Principal & Controller of the Institute and Institutional Ethical Committee was taken.

Step 2. Consent from the closest relative of the deceased individual was also obtained for the study.

Step 3. The study comprised 90 cases involving alleged road traffic accidents brought to the mortuary for post-mortem examination. Cases fulfilling the specific criteria of the study were included.

Step 4. Relatives of the deceased individual were assured that the information revealed by them would be kept confidential and used for research purposes only.

Step 5. Post-mortem examinations were conducted on identified deceased bodies in the mortuary. Before and during the conduction of post-mortem examinations, data were collected using a pre-designed semi-structured proforma.

Step 6. The proforma comprised relevant data such as the date of the post-mortem examination, name, age, sex, occupation, time since death, socio-demographic factors, type of vehicle, pattern and distribution of injuries involving

external and internal parts of the deceased's body, and cause of death.

Step 7. This information was noted in a pre-validated proforma designed for the study.

Step 8. Types of injuries, such as abrasions, contusions, lacerations, fractures, and other injuries, were recorded.

Step 9. Lacerations included stitched wounds, crushed lacerated wounds, and avulsed lacerated wounds.

Step 10. Swellings with visible deformities were included in the "other" type of injuries category.

Step 11. The data thus obtained were subjected to further suitable statistical analysis.

Biomedical Waste Disposal:

All the biomedical waste generated during this study was discarded as per the Biomedical Waste Management and Handling Rules, 2016 (10).

4. Observation and Results

Among the 90 victims who met our inclusion criteria, the majority were in the age group of 31-40 years, accounting for 21.1% (19), followed closely by those aged 51-60 years at 20% (18). (Table 1). Out of the total, 80 were male and only 10 were female, resulting in a male to female ratio of 8:1. (Table 2). The distribution of victims was nearly equal between rural and urban areas, with 45.6% from rural regions and 54.4% from urban regions. (Table 3). Our research indicates that the majority of incidents occurred in the afternoon and evening, accounting for 31.1%, and this distribution is nearly uniform across all quarters of the day: morning, afternoon, evening, and night. (Table 4)

The majority of the victims passed away during the treatment period of 1 to 3 days. Additionally, 24.4% of the victims were brought in dead upon arrival at the hospital, while 21.1% succumbed after receiving treatment for more than 7 days. (Table-5). Our research indicates that 58.9% of the victims were on two-wheelers, while 13.3% were pedestrians, and 1% were heavy vehicle drivers only. (Table-6). In many instances, the specific vehicle that struck the deceased was not identified, accounting for 25.6% of cases, while 16.7% of the deceased were hit by a car. Additionally, 20% of the deceased suffered from self-inflicted falls. (Table-7) A significant 57.8% of fatalities were attributed to head injuries, followed by 18.9% due to polytrauma. (Table-8) During the autopsy, the injury patterns of the victims were examined and categorized by body parts. It was noted that the majority of injuries were located on the head, comprising 21.9%, followed by injuries to the facial region at 15.9%. (Table-9). The analysis of injury patterns reveals that the majority of cases involved only abrasions, accounting for 43.2% of instances. Lacerations were noted in 18.7% of cases, while a combination of abrasion, laceration, and fracture was observed in 8.1% of cases (Table-10). In 73 instances, Brain was associated solely with hemorrhages, contusions, and a combination of haemorrhagic contusions and contused lacerations. (Table-11).

Mean Age- 41.83±16.41

Table 1: Age-Groups of participants (n=90)

| Age Groups | Total (%) |
|------------|------------|
| 0-10 | 1 (1.1%) |
| 11-20 | 9 (10%) |
| 21-30 | 15 (16.7%) |
| 31-40 | 19 (21.1%) |
| 41-50 | 17 (18.9%) |
| 51-60 | 18 (20%) |
| 61-70 | 8 (8.9%) |
| 71-80 | 2 (2.2%) |
| 81-90 | 1 (1.1%) |

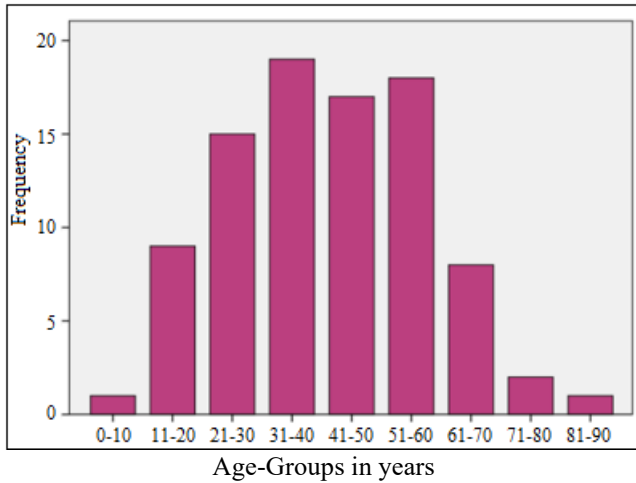


Table 2: Gender Distribution

| Gender | Total (%) |
|--------|------------|
| Male | 80 (88.9%) |
| Female | 10 (11.1%) |

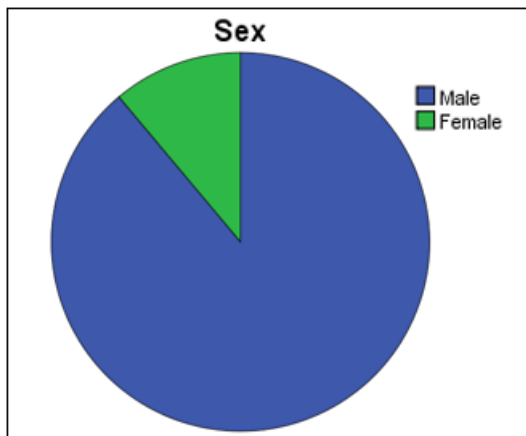


Table 3: Domicile of participants

| Domicile | Total (%) |
|----------|------------|
| Rural | 41 (45.6%) |
| Urban | 49 (54.4%) |

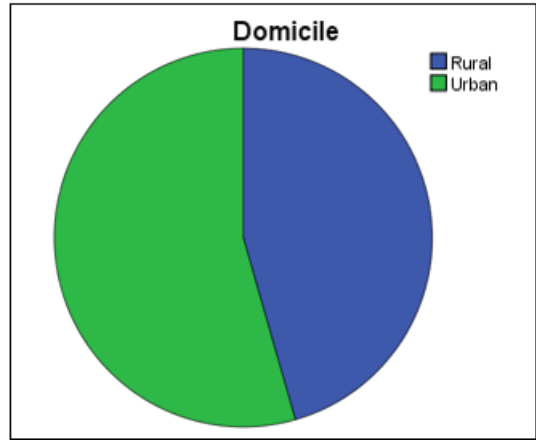


Table 4:

| Time of Accident | Total (%) |
|------------------|------------|
| Morning | 16 (17.8%) |
| Afternoon | 28 (31.1%) |
| Evening | 28 (31.1%) |
| Night | 18 (20.0%) |

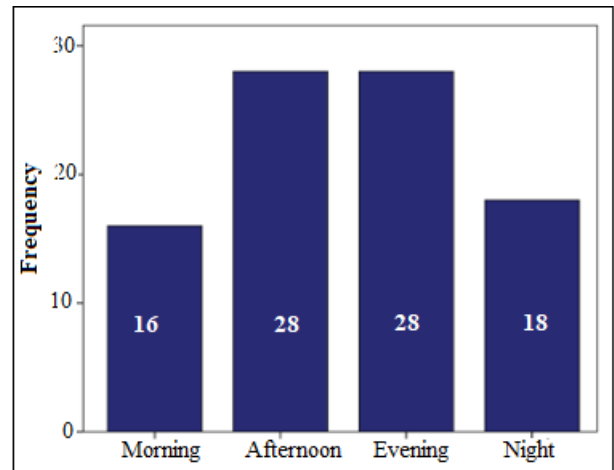


Table 5:

| Time of Hospitalization | Total (%) |
|-------------------------|------------|
| Br Dead | 22 (24.4%) |
| 1-3 days | 35 (38.9%) |
| 5-7 days | 14 (15.6%) |
| >7 days | 19 (21.1%) |

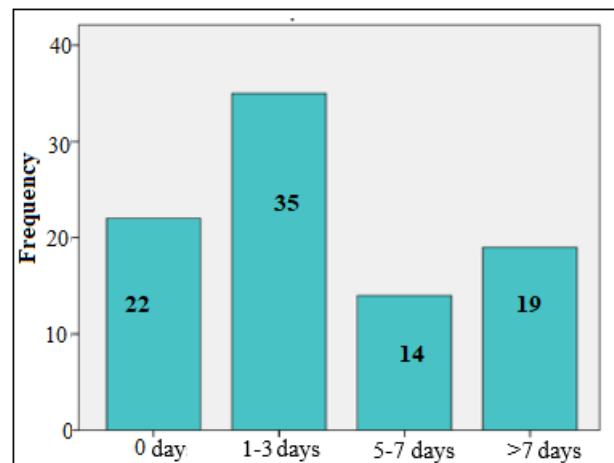


Table 6

| Position of Victim | Total (%) |
|-------------------------|------------|
| Pedestrian | 12 (13.3%) |
| Heavy Vehicle-Passenger | 4 (4.4%) |
| 2W-Driver | 53 (58.9%) |
| 4W-Driver | 9 (10.0%) |
| Heavy Vehicle-Driver | 1 (1.1%) |
| 2W-Passenger | 7 (7.8%) |
| 4W-Passeger | 4 (4.4%) |

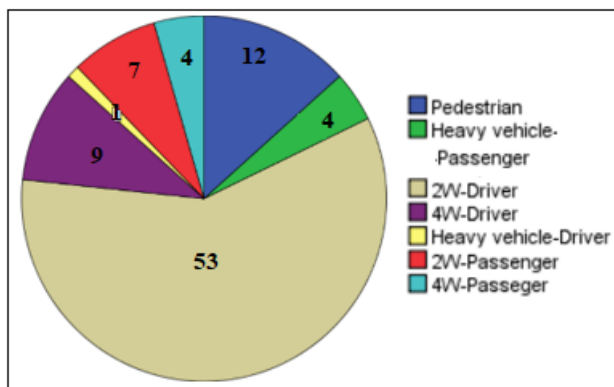


Table 7

| Hit by | Total (%) |
|--------------------|------------|
| Animal | 4 (4.4%) |
| Auto | 1 (1.1%) |
| Bike | 5 (5.6%) |
| Bus | 2 (2.2%) |
| Car | 15 (16.7%) |
| Heavy vehicle | 6 (6.7%) |
| JCB | 1 (1.1%) |
| Loading vehicle | 1 (1.1%) |
| NA (Not Available) | 23 (25.6%) |
| Pole | 1 (1.1%) |
| Road divider | 2 (2.2%) |
| Self fall | 18 (20.0%) |
| Trailer vehicle | 2 (2.2%) |
| Tree | 2 (2.2%) |
| Truck | 4 (4.4%) |
| Vehicle (unknown) | 3 (3.3%) |

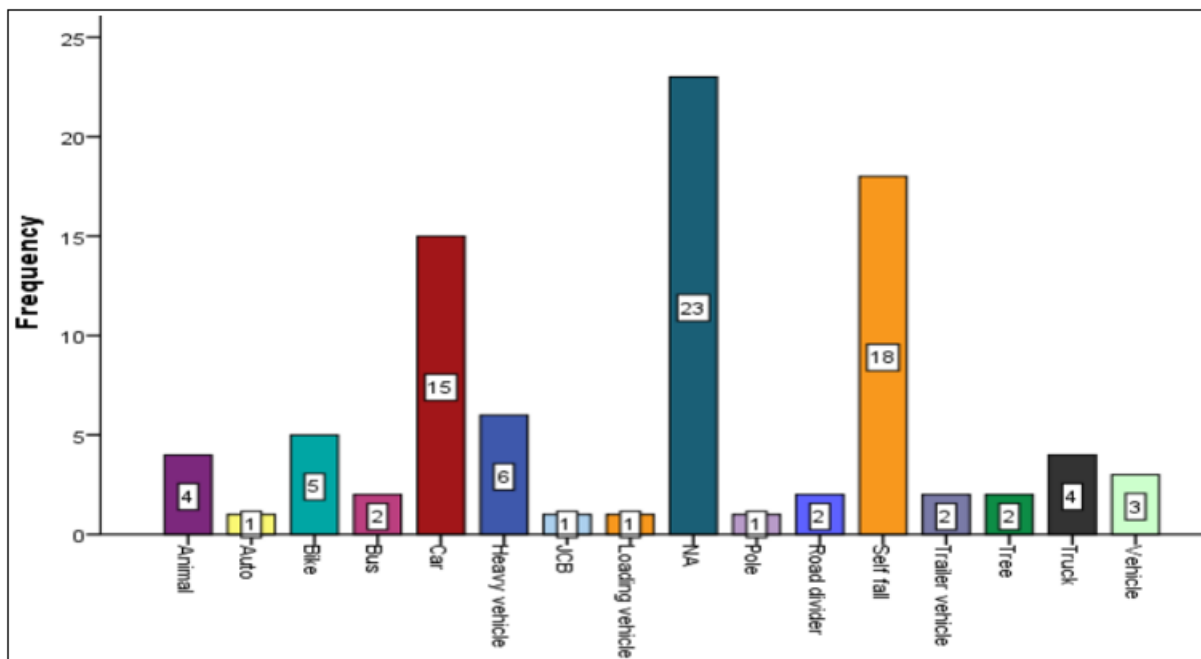


Table 8

| Cause of death | Total (%) |
|----------------|------------|
| Head | 52 (57.8%) |
| Abdomen | 4 (4.4%) |
| Chest | 7 (7.8%) |
| Pelvic | 3 (3.3%) |
| Polytrauma | 17 (18.9%) |
| Septicaemia | 3 (3.3%) |
| Shock | 2 (2.2%) |
| Others | 2 (2.2%) |

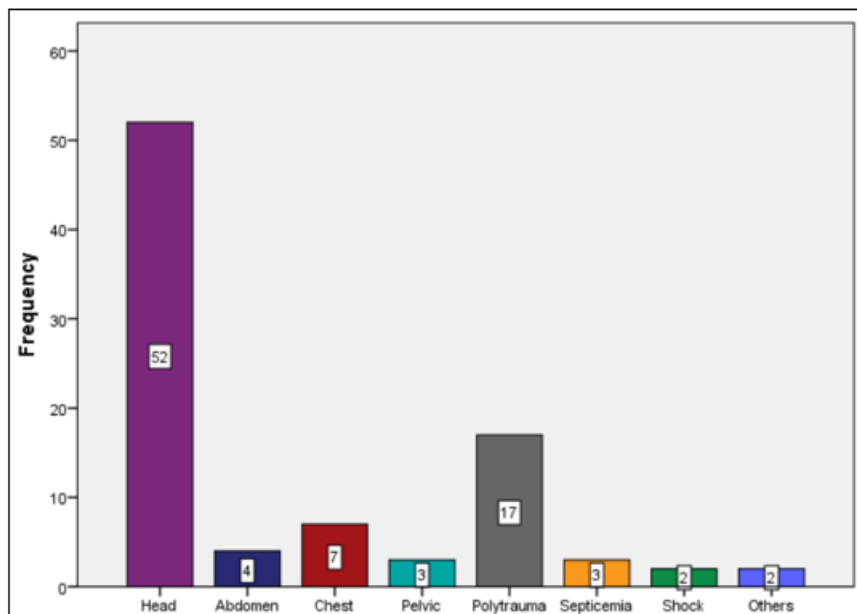


Table 9

| | Frequency | Percent |
|-------------------------|-----------|---------|
| Head injury | 76 | 21.9 |
| Face injury | 55 | 15.9 |
| Neck injury (Cervical) | 3 | .9 |
| Thorax injury | 40 | 11.5 |
| Abdomen injury | 16 | 4.6 |
| Pelvic injury | 23 | 6.6 |
| Left upper limb injury | 36 | 10.4 |
| Right upper limb injury | 32 | 9.2 |
| Left lower limb injury | 35 | 10.1 |
| Right lower limb injury | 31 | 8.9 |
| Total | 347 | 100.0 |

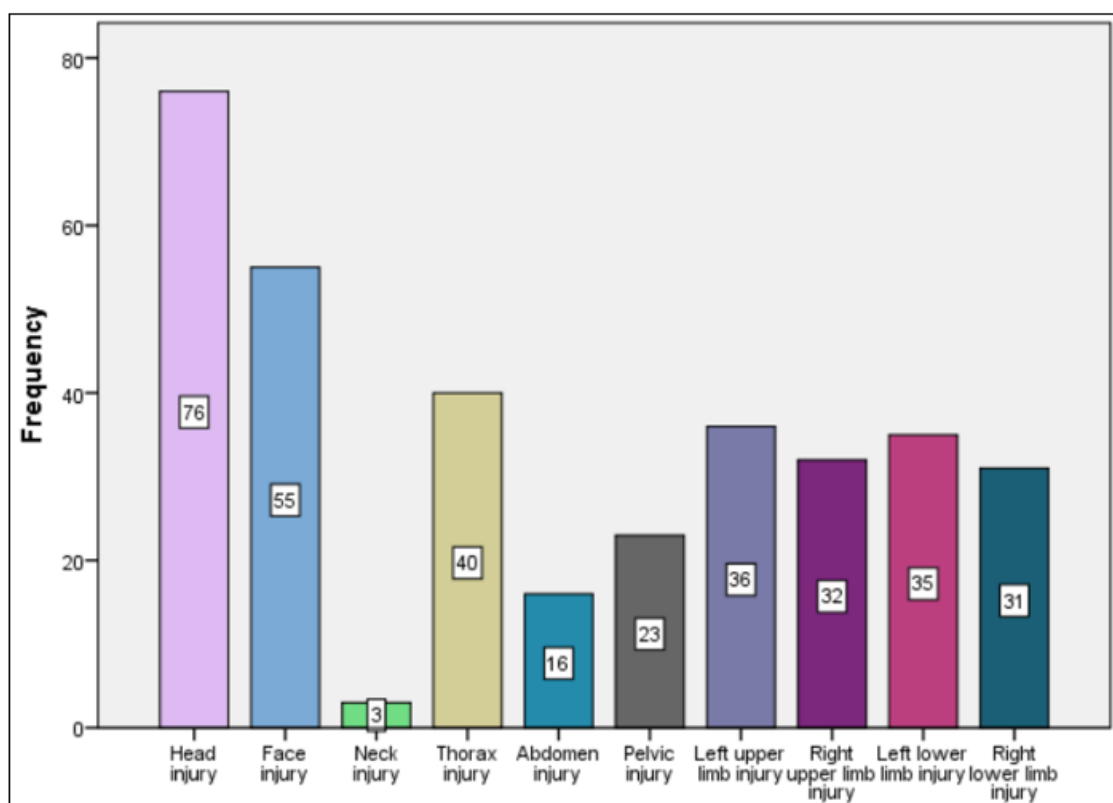


Table 10

| Pattern of injury | Frequency | Percent |
|--|-----------|---------|
| Abrasion | 150 | 43.2 |
| Contusion | 4 | 1.2 |
| Laceration | 65 | 18.7 |
| Perforation | 1 | .3 |
| Penetration | 1 | .3 |
| Fracture/Dislocation | 13 | 3.7 |
| Abrasion+ Contusion+ Laceration+ Fracture | 5 | 1.4 |
| Abrasion+ Laceration+ Fracture | 28 | 8.1 |
| Abrasion+ Fracture | 20 | 5.8 |
| Abrasion+ Laceration | 20 | 5.8 |
| Laceration+ Fracture | 21 | 6.1 |
| Laceration+ Perforation | 3 | .9 |
| Abrasion+ Contusion+ Fracture | 1 | .3 |
| Contusion+ Laceration+ Perforation | 1 | .3 |
| Abrasion+ Contusion+ Laceration+ Perforation | 1 | .3 |
| Abrasion+ Contusion+ Laceration | 1 | .3 |
| Contusion+ Fracture | 3 | .9 |
| Contusion+ Laceration | 4 | 1.2 |
| Abrasion+ Contusion | 5 | 1.4 |
| Total | 347 | 100.0 |

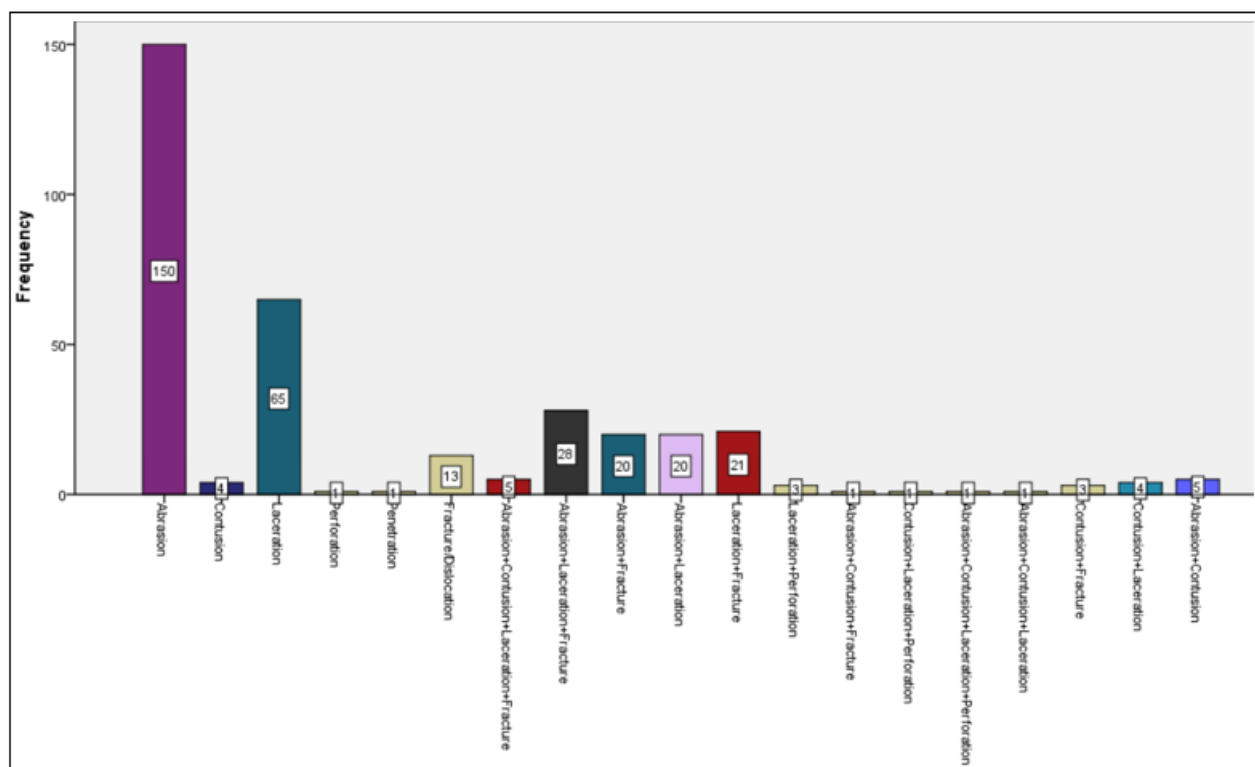
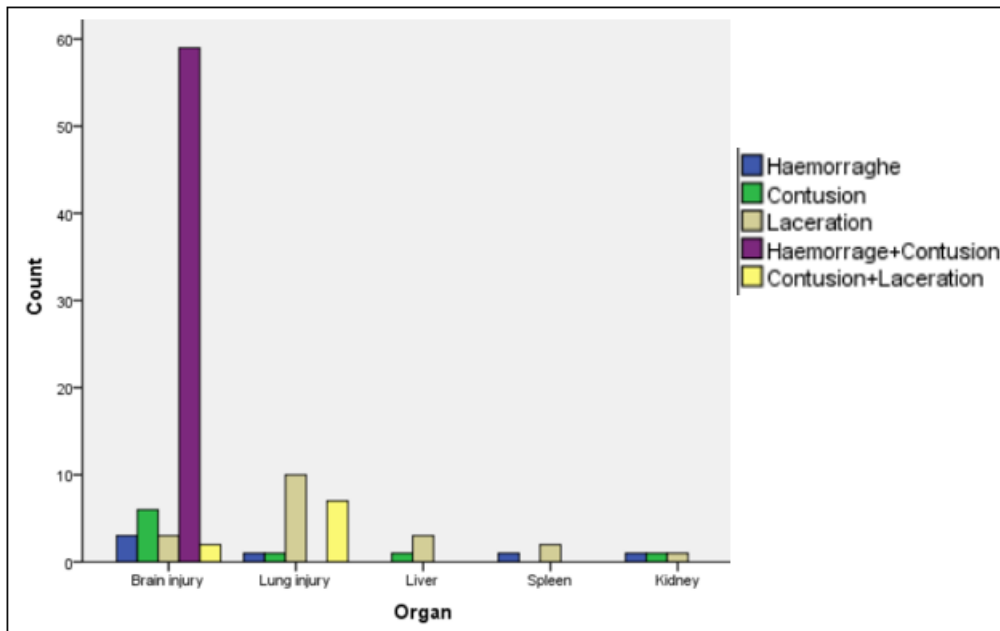


Table 11:

| | Haemorrhage | Contusion | Laceration | Haemorrhage+ Contusion | Contusion+ Laceration | |
|--------------|-------------|-----------|------------|------------------------|-----------------------|-----|
| Brain injury | 3 | 6 | 3 | 59 | 2 | 73 |
| Lung injury | 1 | 1 | 10 | 0 | 7 | 19 |
| Liver | 0 | 1 | 3 | 0 | 0 | 4 |
| Spleen | 1 | 0 | 2 | 0 | 0 | 3 |
| Kidney | 1 | 1 | 1 | 0 | 0 | 3 |
| | 6 | 9 | 19 | 59 | 9 | 102 |



5. Discussion

Worldwide, approximately 1.2 million fatalities occur annually due to road traffic accidents (RTAs), with nearly 90% of these deaths reported in low- and middle-income countries.¹¹ The Asia-Pacific region accounts for 54% of the global population but possesses only 16% of the world's vehicles, while contributing to 44% of RTA-related deaths.¹²

In the present study, among 90 victims meeting the inclusion criteria, the highest proportion belonged to the 31–40 years age group (21.1%), followed by the 51–60 years age group (20%). Shamim¹³ reported that the majority of victims were in the 21–30 years age group, which differs from our findings. However, Farooqui et al.¹⁴ observed that most victims were aged 30–39 years, which is consistent with our results. The predominance of younger and middle-aged individuals may be attributed to their increased mobility, occupational exposure, and frequent use of personal or public transportation. These age groups are more vulnerable to RTAs due to greater outdoor activity and travel requirements.¹⁵

Gender distribution in the present study showed a marked male predominance, with 80 males and 10 females (male:female ratio = 8:1). Singh et al.¹⁶ reported a ratio of 3:1, whereas findings by Farooqui et al.¹⁴ and Shamim¹³ showed results comparable to the present study. The higher incidence of RTAs among males may be attributed to greater exposure to outdoor activities, risk-taking behaviour, speeding, reckless driving, and driving under the influence of alcohol or without protective measures.^{17–20} Additionally, males are more frequently employed in occupations requiring travel and are often primary earners, making their loss associated with significant socioeconomic consequences for families.²¹

The distribution of victims was nearly equal between rural (45.6%) and urban (54.4%) areas. Few studies have reported such comparative distribution. Improved infrastructure, increased rural connectivity, and enhanced economic

activity in rural areas may explain the comparable incidence in both settings.

The temporal distribution of RTAs showed a higher incidence during afternoon and evening hours (31.1%), although cases were relatively evenly distributed throughout the day. This increased incidence may be related to peak traffic hours, commuting patterns, fatigue, and social activities, including alcohol consumption during evening hours.

Regarding survival period, most victims died within 1–3 days of treatment, while 24.4% were brought dead and 21.1% survived for more than seven days before death. The availability of emergency ambulance services may facilitate hospital access; however, delays in primary management and inadequate emergency care facilities may contribute to mortality within the initial days following injury.

In the present study, 58.9% of victims were two-wheeler riders, followed by pedestrians (13.3%), whereas heavy vehicle drivers constituted only 1% of cases. Shamim¹³ also reported a predominance of two-wheeler victims (73.5%). In contrast, Singh et al.¹⁶ reported a higher proportion of four-wheeler occupants, possibly due to their urban study setting where four-wheelers are more common. Poor compliance with safety measures such as helmet and seat-belt use, speeding, and negligent driving practices contribute significantly to RTA incidence.

In 25.6% of cases, the offending vehicle could not be identified, while 16.7% of victims were struck by cars and 20% experienced self-fall incidents. The high proportion of unidentified vehicles may reflect hit-and-run cases, particularly in areas lacking adequate surveillance systems.

Head injury was the most common cause of death (57.8%), followed by polytrauma (18.9%). Similar findings were reported by Shamim,¹³ Farooqui et al.,¹⁴ and Singh et al.,¹⁶ indicating that the head remains the most vulnerable region in RTAs and highlighting the importance of protective measures.

Autopsy findings showed that injuries were most frequently observed on the head (21.9%), followed by facial injuries (15.9%). This distribution correlates with the predominance of two-wheeler accidents and inadequate use of protective gear. Abrasions were the most common type of injury (43.2%), followed by lacerations (18.7%) and combined injuries including abrasions, lacerations, and fractures (8.1%). Shamim¹³ and Singh et al.¹⁶ reported lacerations as the predominant injury, whereas Farooqui et al.¹⁴ observed abrasions as the most frequent, consistent with our findings. These injuries primarily result from primary and secondary impact forces and contact with blunt road surfaces.

Brain examination revealed hemorrhages, contusions, and hemorrhagic contusions in the majority of cases, indicating severe cranio-cerebral trauma. Similar observations were reported by Farooqui et al.,¹⁴ Singh et al.,¹⁶ and other studies.²²⁻²⁹ These findings further emphasize that head injuries constitute the leading cause of mortality in fatal RTAs and underline the need for strict enforcement of preventive measures and road safety regulations.

6. Conclusion

Research findings reveal that most fatalities from road traffic accidents (RTA) involving two-wheelers occur within 1 to 3 days of hospitalization, with head injuries identified as the primary cause of death. The patterns of injuries related to road traffic incidents in this city are distinct from those seen in other urban areas, providing critical insights for the development of policies aimed at improving prevention and control strategies. It is noteworthy that this city traffic lights free city and major intersections are not equipped with speed breakers, contributing to the occurrence of RTAs. There is an urgent requirement for protective measures targeting three key vulnerable groups: two-wheeler users. To achieve effective outcomes, traffic safety policies in the city must be based on local evidence and research, specifically designed to fit the unique social, political, and economic conditions of the region. In particular, these policies should focus on safeguarding economically disadvantaged individuals, who are disproportionately affected by road traffic accidents due to the presence of vehicles and unprotected road users sharing the same roadways, among other factors. It is essential to promote collaboration to enhance knowledge sharing among individuals regarding effective policies that can significantly reduce the injury burden associated with road traffic accidents. Law enforcement agencies and the media ought to collaborate in informing the public about the utilization of safety devices and the regulations governing road usage.

Source of support: Nil

Conflict of interest: Nil

Ethical clearance:

Taken from the institute. Vide letter no. IEC, Govt Medical College Kota vide letter no F.3()Acad.ethical/Clerance/2024/07 dated 27/09/24 (Letter is attached)

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