Original Article

Epidemiology and Outcomes of Emergency Trauma Cases on a South-Indian National Highway Hospital: A Prospective Observational Study

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Abstract

Background: Trauma causes substantial morbidity and mortality worldwide, especially in low- and middle-income countries (LMIC) like India. Trauma in LMICs accounts for 45 million mortalities every year, of which 54% could be prevented by proper prehospital care. The study aimed to evaluate the trauma patterns and outcomes in a South Indian highway Emergency Department. **Materials and Methods:** This prospective observational study was conducted between June 2023 and May 2024 in Emergency department of Government Chengalpattu Medical College Hospital. Demographics, injury type, GCS, ISS, timing, protective gear, alcohol, outcomes and other details were recorded. **Results:** The study analysed 7,943 trauma cases (29% of Emergency Department admissions), focusing on demographic trends, injury patterns, and outcomes. The majority of trauma patients (80%) were aged 19–59 years, with male predominance (80%). Road traffic accidents (RTAs) constituted 64.9% of trauma cases, followed by assaults (13%) and self-fall injuries (7.2%). Notably, 92.7% of two-wheeler victims and 95% of four-wheeler victims lacked protective gear, correlating with higher injury severity. Among RTAs, 36% of fatalities occurred between 4 PM and 9 PM, with alcohol involvement noted in 64.3% of RTA deaths. Geriatric trauma patients (>59 years) represented 11% of admissions but accounted for 29% of deaths, highlighting their vulnerability. Polytrauma (6.7%) and traumatic brain injuries (11.29%) were associated with poor outcomes, with 59% of fatalities observed in patients with Glasgow Coma Scale (GCS) < 9. **Conclusion**: This study highlights the importance of addressing risk factors, such as drunk driving and safety measures, along with trauma care systems and public health programs, in order to minimize trauma-related morbidity and mortality.

Keywords: Trauma, Emergency department, Mortality, Accidents, Protective gear.

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Introduction

Trauma is a major global health issue, contributing to 11% of disability-adjusted life years in low- and middle-income countries.[1] Road traffic accidents (RTAs) in India, account for around 6% of global RTAs each year, and are also the leading cause of mortality, rendering them a substantial national issue.[2] Increased industrialisation, motorisation, and unsafe driving behaviours are exacerbating risks. Industrial injuries remain prevalent due to inadequate safety measures. Despite the significant impact, comprehensive data on trauma types, severity, seasonal trends, and accident hotspots is scarce.[3] This study aims to analyse trauma patterns, demographic differences, and causal factors to inform preventative strategies and guide policies, healthcare improvements, and public awareness efforts.

Materials and Methods

This study was a prospective observational study between June 2023 and May 2024 conducted in the Emergency Department of Government Chengalpattu Medical College Hospital, Tamil Nadu, and South India—a tertiary care centre located on a

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national highway. Ethical approval was obtained from the Institutional Ethics Committee (IEC No. IEC-CMC/Approval/19/2022).

Patients, who presented to the Emergency Department during the study period, were screened for eligibility. Inclusion criteria were patients of all ages presenting to the Emergency Department with trauma-related injuries, including vehicular accidents, falls, or assaults. Patients presenting with non-trauma-related emergencies, such as medical or surgical conditions unrelated to injury; pre-existing terminal illnesses; patients with terminal illnesses or those under palliative care prior to the trauma; and those declared dead upon arrival were excluded from the study.

Consecutive sampling was used, and all eligible trauma patients who presented during the study period and met the inclusion criteria were enrolled. Confidentiality was maintained using coded data and restricted access to electronic records. Data were collected using a pre-designed structured data collection form. We collected data from electronic medical records using standard forms. The data included demographic profiles, clinical profiles, and injury details. Scoring systems used in this study include the Glasgow Coma Scale (GCS) and the Injury Severity Score (ISS). Polytrauma was defined by the involvement of more than one system. All patients were managed according to standard ATLS-based resuscitation and stabilization protocols. After initial resuscitation and stabilization, adequate history, head-to-toe examination, imaging, and appropriate treatment were instituted. Information regarding mode of injury, time of injury, location of accident, mode of transportation to hospital, alcohol influence, wearing a seatbelt/helmet, vehicle involved, mass/multiple casualty pattern, diagnosis made, and management outcomes was documented on a daily basis in a chart and consolidated for each month. The study included measures to identify seasonal variations. Data were entered using Microsoft Excel 2016 and analysed using SPSS version 25.0 (IBM Corp., USA). Continuous variables were summarized using mean ± standard deviation or median (IQR) depending on distribution. Categorical variables were presented as frequency and percentage. Comparisons between categorical variables were performed using the chi-square test. Non-parametric comparisons between numeric variables were analyzed using the Mann–Whitney U test for two groups and the Kruskal–Wallis test for more than two groups. A p-value < 0.05 was considered statistically significant.

Results

This prospective study, conducted between June 2023 and May 2024, reviewed 27,484 Emergency Department (ED) admissions, of which 7,943 were trauma patients. Trauma admissions accounted for 29% of total ED admissions. The majority (80%) of trauma patients were aged 19–59 years, while 11% were geriatric (>59 years), and 4% were paediatric (<12 years). Male patients predominated the trauma population (80%). Among the trauma cases, 64.9% (n=5,164) were due to road traffic accidents (RTA), followed by 13% (n=1,034) assault cases, 7.2% (n=574) ground-level fall injuries, and 6.4% (n=514) occupational injuries. Additional causes included train accidents (n=68), bull gore injuries (n=63), wall collapses (n=20), burns (n=153), falls from height (n=350), and gunshot injuries (n=3) [Table 1].

A significant proportion (81.5%) of trauma patients reached the tertiary care centre within 6 hours of injury, with 9% arriving within 1 hour. The mortality rate among trauma patients reaching the hospital within 1 hour of incident was 8.1%, whereas the mortality rate in trauma population reaching the hospital after 24 hours of incident was 21.5 % ($p=0.002$). The majority (87.4%) were admitted with a Glasgow Coma Scale (GCS) >12, and only 5% had a GCS <9 ($p<0.0001$). About 92.7% of two-wheeler RTA victims were not wearing helmets, and 95% of four-wheeler RTA victims were not wearing seatbelts. Proportional mortality rate for those who travelled without protective gear was found to be about 73%, which was remarkably high. The mortality rate in helmet wearers (5.1%) is slightly higher than those not wearing helmet (4.65%). This discrepancy may be attributed to the lesser number of RTA admissions in helmet wearers group than those not wearing helmet.

Among total RTA admissions, 29.3% of victims consumed alcohol. The probabilities of death were approximately 4.8 times higher among those who had consumed alcohol than the non-consumers, indicating that alcohol consumption is a significant predictor of mortality in RTA victims (OR ≈ 4.8). Operating a Vehicle Under the Influence (OVI) had been a major contributor to RTA deaths (64.3% of total RTA deaths, $p<0.0001$). Injury types included 45.8% musculoskeletal injuries, 11.29% isolated traumatic brain injuries, 4.06% blunt torso injuries, 6.7% polytrauma, and 31.99% minor injuries [Figure 1].

The number of trauma cases peaked in March 2024 with 750 admissions, while the lowest number was observed in June 2023 with 539 cases. Despite fewer cases in April 2024 compared to March 2024, deaths were higher in April [Figure 2].

Of the 7,943 trauma inpatients, 316 deaths were recorded, representing 4% of trauma admissions. Deaths were most common among the 19–59 age group (66%) and geriatric victims (29%) [Figure 3b]. Fatalities were associated with GCS <9 in 59% of cases and an Injury Severity Score (ISS) of 9–24 in 70% of cases ($p<0.0001$). Isolated Traumatic brain injury (TBI) and Polytrauma contributed about 53.16% and 34.8% respectively to the antecedent cause of death among trauma victims. Traumatic Brain Injury was found to be a major contributor to the immediate cause of death, including those in Polytrauma and isolated brain injury (72.7%) and haemorrhagic shock was next to it with 14.5% [Figure 4].RTAs were most frequent between 6 AM and 4 PM (36.8%), followed by 4 PM to 9 PM (33.2%) and 9 PM to 6 AM (30%). Operating a Vehicle Under the Influence (OVI) was more common during 4 PM to 9 PM and contributes to about 36.4% RTAs during the aforementioned period [Figure 5].

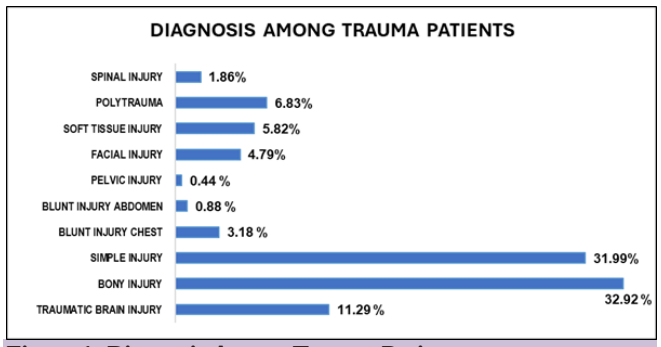

Figure 1: Diagnosis Among Trauma Patients

In our study, we recorded 35 mass casualty incidents (MCIs), of which 34 were road traffic accidents, and 1 involved a gang rumble among juvenile prisoners. Upon analysing the locations of these incidents, we found that 18 occurred on national highways, 9 on state highways, and 8 on local roads or areas [Figure 6a]. Over the course of a year, 302 patients presented to the Emergency Department (ED) due to MCIs, with a female predominance of 52.3% [Figure 6b]. Among the trauma victims admitted due to MCIs, there were 2 reported deaths, while 300 patients survived. Surveillance of the vehicles involved in MCIs revealed that most incidents involved company vans (n=10), primarily transporting female industrial workers during early morning or late-night hours. Of the total MCI patients, 266 (88%) were discharged from the ED, while the remaining 12% were admitted for further evaluation and management.

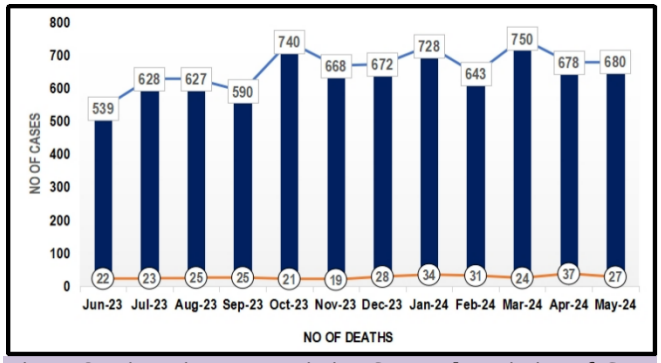

Figure 2: Line Diagram Depicting Seasonal Variation of Case Fatality of Trauma Patients

Figure 3a: Age Distribution in Survived Population

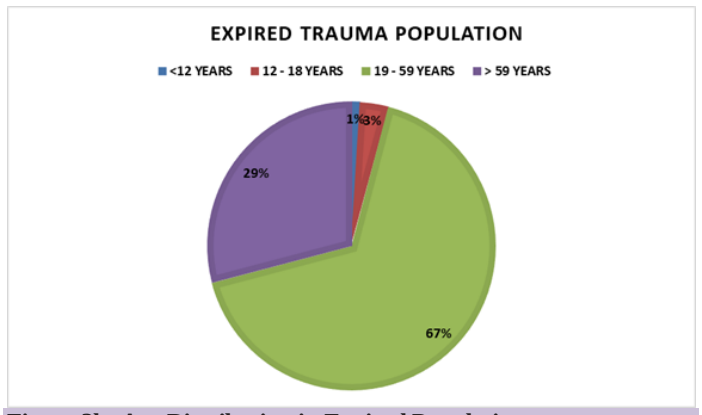

Figure 3b: Age Distribution in Expired Population

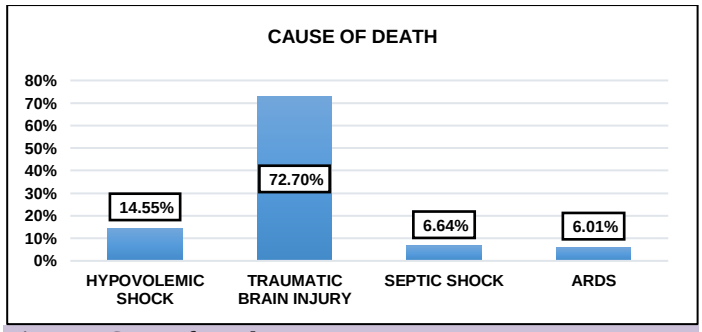

Figure 4: Cause of Death

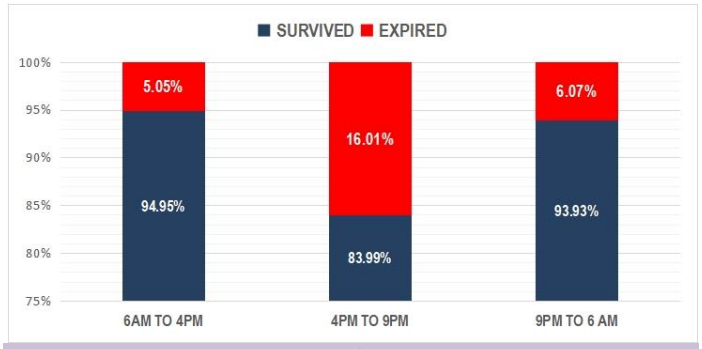

Figure 5: Timewise Distribution of RTA Patients

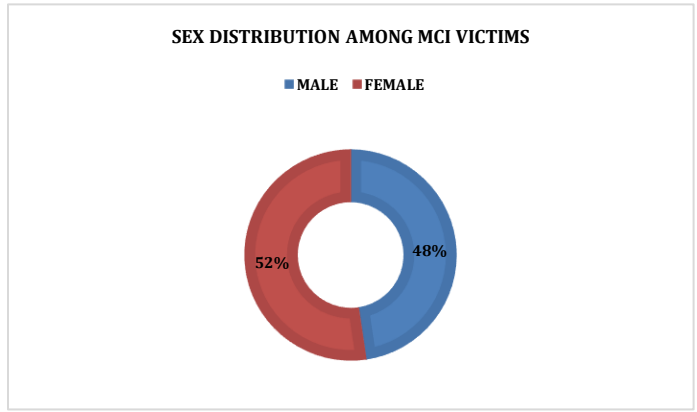

Figure 6a: Area Mapping in Mass Casualty Incidents (MCIS)

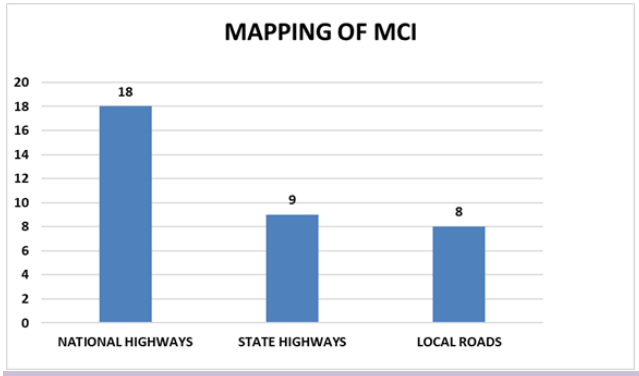

Figure 6b: Sex Distribution in Mass Casualty Incidents (MCIS).

Table 1: Baseline characteristics of study population

Parameter	**Frequency (%)**
Age (Mean ± 2 SD)	27.9 ± 15.63 (Range: 4 to 89)
Age group (n=7943)	
0 To 12 years	312 (3.92%)
12 To 18 years	444 (5.58%)
19 To 59 years	6342 (79.86%)
>59 years	845 (10.62%)
Gender(n=7943)	
Male	6363 (80.10%)
Female	1580(19.90%)
Type of Trauma(n=7943)	
RTA	5164(64.93%)
Assault	1034 (13.00%)
Self-fall	574 (7.21%)
Household/self-inflicted	440(5.53%)
Industrial	74(0.93%)
Fall from height	350(4.40%)
Burns	153(1.92%)
TTA	68(0.85%)
Bull gore injury	63(0.79%)
Wall collapse	20(0.25%)
Gunshot injury	3(0.03%)
Time lapsed between Incident & Admission(n=7943)	
<= 1 hour	718(9.02%)
1 to 6 hours	5769(72.5%)
6 to 12 hours	1085(13.64%)
12 hours to 24hours	224(2.81%)
>24 hours	147(1.84%)
GCS(n=7943)	
<9	399 (5.01%)
9 TO 12	590(7.41%)
13 T0 15	6975(87.54%)
ISS(n=7943)	
<9	5360 (67.48%)
9-24	2395 (30.15%)
>24	188 (2.36%)
Treatment Outcome(n=7943)	
Discharged (Survived during the period of stay)	7627(96.02%)
Expired	316(3.97%)

Discussion

Trauma is a major public health issue in India and one of the most common presentations in emergency departments, often leading to disability, financial burden, and high mortality. The emergency department (ED) has been described as the "canary in the coal mine" of public health, reflecting its vital role in detecting emerging health threats and trends.[4] Access to hospital-based medical care remains challenging for certain communities.[5]

Previous studies have documented the majority of trauma-related outcomes observed in younger age groups, with sparse geriatric population in their studies.[5-7] Although the majority of trauma-related deaths in our study occurred in the 19–59-year age group, 29% of fatalities were observed among geriatric trauma victims (>59 years), highlighting their increased vulnerability due to factors such as frailty, reduced physiological reserves, delayed response to injury, and multiple comorbidities.

Our research found that falls from height were the leading cause of spinal cord injuries. In contrast, studies from more developed

countries have pointed to frontal vehicle collisions as the most common cause, highlighting regional variations in the primary causes of these injuries.[8] In our area, key factors contributing to falls from height included rooftop falls due to alcohol intoxication, unsafe construction sites, and falls from trees. These findings underscore how trauma patterns are shaped by local conditions and highlight the role of specific regional factors in injury causes.

Results from our study suggest that occupational injuries make up around 6.4% of trauma cases, often linked to heavy machinery and commonly resulting in hand injuries, which is in relevance with the previous studies. [9-12]

Timely access to care was evident, as 81.5% of trauma victims reached the tertiary centre within 6 hours, and 9% arrived within the critical "golden hour" ($p = 0.002$), known to improve survival. This reflects an efficient trauma system enabling rapid transport, triaging, and early intervention. Comparable studies report variable golden-hour arrivals, such as 20.6% in one series and 61.3% hospital accessibility from accident sites in another.[10] Antony et al. found that 55% of RTA victims arrived within one hour, with a median arrival time of three hours (IQR 1.3–5.1).[13]

Motorized two-wheelers were involved in 53.4% of RTAs, mirroring regional transport trends where motorcycles dominate in rural and urban settings. Similar results were reported in an autopsy-based study of 245 deaths, where riders constituted 76.33% and pillion riders 23.67% of fatalities, with males accounting for 87.75%. Skull fractures were noted in 67.75% of cases. [14]

Lack of safety gear significantly contributed to injury severity; in our study, 92.7% of two-wheeler victims were not wearing helmets and 95% of four-wheeler victims were not using seatbelts. Overall, 73% of accident-related deaths were linked to the absence of protective gear, and 64% were associated with alcohol use and drunk driving. Fitzharris et al. demonstrated a fivefold increase in head injuries and prehospital deaths among riders without helmets, a finding echoed in other studies linking non-helmet use and alcohol to increased TBI incidence.[15-17]

These highlight the urgent need for public health campaigns, stricter enforcement of safety laws, and education on road safety. Severe head injury (GCS ≤ 8), circulatory shock, and pedestrian injuries have been consistently associated with increased in-hospital mortality.[18] A 1991 Chennai study reported 11% life-threatening injuries, 11% serious injuries, and 38% minor injuries among RTA victims.[19,20] Our findings were similar, with 32% sustaining only minor injuries. Injury profiles showed 45.8% musculoskeletal injuries, 11.29% isolated TBI, 4.06% blunt torso trauma, 6.7% polytrauma, and 31.99% minor injuries. Although 87.4% presented with GCS > 12, only 5% had GCS < 9 ($p < 0.0001$). Importantly, 59% of deaths occurred in patients with GCS < 9, and 70% in those with ISS 9–24, confirming the strong association between low GCS, higher ISS, and mortality. Isolated TBI and polytrauma accounted for nearly 88% of trauma-related deaths. In our series, 53.16% of deaths were due to isolated TBI and 34.8% to polytrauma, with 72.7% of all fatalities linked to TBIs, either isolated or part of polytrauma. This underscores the pivotal role of neurological injuries and multisystem trauma in mortality. Helmet use and strict enforcement of traffic regulations could significantly mitigate this burden. Similar associations between severe head injury, polytrauma, hemodynamic instability, and mortality have been reported elsewhere.[21]

The highest proportion of RTA deaths (36%) occurred between 4 PM and 9 PM, consistent with previous research identifying evening hours as high-risk periods due to congestion and reduced visibility.[17,22] In contrast, Misra et al. noted higher accident rates from midnight to early morning in metropolitan areas, attributed to nightlife culture and relaxed driving norms.[23] Such differences highlight the influence of regional and lifestyle factors on accident patterns. Mass casualty incidents (MCIs) are an increasing concern with urbanization and motorization. In our study, RTAs accounted for 97% of MCIs, in line with global findings.[24,25]

Over one year, 302 patients presented with MCIs, with a slight female predominance (52.3%)—largely female industrial workers in company vans during off-peak hours. Two deaths occurred, 88% were discharged from the ED, and 12% required admission. These results reflect the vulnerability of certain occupational groups and the need for targeted safety measures. Early trauma care, guided by prognostic indicators such as GCS and ISS, allows clinicians to anticipate patient outcomes and guide families. Strengthened trauma systems improve survival by addressing gaps such as workforce shortages and inadequate infrastructure. The Tamil Nadu Accident & Emergency Care Initiative (TAEI), launched in 2017, has transformed casualty wards into advanced EDs with triage systems, pre-arrival notifications, trauma registries, resuscitation bays, extended-Focused Assessment of Sonography in Trauma (e-FAST), Point-of-care testing (POCT), and protocol-based care, greatly enhancing outcomes. Globally, entities such as the American College of Surgeons Committee on Trauma utilize data systems like the National Trauma Data Bank, while injury scoring systems (TRISS, ISS, AIS) and preventive programs (BLS, ATLS, disaster preparedness, bystander training) reduce trauma-related mortality. Strengthening trauma registries enables better planning and resource allocation.[26-28]

In 2017, the Supreme Court of India proposed amendments to the Motor Vehicles Act (1988), mandating District Road Safety Committees to map accident blackspots, deploy Road Safety Patrols, and place BLS ambulances every 50 km on National Highways. Blackspots—often due to poor road engineering, unsafe driving, and lack of pedestrian facilities—account for two-thirds of RTA deaths. Establishing trauma care near these sites is essential to deliver timely care within the golden hour. The Greater Chennai Traffic Police's "Zero Accident Day" awareness drive in August 2024 exemplifies proactive approaches to prevention.[29] Regular such initiatives, along with periodic industrial safety inspections, can significantly reduce the burden of trauma in India.

Conclusion

Our study indicates that road traffic accidents are the primary source of trauma, predominantly impacting young adult males. The absence of helmets and seatbelts, along with alcohol intake, significantly contributed to mortality, with alcohol-related road

traffic accidents exhibiting dramatically elevated fatality rates. We highly correlated significant head trauma and delayed hospital admission with unfavourable outcomes. These findings emphasize the imperative for stringent road safety enforcement, the prevention of impaired driving, and prompt access to expert trauma care to reduce mortality and morbidity.

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Conflicts of interest
There are no conflicts of interest.

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