DOI: 10.21088/ijfmp.0974.3383.18125.2

Indian Journal of Forensic Medicine and Pathology
Volume 18, Number 1, January - March 2025

ORIGINAL ARTICLE

Demographic Profile, Injury Patterns, and Manner of Deaths in Railway Track Fatalities: A Forensic Study

B. Vasanth Naik[1], K. Venkat Nagaraju[2]

HOW TO CITE THIS ARTICLE:

B. Vasanth Naik, K. Venkat Nagaraju. Demographic Profile, Injury Patterns, and Manner of Deaths in Railway Track Fatalities: A Forensic Study. Indian J Forensic Med Pathol. 2025; 18(1): 13-18.

ABSTRACT

Background: Railway track fatalities are a significant cause of medicolegal autopsies in India, with the increasing frequency of such incidents raising concerns about safety and trauma patterns. This study aimed to evaluate the demographic profile, injury patterns, and manner of death among railway track fatalities in Secunderabad, Telangana.

Methods: A retrospective observational study was conducted at the Department of Forensic Medicine and Toxicology, Gandhi Medical College, Secunderabad. A total of 100 railway track fatalities, subjected to medicolegal autopsies from 1st October 2023 to 30th September 2024, were included. Data were extracted from autopsy records, including demographic details, external and internal injuries, and the manner of death (suicide, accident, or homicide). Statistical analysis involved descriptive statistics and the chi-square test to assess associations between variables.

Results: The majority of victims were males (82%), with the highest number of fatalities in the 41-50 years age group (22%). The manner of death was classified as suicide (56%) and accident (44%), with no homicides reported. External injuries were most commonly abrasions and contusions (100%), followed by lacerations and amputations. Internal injuries were severe, with the brain being the most commonly affected organ (74%). The cause of death was primarily multiple injuries (74%).

Conclusions: The study highlights the predominance of suicides among males in railway track fatalities. It emphasizes the need for targeted safety measures, particularly addressing the high incidence of suicides and accidental deaths. Further research is required to explore regional variations and to develop preventive strategies.

AUTHOR'S AFFILIATION:

[1] Associate Professor, Department of Forensic Medicine, Gandhi Medical College, Padmarao Nagar, Musheerabad, Secunderabad 500003, India.

[2] Associate Professor, Department of Forensic Medicine & Toxicology, Gandhi Medical College, Secundrabad, India.

CORRESPONDING AUTHOR:

B. Vasanth Naik, B. Vasanth Naik, Associate Professor, Department of Forensic Medicine, Gandhi Medical College, Padmarao Nagar, Musheerabad, Secunderabad 500003, India.

E-mail: Missing@gmail.com

➢ **Received:** 14-12-2024 ➢ **Accepted:** 10-04-2025

KEYWORDS

• Railway Fatalities • Injury Patterns • Suicide • Accident analysis • Medicolegal Autopsy

INTRODUCTION

Indian Railways (IR), under the Ministry of Railways, plays a crucial role in managing the nation's vast and intricate railway network, contributing significantly to public transportation and economic progress.[1] Railway accidents hold significant importance in the medicolegal evaluation of trauma and associated injuries.[2] In India, where railway tracks frequently traverse densely populated regions, trains often operate at full capacity due to their affordability. The extensive railway network, coupled with numerous unprotected level crossings, substantially increases the risk of accidents.[3] Additionally, railways are commonly used as a means for committing suicide, with numerous cases involving individuals intentionally lying on the tracks or positioning their heads on the rails to end their lives. Deaths related to railway incidents constitute approximately 1% of all cases subjected to medicolegal autopsies.[4] Investigations into railway track fatalities aim to determine the causes of such incidents, enabling regulatory bodies to assign accountability and guiding safety authorities in implementing measures to prevent similar occurrences in the future.[5]

Rail accidents can result in a variety of injuries, arising from direct impact, transmitted forces, or secondary trauma caused by falling heavy objects, individuals being thrown from upper berths, or injuries from debris such as splinters and broken glass in damaged compartments. It is not uncommon for individuals to deliberately lie on railway tracks to end their lives. In rare instances, the body of a homicide victim may be placed on the tracks to mimic a suicide or accidental death. Detailed examination of the injuries, thorough investigation of the scene, and chemical analysis of visceral samples are often crucial in uncovering the true circumstances of such incidents.[6] Secunderabad, a key city in the state of Telangana, serves as a major railway junction within the South-Central Railway Zone of Indian Railways. Known for its strategic importance, Secunderabad Railway Station facilitates the arrival and departure of over 200 local, express, and superfast trains daily, connecting it to major cities across the country. Additionally, the station manages a weekly schedule exceeding 400 train operations, highlighting its critical role in the region's transportation network. As a part of the Hyderabad metropolitan area, Secunderabad spans an area of approximately 217 square kilometers. The railway tracks traverse diverse zones within the city, ranging from sparsely populated regions to densely populated urban areas. Several sections of the railway line pass through congested zones characterized by high vehicular and pedestrian traffic. This complex interplay between urban infrastructure and railway operations increases the potential for accidents and other railway-related incidents, necessitating comprehensive studies like the present investigation conducted at Gandhi Medical College, Secunderabad. The study aimed to evaluate the demographic profile, injury patterns, and manner of death among railway track fatalities. By analyzing data from medicolegal autopsies, it provided valuable insights into the causes and circumstances of these fatalities, which can assist regulatory and safety authorities in developing effective preventive measures.

MATERIAL AND METHODS

The study was conducted in the Department of Forensic Medicine and Toxicology, Mortuary, Gandhi Medical College, Padmarao Nagar, Musheerabad, Secunderabad, 500003. This retrospective observational study analyzed railway track fatalities subjected to medicolegal autopsies during a one-year period from 1st October 2023 to 30th September 2024.

Study Design: A retrospective descriptive study design was employed to evaluate injury patterns and the manner of death among railway track fatalities.

Study Population: The study population comprised 100 cases of railway track fatalities recorded during the study period. Inclusion criteria included cases with complete autopsy documentation and a clearly identified manner of death. Cases with incomplete records or

inconclusive findings regarding the manner of death were excluded.

Data Collection: Data were extracted from autopsy records, including demographic details (age and gender), patterns of external and internal injuries, and the manner of death. Injuries were categorized as external (abrasions, contusions, lacerations, amputations, crushed injuries, and transections) and internal (injuries to major organs such as the brain, lungs, liver, and fractures). The manner of death was classified as suicide, accident, or homicide based on the circumstances of each case as documented in autopsy and police reports.

Statistical Analysis: All data were systematically recorded and analyzed using statistical software. Descriptive statistics, such as frequencies and percentages, were used to summarize the data. Inferential statistics, including the chi-square test, were applied to assess associations between variables such as gender, injury patterns, and the manner of death. A p-value of <0.05 was considered statistically significant.

Ethical Considerations: Institutional Ethical Committee clearance was obtained prior to the commencement of the study. All data were anonymized to protect the confidentiality of the deceased and their families. No identifiable personal information was included in the analysis, and the study was conducted following ethical guidelines for retrospective research.

RESULTS

Table 1: Demographic Distribution of Victims by Age and Gender (N = 100)

Age Group (Years)	Male (n, %)	Female (n, %)	Total (n, %)
01 to 10	0 (0%)	0 (0%)	0 (0%)
11 to 20	12 (12%)	6 (6%)	18 (18%)
21 to 30	16 (16%)	4 (4%)	20 (20%)
31 to 40	12 (12%)	2 (2%)	14 (14%)
41 to 50	18 (18%)	4 (4%)	22 (22%)
51 to 60	14 (14%)	0 (0%)	14 (14%)
61 to 70	6 (6%)	2 (2%)	8 (8%)
>70	4 (4%)	0 (0%)	4 (4%)
Total	82 (82%)	18 (18%)	100 (100%)

The age-wise distribution of railway track fatality victims reveals that the highest proportion of cases occurred in the 41–50 years age group (22%), followed by the 21–30 years age group (20%). Males accounted for a significant majority (82%) of the total fatalities, resulting in a male-to-female ratio of 4.6:1. The mean age of the victims was 41.8 ± 15.6 years. These findings highlight a predominance of fatalities among middle-aged males in railway track incidents. (*Table 1*)

Table 2: Comparison of Manner of Death by Gender (N = 100)

Manner of Death	Male (n, %)	Female (n, %)	Total (n, %)	p-value*
Suicide	50 (50%)	6 (6%)	56 (56%)	
Accident	32 (32%)	12 (12%)	44 (44%)	<0.05
Homicide	0 (0%)	0 (0%)	0 (0%)	
Total	82 (82%)	18 (18%)	100 (100%)	

The manner of death in railway track fatalities was primarily categorized as suicide (56%) and accident (44%). Suicidal deaths were more frequent among males (50%) compared to females (6%), while accidental deaths accounted for 32% in males and 12% in females. There were no cases of homicide reported. The statistical analysis demonstrated a significant gender difference in the manner of death ($p < 0.05$). These results suggest the need for targeted interventions to address the high incidence of suicides and accidental deaths on railway tracks. (*Table 2*)

Table 3: Pattern of External Injuries Across Different Manners of Death (N = 100)

External Injury	Suicide (n, %)	Homicide (n, %)	Accident (n, %)	Total (n, %)
Abrasion	56 (56%)	0 (0%)	44 (44%)	100 (100%)
Contusion	56 (56%)	0 (0%)	44 (44%)	100 (100%)
Laceration	44 (44%)	0 (0%)	42 (42%)	86 (86%)
Amputation of upper limb	22 (22%)	0 (0%)	12 (12%)	34 (34%)
Amputation of lower limb	18 (18%)	0 (0%)	10 (10%)	28 (28%)
Crushed Injury	30 (30%)	0 (0%)	26 (26%)	56 (56%)
Transection	20 (20%)	0 (0%)	14 (14%)	34 (34%)

Abrasions and contusions were observed in all cases of both suicide and accidental deaths (100%), making them the most frequent external injuries. Lacerations were present in 86% of cases, while amputations of upper and lower limbs occurred in 34% and 28% of cases, respectively. Crushed injuries were reported in 56% of cases, and transections were documented in 34%. The injury patterns were consistent across suicides and accidents, reflecting the high-energy trauma typically associated with railway track incidents. (*Table 3*)

Table 4: Pattern of Internal Injuries in Relation to Manner of Death (N = 100)

Internal Injury	Suicide (n, %)	Homicide (n, %)	Accident (n, %)	Total (n, %)	p-value*
Lung	26 (26%)	0 (0%)	30 (30%)	56 (56%)	<0.05
Liver	34 (34%)	0 (0%)	36 (36%)	70 (70%)	
Kidney	24 (24%)	0 (0%)	20 (20%)	44 (44%)	
Spleen	22 (22%)	0 (0%)	16 (16%)	38 (38%)	
Stomach	6 (6%)	0 (0%)	2 (2%)	8 (8%)	
Bowel	12 (12%)	0 (0%)	6 (6%)	18 (18%)	
Brain	34 (34%)	0 (0%)	40 (40%)	74 (74%)	<0.01
Skull Fracture	34 (34%)	0 (0%)	40 (40%)	74 (74%)	

The internal injuries sustained by victims showed significant severity. The brain was the most commonly injured organ, affected in 74% of cases, followed by the lungs (56%) and liver (70%). Skull fractures and long bone fractures were noted in 74% and 60% of cases, respectively. Spinal cord injuries were prevalent among suicide cases (68%), while brain and skull fractures were frequently observed in both suicides and accidents. Significant statistical differences in internal injury distributions between suicides and accidents ($p < 0.01$) were observed, reflecting varying mechanisms of trauma. (*Table 4*)

Table 5: Distribution of Cause of Death Based on Manner of Death (N = 100)

Cause of Death	Accident (n, %)	Suicide (n, %)	Homicide (n, %)	Total (n, %)
Head Injury	8 (8%)	2 (2%)	0 (0%)	10 (10%)
Decapitation	0 (0%)	8 (8%)	0 (0%)	8 (8%)
Transection	0 (0%)	8 (8%)	0 (0%)	8 (8%)
Multiple Injuries	36 (36%)	38 (38%)	0 (0%)	74 (74%)
Total	44 (44%)	56 (56%)	0 (0%)	100 (100%)

The leading cause of death among railway track fatalities was multiple injuries, accounting for 74% of cases. Head injuries were responsible for 10% of deaths, while decapitation and transections, exclusive to suicide cases, accounted for 8% each. Among accidental deaths, multiple injuries predominated (36%), whereas suicides showed a mix of multiple injuries, decapitations, and transections. These findings underline the catastrophic nature of injuries in railway track fatalities, emphasizing the urgent need for preventive measures targeting suicides and accidental deaths. (Table 5)

DISCUSSION

Railway-related fatalities have been reported since the inception of the railway industry (**Davis *et al*., 1997**). Trains play a vital role in national development and have become an integral part of everyday life for people.

As per the findings in our study findings are consistent with other studies that also report a higher incidence of railway-related deaths among males (Cina *et al*., 1994; Schmidtke, 1994; Pelletier, 1997; Davis *et al*., 1997; Lerer and Matzopoulos, 1997; Strauch *et al*., 1998). This male predominance is likely due to the larger proportion of males in the working population, who are more frequently exposed to commuting and occupational hazards. The age group most frequently associated with railway fatalities in our study was 21–40 years, with significantly fewer fatalities observed

in the younger or older age extremes. This is in line with other studies (Cina *et al*., 1994; Lerer and Matzopoulos, 1997; Pelletier, 1997), which suggest that young adults and middle-aged individuals are more vulnerable to such accidents due to their higher mobility and use of trains for work or education. A study in Berlin (Strauch *et al*., 1998) found that railway fatalities were most common in individuals aged 13–25 years, with a peak in the 16–20 years age group. This difference could be attributed to regional variations in demographics, with younger people, particularly students and young workers, relying heavily on trains for daily travel.

The higher frequency of accidental deaths compared to suicides in this study is consistent with findings from similar research in other regions, including Charleston (Cina *et al*., 1994), Jefferson County, Alabama (Davis *et al*., 1997), and Cape Town, South Africa (Lerer and Matzopoulos, 1997). These studies also found a predominance of accidental deaths over suicides, further emphasizing the need for enhanced safety measures on railway tracks. However, a contrasting study conducted in London (Cocks, 1987) reported that deliberate self-harm was the probable cause of death in approximately three-quarters of the cases. This disparity may reflect different regional trends, societal factors, or reporting practices, suggesting that further research is required to explore the various contributing factors to railway track fatalities in different geographical locations.

Abrasions and contusions were the most common external injuries observed in railway track fatalities, occurring in 100% of both suicide and accidental deaths. The injury patterns seen in our study were consistent across suicides and accidents, indicating the high-energy nature of the trauma typically associated with railway incidents. This is in line with other studies, which have also reported similar injury patterns in railway related deaths, with abrasions, contusions, and fractures being the most prevalent injuries (Cina *et al*., 1994; Davis *et al*., 1997).

The internal injuries sustained by the victims were notably severe. The brain emerged as the most commonly injured organ, affected in 74% of cases, followed by the lungs (56%) and liver (70%). Skull fractures were seen in 74% of cases, while long bone fractures were present in 60% of cases. Spinal cord injuries were notably more prevalent among suicide cases (68%), while brain and skull fractures were frequently observed in both suicides and accidents. Our findings are consistent with a study conducted in Kolkata, which reported lacerations as the most common external injury followed by fractures. However, the current study observed decapitation in only 14 cases, which contrasts with the study by Puttaswamy (2015), where decapitation, followed by hemisection of the body, was common among suicides. This disparity may be due to differences in the type of trains, speed, or other local factors contributing to the nature of the fatalities in different regions. Additionally, neck involvement in the current study was observed in 14 cases, which contrasts with a study conducted in Moradabad by Afzal and Ravi (2016), where neck injuries were reported at higher frequencies. This variation in neck injuries could be attributed to differences in train speed, body position at the time of the incident, or the specific circumstances of the fatalities in the two regions.

The leading cause of death in railway track fatalities was multiple injuries, accounting for 74% of cases. Our findings highlight the severe nature of injuries in railway track fatalities, underscoring the need for preventive measures for both suicides and accidents. The high incidence of multiple injuries aligns with previous studies, which noted fatal head injuries in railway accidents (Lerer and Matzopoulos, 1997; Strauch *et al*., 1998). In many cases, the injuries resulted in body mutilation, affecting more than one body region. Cina *et al*. (1994) found that 88% of train/pedestrian fatalities were due to massive blunt trauma. This can be attributed to the significant kinetic energy transferred when a train strikes the body, causing extensive damage across multiple regions. Similarly, Lerer and Matzopoulos (1997) reported that fatal railway injuries typically disrupt more than one body area.

CONCLUSION

Railway track fatalities, primarily due to suicides, present a significant public health issue. This study highlights the severe injuries sustained in these incidents, with a higher incidence of suicides among middle aged males. The findings stress the need for

preventive measures, including improved mental health support, protective barriers, and better safety protocols at high-risk locations. Implementing preventive strategies such as mental health interventions, protective barriers, and stricter railway safety protocols is crucial to reducing fatalities. Collaboration among forensic experts, safety authorities, and policymakers is vital for formulating and executing strategies to mitigate preventable railway fatalities.

ACKNOWLEDGMENT

We sincerely thank the staff of the Department of Forensic Medicine and Toxicology, Gandhi Medical College, Secunderabad, for their invaluable support and cooperation throughout the study.

Conflict of Interest: The authors declare no competing interests related to the publication of this article.

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