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# Epidemiology and risk factors of orthopedic injuries in a tertiary care hospital: A retrospective study. A three-month analysis of trauma admissions in India.



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## Abstract

### Background

Orthopedic injuries, including road traffic accidents (RTAs) and falls, are a major public health concern in India, yet region-specific epidemiological data are limited.
Objective: To describe the epidemiology and risk factors of orthopedic injuries in a tertiary care hospital in India over three months.

### Methods

A retrospective observational study analyzed 287 trauma admissions from January 1 to March 31, 2025, using anonymized clinical communication records from a tertiary care hospital. Data included age, sex, injury mechanism, co-morbidities, and attending doctor. Descriptive statistics, chi-square tests, and logistic regression assessed associations between demographics, co-morbidities, and injury severity.

### Results

Of 287 patients, 59.6% were male, with a mean age of 45.3 years (SD 24.3). Falls (45.3%) and RTAs (39.7%) were the leading injury mechanisms. Falls predominated in patients >60 years (71.2%), while RTAs were common in those aged 18–40 years (59.0%) (p<0.001). Hypertension (25.1%) and diabetes mellitus (15.0%) were frequent co-morbidities, significantly associated with older age ($p < 0.001$). Major injuries (29.6%) were linked to younger age (OR 0.97, 95% CI 0.96–0.99) and RTAs (OR 2.29, 95% CI 1.33–3.94).

### Conclusion

Falls and RTAs drive orthopedic trauma, with distinct age and sex patterns. Targeted prevention, including fall safety for the elderly and road safety measures, is essential.

### Recommendation

Implementation of targeted public health interventions focusing on fall prevention in the elderly and enhanced road safety measures is urgently needed to reduce orthopedic injuries.

***Keywords:*** *Orthopedic injuries, trauma, road traffic accidents, falls, epidemiology, India.*
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## Introduction

Trauma remains a leading cause of death and disability worldwide, accounting for approximately five million fatalities annually and contributing significantly to the global burden of disease [1]. In low- and middle-income countries (LMICs) like India, the impact is particularly pronounced due to rapid urbanization, inadequate infrastructure, and strained healthcare systems. Orthopedic

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injuries—especially those resulting from road traffic accidents (RTAs) and falls—form a substantial component of this trauma burden, often requiring specialized care and prolonged rehabilitation [2,3].

India reports over 1.5 million injuries related to RTAs every year, with two-wheeler incidents representing nearly 40% of cases [4]. These injuries are driven by a combination of poor road conditions, limited enforcement of traffic laws, and widespread non-compliance with safety measures. Concurrently, falls—particularly among older adults—are rising in prevalence due to the aging population, increased life expectancy, and limited implementation of fall prevention strategies in homes and communities [5,6].

Despite the scale of the problem, region-specific data on the epidemiology and risk factors associated with orthopedic trauma remain limited, especially from tertiary care hospitals that serve as major referral centers for complex injuries. This lack of localized evidence poses challenges for policymakers and clinicians seeking to implement targeted injury prevention and management strategies.

Moreover, co-morbidities such as hypertension and diabetes mellitus, highly prevalent in the Indian population, can influence both the severity and recovery trajectory of orthopedic injuries. These conditions may complicate surgical decision-making, prolong hospital stays, and increase the risk of complications, yet their role in the context of trauma has not been adequately explored in existing literature [7,8].

This study aims to address these gaps by analyzing the demographic patterns, injury mechanisms, and associated risk factors among orthopedic trauma patients admitted to a tertiary care hospital in Rajkot, Gujarat, over three months. By examining the influence of variables such as age, sex, mechanism of injury, and presence of co-morbidities, we aim to generate actionable insights. The findings are intended to inform targeted prevention efforts, guide clinical decision-making, and support the development of compatible medical infrastructures, including orthopedic instruments and diagnostic equipment, to enable faster and more effective management of trauma cases across similar healthcare settings in India.

## Methods

### Study Design and Setting

This retrospective observational study analyzed trauma admissions from a tertiary care hospital in Rajkot, Gujarat. The study period covered trauma admissions between January 1 and March 31, 2025. No follow-up period was included as the study focused on initial admission data. The hospital serves urban and rural populations, managing a high volume of orthopedic cases.

### Participants

Eligible participants included all patients admitted with orthopedic injuries during the study period. Patients were selected through a systematic review of anonymized clinical communication records documenting trauma admissions. Inclusion criteria comprised patients with complete data on age, sex, injury history, co-morbidities, and attending physician. One case was excluded due to missing injury history, resulting in a final sample size of 287 patients.

### Study Size

The sample size was determined based on the total number of orthopedic trauma admissions recorded at the hospital during the three-month study window, representing a convenience sample that reflects real-world patient flow without prior sampling or power calculations.

### Bias

To minimize selection bias, all eligible trauma admissions within the timeframe were included. Data extraction was performed manually by trained personnel using standardized protocols to reduce information bias. Any ambiguous or incomplete data entries were cross-verified with source records where possible. Duplicate entries were retained only if they represented separate trauma incidents.

### Data Source

Data were extracted from structured clinical communication records (anonymized staff correspondence), providing real-time details on trauma admissions.

### Variables

- Demographics: Age (categorized as <18, 18–40, 41–60, >60 years), sex (male, female).
- Injury Details: Mechanism (e.g., RTA, fall, machine injury), date of injury.
- Clinical Data: Co-morbidities (e.g., hypertension, diabetes, none), attending doctor.
- Severity: Inferred from admission category ("major" vs. non-major, based on surgical intervention or complexity).

### Data Processing

Data were manually extracted and standardized. Dates were formatted as DD/MM/YYYY, with typos corrected (e.g., "31/12/24" to "31/12/2024"). Vague dates (e.g., "2 months ago") were approximated using record timestamps. Co-morbidities were listed as positive conditions (e.g.,

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"K/C/O HTN" as "Hypertension"); negative findings (e.g., "No DNVD") were excluded. Sex was normalized to "Male" or "Female". Duplicate entries were retained as separate incidents unless identical across all variables.

## Statistical Analysis

Descriptive statistics summarized patient characteristics (frequencies, percentages for categorical variables; mean, standard deviation \[SD\] for age). Chi-square tests compared injury mechanisms and co-morbidities by age group and sex. Multivariable logistic regression assessed risk factors (age, sex, co-morbidities, injury mechanism) for major injuries, reporting odds ratios (ORs) and 95% confidence intervals (CIs). Analyses were conducted using R (version 4.2.1). A p-value <0.05 was significant.

## Ethics

Data were anonymized, with no patient identifiers, and stored securely, adhering to ethical standards. The study was approved by the Institutional Ethics Committee of the institute in a tertiary care hospital in Rajkot, Gujarat.

## Results

A total of 288 trauma admissions were initially screened. One patient was excluded due to missing injury history, resulting in a final sample of 287 patients included in the analysis. No other exclusions or dropouts occurred as the data were retrospective and anonymized.

Patient Characteristics Of 287 patients, 171 (59.6%) were male, with a mean age of 45.3 years (SD 24.3, range 3–98). Age distribution was: <18 years (14.6%, n=42), 18–40 years (34.8%, n=100), 41–60 years (25.1%, n=72), >60 years (25.4%, n=73). (Table 1).

**Table 1: Demographic and Clinical Characteristics (n=287)**

| Variable | n (%) or Mean (SD) |
|---|---|
| Age (years) | 45.3 (24.3) |
| <18 | 42 (14.6%) |
| 18–40 | 100 (34.8%) |
| 41–60 | 72 (25.1%) |
| >60 | 73 (25.4%) |
| **Sex** | |
| Male | 171 (59.6%) |
| Female | 116 (40.4%) |
| **Co-morbidities** | |
| None | 172 (59.9%) |
| **Hypertension** | 72 (25.1%) |
| **Diabetes Mellitus** | 43 (15.0%) |
| Other* | 29 (10.1%) |
| Others | 89 (31.0%) |

*Includes asthma, thyroid, ischemic heart disease, etc.

Injury Mechanisms Falls were the most common injury mechanism (130, 45.3%), followed by RTAs (114, 39.7%), machine injuries (15, 5.2%), and others (28, 9.8%) (Figure 1). Falls predominated in patients >60 years (52/73, 71.2%), while RTAs were common in those aged 18–40 years (59/100, 59.0%) (p<0.001). Males had a higher proportion of RTAs (77/171, 45.0%) than females (37/116, 31.9%) (p=0.02) (Table 2).

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**Figure 1: Distribution of Injury Mechanisms. Pie chart showing Falls (45.3%, green), RTAs (39.7%, red), Machine Injuries (5.2%, blue), and Others (9.8%, yellow). Generated as PNG (300 dpi). See Supplementary Material.**



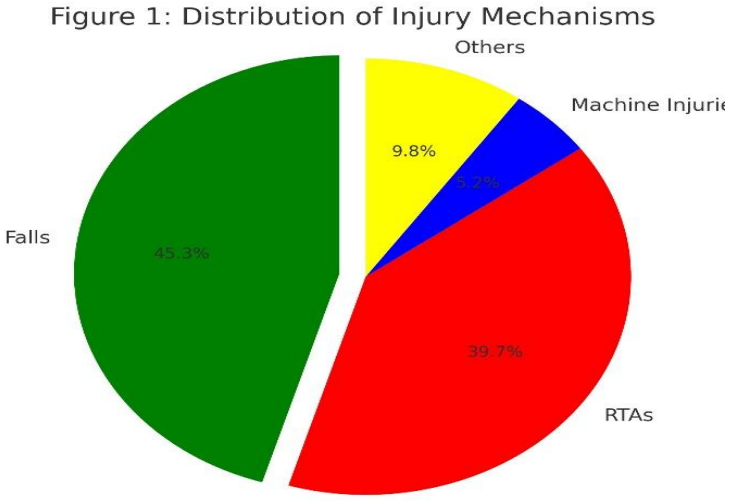


**Table 2: Injury Mechanisms by Age Group and Sex**

| Mechanism | <18 (n=42) | 18-40 (n=100) | 41-60 (n=72) | >60 (n=73) | Male (n=171) | Female (n=116) |
|---|---|---|---|---|---|---|
| Fall | 16 (38.1%) | 23 (23.0%) | 40 (55.6%) | 52 (71.2%) | 67 (39.2%) | 63 (54.3%) |
| RTA | 14 (33.3%) | 59 (59.0%) | 29 (40.3%) | 12 (16.4%) | 77 (45.0%) | 37 (31.9%) |
| Machine Injury | 2 (4.8%) | 10 (10.0%) | 3 (4.2%) | 0 (0.0%) | 12 (7.0%) | 3 (2.6%) |
| Other | 10 (23.8%) | 8 (8.0%) | 0 (0.0%) | 9 (12.3%) | 15 (8.8%) | 13 (11.2%) |
| p-value | <0.001 (Age) | 0.02 (Sex) | | | | |

Co-morbidities were present in 115 patients (40.1%), with hypertension (72, 25.1%) and diabetes mellitus (43, 15.0%) most common. Co-morbidities were significantly more frequent in patients >60 years (44/73, 60.3%) compared to those <40 years (27/142, 19.0%) (p<0.001). Females had a slightly higher prevalence (50/116, 43.1%) than males (65/171, 38.0%) (p=0.37) (Table 3).

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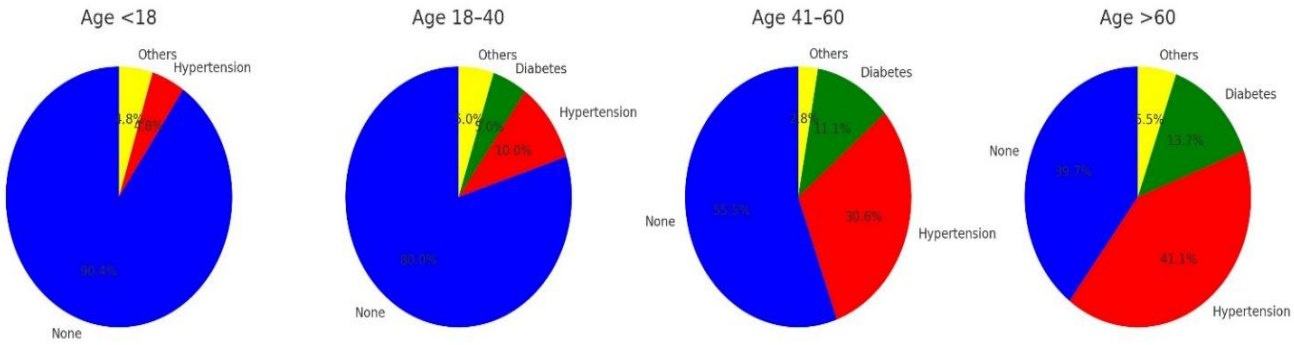
**Table 3: Summary of comorbidities in the patients**

| Group | With Co-morbidities | Without Co-morbidities | % With Co-morbidities | p-value |
|---|---|---|---|---|
| All Patients (n = 287) | 115 | 172 | 40.1% | — |
| > 60 years (n = 73) | 44 | 29 | 60.3% | < 0.001 |
| < 40 years (n = 142) | 27 | 115 | 19.0% | |
| Female (n = 116) | 50 | 66 | 43.1% | 0.37 |
| Male (n = 171) | 65 | 106 | 38.0% | |
| Hypertension | 72 | | 25.1% | — |
| Diabetes Mellitus | 43 | | 15.0% | — |

**Figure 2: Co-morbidities by Age Group**




Injury Severity Major injuries occurred in 85 patients (29.6%). In multivariable logistic regression, younger age (OR 0.97 per year, 95% CI 0.96–0.99, p=0.002) and RTA mechanism (OR 2.29, 95% CI 1.33–3.94, p=0.003) were associated with major injuries. Sex and co-morbidities were not significant (p> 0.05) (Table 4).

**Table 4: Logistic Regression for Major Injuries**

| Variable | OR (95% CI) | p-value |
|---|---|---|
| Age (per year) | 0.97 (0.96–0.99) | **0.002** |
| Sex (Male vs. Female) | 1.11 (0.64–1.92) | 0.70 |
| RTA (vs. Fall) | 2.29 (1.33–3.94) | **0.003** |
| Co-morbidity (Yes vs. No) | 0.90 (0.51–1.60) | 0.72 |

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Data on attending doctors showed that 62% of cases were managed by orthopedic specialists, while the remaining were attended by general surgeons or emergency medicine physicians. Cases managed by orthopedic specialists had a higher proportion of major injuries (34%) compared to others (22%), reflecting referral patterns for more severe trauma.

Temporal Trends:

Admissions were highest in March (104 cases) compared to January (80) and February (103), possibly due to festivals or weather (p=0.09).

## Discussion

This study provides important insights into the epidemiology and risk factors of orthopedic trauma in a tertiary care setting in western India. The findings highlight that falls and road traffic accidents (RTAs) are the leading causes of orthopedic injuries, with clear variations across age and sex groups.

Falls were the predominant mechanism of injury among elderly patients (>60 years), consistent with global patterns where age-related decline in balance, strength, and vision contributes to increased fall risk. In our study, over 71% of elderly patients sustained injuries due to falls, often occurring within domestic environments. These data support the need for targeted fall-prevention strategies such as home safety modifications, the use of assistive devices, and community awareness programs.

Notably, countries like Brazil have demonstrated the effectiveness of national fall prevention initiatives that include public education, elder-friendly urban planning, and home-based interventions. These strategies have significantly reduced the incidence of fall-related fractures among older adults in community settings [21]. Adapting such multi-pronged models to rural and urban Indian contexts could be instrumental in mitigating the orthopedic trauma burden.

RTAs were more common among younger adults, particularly males aged 18–40 years, reflecting known national trends. The high involvement of two-wheelers and bike skids in this group points to a significant behavioral and infrastructural risk. Contributing factors likely include poor road conditions, lack of helmet usage, and limited enforcement of traffic laws. These findings highlight the importance of road safety education, stricter regulation, and improved road maintenance, particularly in semi-urban and rural areas.

Although co-morbidities such as hypertension and diabetes mellitus were not significantly associated with major injury in the present study's regression analysis, their high prevalence, particularly in patients over 60, remains clinically relevant. Chronic conditions like these can negatively impact bone health, wound healing, and postoperative recovery, making integrated trauma care essential. Routine screening and optimization of such co-morbidities in trauma patients could enhance recovery outcomes and reduce complication rates.

Major injuries were more frequently observed in younger patients and those involved in RTAs, suggesting a link with high-energy trauma mechanisms. These patients often require urgent surgical intervention and multidisciplinary management, underlining the need for efficient triage systems, advanced diagnostic tools, and trauma-trained personnel.

The current study also reflects the high burden of trauma cases managed in a single tertiary hospital over just three months. This underscores the urgent need to scale up trauma care infrastructure across similar healthcare settings. Establishing dedicated orthopedic trauma units, improving referral systems, and expanding access to rehabilitation services could help address the growing burden.

While the present study's findings align with several national and international studies, some unique regional patterns emerged. For example, the relatively higher proportion of fall-related injuries may reflect the older demographic in our catchment area, which includes rural populations with limited access to preventive care. The presence of machine-related injuries, although less common, suggests occupational hazards that may be underreported in existing literature and merit further exploration.

## Generalizability

The findings are primarily applicable to similar tertiary care settings in urban and rural India but may have limited generalizability to other regions or healthcare systems.

## Recommendations

The study recommends implementing targeted prevention strategies focused on fall risk reduction among the elderly and enhanced road safety measures for younger adults to reduce orthopedic injuries. Strengthening early diagnosis and prompt management in tertiary care settings can improve patient outcomes. Further research is needed to explore tailored interventions based on demographic and injury patterns.

Implications: Public health strategies should prioritize elderly fall prevention (e.g., home modifications) and road safety (e.g., helmet laws) [13]. Clinically, screening for co-morbidities can optimize trauma care [14]. The high caseload (287 cases in 3 months) underscores the need for enhanced trauma care capacity [15].

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Comparison: The fall prevalence (45.3%) in the present study exceeds urban Indian studies (30–35%) [16], possibly due to a rural catchment with older populations. The RTA pattern mirrors national data [4], but bike skids highlight local road safety issues [17]. Machine injuries (5.2%) suggest occupational risks, less reported in Indian literature [18].

## Conclusion

Orthopedic trauma in western India is primarily driven by falls and road traffic accidents, with distinct patterns based on age and sex. Elderly individuals are at high risk for falls, often within the home, while younger males are more vulnerable to high-energy injuries from RTAs. Although co-morbidities did not significantly predict injury severity in this study, their high prevalence, particularly among older adults, calls for integrated trauma and chronic disease management approaches.

These findings support the urgent need for preventive strategies tailored to demographic and regional patterns. For older adults, fall prevention through environmental modifications and awareness programs is critical. For younger populations, improving road safety through infrastructure upgrades, stricter enforcement of traffic laws, and community education is essential.

Clinically, there is a pressing need to strengthen orthopedic trauma infrastructure in tertiary and secondary care settings. Investments in diagnostic equipment, surgical tools, and trained personnel will be vital for timely and effective management. Our findings also advocate for broader implementation of routine screening for co-morbidities and structured referral pathways to rehabilitation services.

In summary, addressing India's orthopedic injury burden requires a dual approach: robust public health prevention and system-level enhancements in trauma care delivery. Further research exploring long-term outcomes, socioeconomic factors, and multi-institutional data is essential to inform national policies and optimize patient care.

## Limitations

This study has several limitations. The retrospective design is subject to documentation bias and data inconsistencies (e.g., vague injury dates). As a single-center study, the findings may not be generalizable to other regions. Additionally, we lacked data on functional outcomes, length of hospital stay, or long-term complications. Socioeconomic status, occupational exposure, and access to rehabilitation services were also not captured. Future prospective multicenter studies are needed to build a more comprehensive understanding of orthopedic trauma epidemiology in India (19)

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## Conflicts of Interest

The authors declare no conflicts of interest.

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