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Original Research Article

A Prospective Study on Epidemiological Correlates and Fracture Patterns Among Accident Patients Across Age Groups

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Abstract:

Background: Road traffic accidents (RTAs) are a major cause of morbidity and mortality in developing countries like India, with young adults being disproportionately affected. Fractures constitute a significant component of RTA-related injuries.

Aim: To evaluate epidemiological correlates and fracture patterns among accident patients across different age groups.

Methodology: This prospective observational study was conducted over six months at a tertiary care hospital in Bihar, including 98 patients with radiologically confirmed fractures. Data on demographics, risk factors, injury patterns, and fracture types were collected and analyzed using SPSS.

Results: Young adults (21–30 years) were most affected, with a male predominance (70:28). High speed (26 cases) and poor road conditions (22 cases) were leading risk factors. Of 142 fractures, upper limb fractures (68) were most common, followed by lower limb (52) and axial fractures (22). Head injury was the most frequent associated injury (32 cases). Multiple fractures were observed in 30 patients.

Conclusion: RTAs predominantly affect young males, with high-speed travel and environmental factors as key contributors. Upper limb fractures are most common, emphasizing the need for targeted prevention and road safety interventions.

Keywords: Road Traffic Accidents, Epidemiology, Fracture Patterns, Young Adults, Risk Factors, Trauma.

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Introduction

Road traffic accidents (RTAs) have become a major and growing public health problem globally, especially in low- and middle-income countries. They are one of the five leading contributors to morbidity and mortality in South-East Asian nations [1]. Diabetes acts as a disproportionate health burden born mainly by people in their most productive years, impacting not just personal health but household and national socio-economic development as well [2]. In 2017, road traffic accidents were ranked as the ninth leading global contributor to disability-adjusted life years (DALYs) lost and projected that they would be the 3rd prominent cause of DALYs lost by 2020. Such upsurge emphasizes the critical need for systematic research focusing on road traffic accidents epidemiology and injury profiling.

India, as one of the fastest growing economies and with rising level of urbanization and motorization, has experienced a sudden increase in number of vehicles available on the roads, especially two wheelers. Thanks to affordability, fuel economy, and convenience in crowded metropolitan traffic conditions [3-5], two-wheelers turned into one of the most common means of transport. Their extensive usage is also due to inadequate parking infrastructure and rising traffic congestion. Although classified as an unsafe means of transport, two-wheelers continue to be a popular choice, being used not just for commute purposes but also for recreational activities, particularly in urban and semi-urban areas [6].

Two-wheeler users are much more exposed than four-wheeled vehicle occupants. Numerous studies have confirmed that the fatality rates for individuals

involved with two-wheeler accidents are times more than in case of car accident, and injuries are three times higher [7]. This risk is higher because two-wheelers do not have protective features like airbags and seatbelts and an external frame for protection that four-wheelers have. Additionally, two-wheelers are more prone to the disturbances of the environment because they are less stable compared to cars and trucks; they can be affected by different factors such as potholes, oil sheets, watermix, road debris etc or bad quality road (maintenance & flatness) [8] Such risk factors are more predominant in developing nations, India for instance which contributes towards considerably higher number of two wheeler accidents.

Road traffic accidents show a significant variation of epidemiological distribution among the states in India. Over 85,000 deaths occur in India from road traffic accidents annually, with Uttar Pradesh recording the most deaths249 and Tamil Nadu the most injuries6 due to road traffic accidents. Different regions have varying traffic density, road infrastructure, enforcement of traffic laws and accessibility to health care facilities. As per reports cited by ndtv. According to data on fatal accidents in India reported by down-to-earth. This is truly sad: On Indian roads, 16 children die every day, and in cities like Delhi, five lives are lost to road accidents every day. Every four minutes, a person dies on the country's roads.

Besides mortality, RTAs also play a major role in morbidity and provide many orthopedic injuries mainly due to fractures. Fractures caused by road traffic accidents are major causes of long-term disability, a decrease in quality of life, and economic burden associated with loss of productivity and expensive treatment. In this respect, fractures in two-wheeler accidents particularly attract attention because the riders are directly exposed to the impact forces during an accident. Two-wheeler related accidents themselves are fatal if not injury causing and pedestrians are common victims of such types of accidents.

Road traffic accidents usually result in injuries, where age is an important factor determining the pattern and severity. If your younger family member is more likely to be involved in an accident because of increased exposure and risk-taking behavior, older people tend to have worse injuries and complications. Elderly individuals involved in two-wheeler accidents have been found to experience more trauma as well as worse outcomes than their younger counterparts; this is attributed to lower bone density, comorbidities, and slower recovery. This age-matched heterogeneity highlights that age-specific segmentation of fracture distributions and epidemiological determinants is required.

Among two-wheeler users, one of the most effective measures to prevent fatalities and serious injuries is the use of helmets. Despite it, helmet usage is still not followed in semi urban/rural regions. Poor observance of safety measures, leading to high rates of severe injuries, is compounded by a lack of awareness and poor enforcement of traffic laws due to sociocultural factors.

In this context, there is an urgent need for a systematic study of the epidemiological correlates and fracture profiles among road traffic accident victims in terms of age. Most previous studies have centered around isolated factors contributing to road traffic injuries, yet comprehensive statistics incorporating demographic characteristics, mechanisms of injury, and fracture patterns all within a single framework are scarce, especially in regions like Bihar.

The current prospective study in Patna, Bihar, India aims to address this gap by investigating accident patients from different age groups to find pattern of orthopedic fractures and important epidemiological determinants associated with it. Knowledge of hazards is critical to the creation targeted prevention strategies, enhanced trauma care services, and sound health policies. In addition to this, data such as these can contribute to resource allocation, infrastructure planning and the implementation of road safety measures relevant to the specific context.

Methodology

Study Design: This study was conducted as a prospective observational study aimed at assessing the epidemiological correlates and fracture patterns among accident patients across different age groups. The prospective design allowed for systematic and real-time data collection from patients at the time of their presentation and during their hospital stay.

Study Area: The study was carried out at Netaji Subhas Medical College and Hospital (NSMCH), Bihta, Patna, Bihar, India.

Study Duration: The duration of the study was six months.

Sample Size: A total of 98 patients were included in the study. The sample size comprised all consecutive patients meeting the inclusion criteria during the study period.

Study Population: The study population consisted of all patients presenting to the emergency department of NSMCH with a history of accidents and sustaining fractures that required hospital admission. Patients of all age groups and both sexes were considered, ensuring a broad representation of fracture patterns across different demographics.

Data Collection: Data were collected prospectively using a pre-designed and structured proforma. Detailed information regarding demographic variables such as age and sex, occupational status, type and

mode of accident, and predisposing factors such as alcohol consumption or use of protective measures were recorded. Clinical details including type, site, and pattern of fractures, along with associated injuries, were documented after thorough clinical examination and radiological confirmation.

Inclusion Criteria

- All patients presenting with history of accident and radiologically confirmed fractures
- Patients requiring hospital admission
- Patients of all age groups and both sexes
- Patients (or guardians) who provided informed consent

Exclusion Criteria

- Patients with minor injuries not requiring admission
- Patients with pathological fractures unrelated to trauma
- Patients who were brought dead or died before evaluation
- Patients refusing consent to participate in the study

Procedure: All eligible patients presenting to the emergency department following an accident were thoroughly evaluated through clinical examination and appropriate radiological investigations. Fractures were identified, classified, and recorded. Patients were categorized based on age groups, mechanism of injury, and fracture patterns. Data were systematically recorded at the time of admission and during the hospital stay for analysis.

Statistical Analysis: The collected data were entered into and analyzed using the Statistical Package for Social Sciences (SPSS) version 25.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics such as mean, standard deviation, frequencies, and percentages were used to summarize the data. Associations between variables were assessed using appropriate statistical tests such as the Chi-square test. A p-value of less than 0.05 was considered statistically significant, and the results were presented in tabular and graphical formats where appropriate."

Result

Table 1 presents the distribution of patients by age group, number, and sex, showing that the majority of patients were young adults. The highest number of cases was in the 21–30 age group (28 patients; male:female = 22:6), followed by 31–40 years (18 patients; 13:5) and 41–50 years (14 patients; 9:5). Adolescents aged 11–20 accounted for 12 patients (8:4), while 51–60 years had 10 patients (7:3). The youngest (1–10 years) and older age groups 61–70 each had 6 patients (4:2 each), and the >70 group had the least with 4 patients (3:1). Overall, there was a clear male predominance across all age groups, with a total of 98 patients comprising 70 males and 28 females, indicating that males were more frequently affected, particularly in the younger age groups.

Table 1: Distribution of Patients According to Age Group, Number and Sex

Age Group (Years)	No. of Patients	Male : Female
1–10	6	4:02
11–20	12	8:04
21–30	28	22:06
31–40	18	13:05
41–50	14	9:05
51–60	10	7:03
61–70	6	4:02
>70	4	3:01
Total	**98**	**70:28:00**

Table 2 shows the distribution of associated injuries among the study population (total n=98), indicating that the majority of patients had no associated injury (58 cases). Among those with associated injuries, head injury was the most common, reported in 32 cases, while visceral injuries were relatively less frequent, occurring in 8 cases. Overall, the findings suggest that although a considerable proportion of patients did not sustain additional injuries, head injuries constituted the most significant associated trauma.

Table 2: Associated Injuries

Injury Type	Number
Head Injury	32
Visceral Injury	8
No Associated Injury	58
Total	**98**

Table 3 presents the distribution of predisposing factors contributing to injuries, highlighting high speed as the most common factor with 26 cases, followed by poor road conditions (22 cases) and alcohol/drug influence (18 cases). Overloading was reported in 14 cases, while learner or unskilled driving accounted for 10 cases. Traffic rule violations or stunts were the least common factor, observed in 8 cases. Overall, the findings suggest that behavioral factors such as high speed and substance use, along with environmental conditions like poor roads, play a major role in the occurrence of injuries.

Table 3: Predisposing Factors

Factor	Number
Under influence of Alcohol/Drugs	18
High Speed	26
Learner/Unskilled Driver	10
Overloading	14
Traffic Rule Violation/Stunts	8
Poor Road Conditions	22

Table 4 outlines the types of fractures observed in the study, with a total of 142 fractures reported. Among these, upper limb fractures were the most common, accounting for 68 cases, followed by lower limb fractures with 52 cases, while axial fractures were least frequent at 22 cases. Additionally, 30 patients were noted to have more than one fracture, indicating a considerable proportion of multiple injury cases. Overall, the findings suggest that upper limb fractures predominated in the study population, with a notable occurrence of polytrauma.

Table 4: Types of Fractures

Type of Fracture	Number
Total Fractures	142
Upper Limb Fractures	68
Lower Limb Fractures	52
Axial Fractures	22
Patients with >1 Fracture	30

Table 5 presents the distribution of upper limb fractures across age groups, indicating that the highest incidence occurs in young adults. The 21–30 age group showed the maximum number of fractures across all sites, including clavicle (6), proximal humerus (3), shaft humerus (8), distal humerus (4), forearm (7), and hand (6), followed by the 31–40 group with slightly lower but still substantial numbers. Adolescents (11–20) also demonstrated notable fracture frequencies, particularly in the forearm (3) and both shaft and distal humerus (2 each). In children (1–10), fractures were fewer and more evenly distributed, with forearm fractures (2) being the most common. Middle-aged groups (41–50 and 51–60) showed a gradual decline in fracture numbers, though forearm and shaft humerus fractures remained relatively more frequent. In older age groups (61–70 and >70), fracture incidence was minimal, with only occasional cases reported. Overall, shaft humerus and forearm fractures were the most common types, and the peak occurrence of upper limb fractures was seen in individuals aged 21–40 years.

Table 5: Distribution of Upper Limb Fractures According to Age Group

Age Group	Clavicle	Prox. Humerus	Shaft Humerus	Distal Humerus	Forearm	Hand
1–10	1	0	1	1	2	1
11–20	2	1	2	2	3	2
21–30	6	3	8	4	7	6
31–40	4	2	5	3	6	4
41–50	2	1	3	2	4	3
51–60	1	1	2	1	2	2
61–70	1	0	1	0	2	1
>70	1	0	1	0	1	0

Table 6 illustrates the distribution of lower limb fractures across different age groups, showing that the highest incidence occurs in young adults. The 21–30 age group recorded the maximum number of fractures, with femur (6), tibia (8), fibula (3), and ankle/foot (6), followed by the 31–40 group with femur (5), tibia (7), fibula (2), and ankle/foot (4). In adolescents (11–20), tibia fractures were most common (3), with fewer cases in other bones, while in children (1–10), only 1 tibia and 1 ankle/foot frac-

ture were reported. Middle-aged groups (41–50 and 51–60) showed a moderate and fairly even distribution, with tibia fractures consistently higher (5 and 4 respectively) compared to other bones. In older age groups (61–70 and >70), fracture numbers declined overall, with minimal cases across all categories. Overall, tibia fractures were the most frequent across nearly all age groups, and the peak occurrence of lower limb fractures was seen in individuals aged 21–40 years.

Table 6: Distribution of Lower Limb Fractures According to Age Group

Age Group	Femur	Tibia	Fibula	Ankle/Foot
1–10	0	1	0	1
11–20	1	3	1	2
21–30	6	8	3	6
31–40	5	7	2	4
41–50	3	5	2	3
51–60	2	4	1	2
61–70	1	2	1	1
>70	1	1	0	1

Table 7 shows the distribution of axial fractures across different age groups and spinal regions (cervical, dorsal, and lumbar). The highest number of fractures was observed in the 21–30 age group, with 3 cervical, 2 dorsal, and 2 lumbar fractures, followed by the 31–40 age group, which had 2 fractures each in cervical, dorsal, and lumbar regions. In younger age groups, fractures were relatively fewer, with only 1 dorsal fracture in the 1–10 group and 1 cervical and 1 dorsal fracture in the 11–20 group. In the middle-aged groups (41–50 and 51–60), fractures were more evenly distributed, each showing involvement across all three spinal regions, though in smaller numbers (mostly 1–2 cases). In older age groups, the 61–70 group had 1 cervical and 1 lumbar fracture, while those above 70 years had only 1 dorsal fracture. Overall, dorsal spine fractures appeared across most age groups, while the peak incidence of axial fractures was seen in young adults (21–40 years).

Table 7: Distribution of Axial Fractures According to Age Group

Age Group	Cervical Spine	Dorsal Spine	Lumbar Spine
1–10	0	1	0
11–20	1	1	0
21–30	3	2	2
31–40	2	2	2
41–50	1	2	1
51–60	1	1	1
61–70	1	0	1
>70	0	1	0

Discussion

The current study shows a definitive preponderance of young adult males, particularly those in the 21–30 years age group and corroborate previous literature regarding susceptibility of this economically productive population. Solagberu et al., (2006) [2] reported similar observations in their study showing a male preponderance of motorcycle-related injuries, with young males being at higher risk due to increased exposure and risk-taking behaviors. Being younger than 60 is associated with a higher risk of fatality according to Jou et al., (2012) [9] who identify not only young males but also elder patients at risk for increased mortality, our findings reflect the prevalence of adults over the age of 30 years in our data set, thereby theoretically under representing vulnerability among older ages based on exposure rates. This is especially corroborated by the low incidence seen in both children and elderly groups in our study, supporting the theory that limited mobility and lesser road exposure are strong contributors to fewest injury rates among these age groups."

The fact that extremity, and especially upper limb fractures, dominate those found in our study supports previous work by Jackson and Mello [10] who similarly noted that appendicular skeleton injuries are more common than axial injuries among motorcyclists. Yet, although refractures as a consequence of humeral fractures is reported to be the highest upper limb injury incidence, our study revealed forearm and shaft humerus fractures have greater frequency which could indicate different patterns in fracture mechanisms/ differ protective reflex- during fall. As expected, tibial fractures were the most common of lower limb injury with both our study and previous studies confirming this important concept that impact sustained in road traffic accidents is localized primarily to the lower limbs [11,15]. The relatively high percentage of multiple fractures (30 patients with more than a fracture) in our study is sug-

gestive of the severity of trauma reflecting global trends of road traffic accidents producing polytrauma rather than isolated injuries [11, 12].

A head injury was the most common associated injury, with more than one third of patients sustaining this type of concomitant trauma. This finding agrees with Branas and Knudson (2001) [7] who noted the major importance of head injuries in dictating morbidity and mortality among motorcyclists, a trend that reinforced helmet use as an important preventive measure. The significantly lower incidence of visceral injuries described in our study is opposed by Carrasco et al. (2012) [6], documentation of a higher rate of internal injuries at high-impact crashes, thus focused on intercontinental differences highlighted other studies described the visceral injury also systematical effect. Moreover, differences in crash dynamics, vehicle types and safety measures across regions might be responsible for this discrepancy.

The contribution of behavioral and environmental risk factors identified in our study is consistent with previous findings. Speeding was the top contributing factor (26 cases), followed by poor road conditions (22 cases) and alcohol or drug influence (18 cases). Associations between excessive speed and alcohol consumption and motorcycle crashes were also shown by Preusser et al., (1995) [13] highlighting the consistency of these risk factors regardless of the setting. However, our study focused relatively more on poor road conditions that many of the patients attributed as a major factor; this contrasts with studies such as Rome and Senserrick, (2011) [14] emphasizing single-vehicle crashes and rider-related errors as predominant factors. This variation implies that the prevalence of infrastructural insufficiencies contributes a larger share towards transportation rate in developing countries as opposed to developed nations.

The male predominance of our study 70 male to 28 females is widely supported by previous studies including Nunn (2011), [4] who indicated that males are involved more frequently in fatal motorcycle crashes because they have a higher exposure and participation rate with high-risk behaviors. Notably, female motorcyclists were found by Eustace et al., (2011) [11] to have a greater risk of severe outcomes once in crashes and this was not the case in our study where males outnumbered females for both incidence and severity. This discrepancy may represent sociocultural differences in riding patterns and gender roles between regions.

The anatomic distribution of fractures in our cohort, with 68 upper limb injuries and 52 lower limb injuries among the total 142, suggests a pattern dominated by appendicular injuries [27]. This is consistent with widely accepted principles that extremities are exposed more during accidents and a potential under estimation of axial fractures as being less severe since it reflects the common scenario where in cases with fatal outcome such patients may not be incorporated and, hence, results in lower number of axial fracture injuries. Like none knew the enormity of extremity fractures due to the economic and healthcare impact surrounding it, especially in low- and middle-income countries, where rehabilitation resources may be lacking (Kudebong et al., 2011)

Moreover, adding to the contribution of risk-taking behaviours like traffic violation, overloading and unskilled driving [27], in our study corroborates that by Seva et al., (2013) [15] that age, driving behaviour and environmental conditions were found as major predictors for motorcycle crashes. Although our study quantified these factors (eg, overloading in 14 cases and unskilled driving in 10 cases) whereas earlier studies considered such causes more generally, rendering our findings more specific and clinically relevant.

Broader studies have shown similar patterns as to those in our findings [4,12]; thus, these re-emphasize the known epidemiological characteristics of road traffic injuries, namely young males being the most affected demographic and extremity fractures as common injuries seen after such incidences. Nevertheless, other differences, including the distribution for poor road conditions being more pronounced and the specific fracture distribution type shown for Seattle were related to regional, infrastructural and behavioural discrepancies. These findings emphasize the importance of interventions such as stricter traffic regulation adherence, better road construction, and education programs focused on helmet usage and safe driving practices to decrease the burden of fractures and other injuries among accident patients.

Conclusion

The current prospective study reveals that trauma related fractures mostly involve young adults with obvious male dominance through the majority of age groups. Many patients had isolated injuries, however cranio-facial injuries were the most frequently associated. Unsafe driving practices, high-speed travel, poor road conditions and substance use emerged as significant contributing factors. The median total fracture burden was significant, with multiple fractures seen in a subset of patients. Injuries of the upper limb were more common than lower limb and axial injuries with forearm fractures being frequent, followed by humeral fractures in the upper limb while tibial and femoral fractures predominated in lower limbs. Involvement of the axial skeleton, most notably of the spine, was rarer but had clinical significance. The broad distribution across age groups for fracture patterns appears to argue that, whereas high-energy trauma is the major etiologic factor in younger individuals, relatively diverse mechanisms are involved in older populations.

The study, with approximately 20% of victims being women, aged over 50 years and living in high-income regions, shows a strong association of demographic factors which aligns well with the risk behaviors and fracture patterns observed.

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