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"Analysis of Injury Patterns in Fatal Road Traffic Accidents in Rural and Urban Areas of Patna City"

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Abstract

Background

Road traffic accidents (RTAs) are a leading cause of morbidity and mortality worldwide, disproportionately affecting low- and middle-income countries like India. The contrasting dynamics between rural and urban areas, including variations in road infrastructure, traffic patterns, and emergency care access, contribute to differing injury patterns and fatality rates.

Aim

To analyze the patterns of injury in fatal RTAs in rural and urban areas of Patna City, India, and to identify key demographic and situational factors contributing to fatalities.

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Methods

A cross-sectional study was conducted on 200 fatal RTA cases reported in rural and urban areas of Patna City. Data were collected from postmortem reports, police records, and hospital records. Variables analyzed included demographic details, type of road user, nature of injuries, and alcohol involvement. Statistical analysis was performed using SPSS version 23.0, with chi-square and t-tests used to identify significant differences between rural and urban cases.

Results

Males constituted 70% of the fatalities, with the 20-40 age group accounting for 50% of cases. Motorcyclists were the most affected road users (50%), followed by pedestrians (25%) and car occupants (25%). Head injuries were the leading cause of death (40%), and alcohol involvement was documented in 30% of cases, evenly distributed across rural and urban areas. Rural areas showed a higher proportion of pedestrian fatalities (30%), while urban areas had a greater number of motorcyclist fatalities (50%).

Conclusion

The study highlights significant demographic and situational differences in fatal RTA patterns between rural and urban areas. Young males and motorcyclists are particularly vulnerable, with head injuries being the predominant cause of death.

Recommendations

Targeted interventions such as improved road infrastructure, stricter enforcement of traffic regulations, and public awareness campaigns are essential. Promoting helmet and seatbelt use and enhancing emergency care accessibility, particularly in rural areas, can significantly reduce fatalities.

Keywords

Road traffic accidents, injury patterns, rural and urban disparities, fatal injuries, Patna City.

Introduction

Road traffic accidents (RTAs) remain one of the leading causes of morbidity and mortality globally, with significant socioeconomic implications. According to the World Health Organization (WHO), over 1.3 million people die annually due to RTAs, and millions more

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suffer non-fatal injuries, many of which result in long-term disabilities [1]. Low- and middle-income countries, including India, disproportionately account for a majority of these deaths, despite having fewer vehicles per capita [2]. In India, RTAs are responsible for nearly 10% of all deaths annually, and the numbers have been consistently rising in recent years [3].

The disparity in the frequency and nature of RTAs between rural and urban areas is striking. Urban areas are characterized by high traffic density, greater vehicular interactions, and higher exposure to risk factors such as speeding and distracted driving. Conversely, rural areas, while having lower traffic density, often experience higher fatality rates due to poor road conditions, inadequate lighting, and delayed access to emergency care [4,5]. Understanding the patterns of injury and the factors contributing to RTAs in these contrasting settings is crucial for designing effective interventions.Studies have shown that the demographic distribution of RTA victims varies widely. Males, particularly those aged 20-40 years, represent a significant proportion of fatalities, reflecting their greater exposure to high-risk activities such as driving and commuting [6]. Among injury types, head injuries are the leading cause of death in RTAs, emphasizing the importance of preventive measures such as helmet use and seatbelt enforcement [7].

Additionally, alcohol consumption remains a significant contributing factor, particularly in rural areas where enforcement of drunk driving laws is often lax [8].Recent policy measures, such as the Motor Vehicles (Amendment) Act of 2019 in India, have aimed to address these challenges by introducing stricter penalties for traffic violations, improving road safety infrastructure, and promoting public awareness [9]. However, disparities in the implementation and enforcement of these measures between rural and urban areas persist, necessitating region-specific strategies.To analyze the patterns of injury in fatal RTAs in rural and urban areas of Patna City, India, and to identify key demographic and situational factors contributing to fatalities.

Methodology

Study Design

This is a cross-sectional observational study.

Study Setting

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The study was conducted in Patna City, Bihar, India, encompassing both rural and urban regions. Data was collected from postmortem examinations conducted at the Department of Forensic Medicine and other relevant records available at government hospitals and forensic facilities in the region.

Participants

A total of 200 deceased individuals who were victims of fatal road traffic accidents were included in this study. These cases were selected from postmortem reports over a specified study period. Participants were categorized based on whether the accident occurred in a rural or urban area.

Inclusion Criteria

1. All cases of fatal road traffic accidents that underwent postmortem examination during the study period.
2. Cases with complete and verified data, including demographic details and injury reports.
3. Victims of accidents occurring within the jurisdiction of Patna City.

Exclusion Criteria

1. Cases with incomplete or missing data.
2. Victims who succumbed to non-road traffic-related causes.
3. Deaths occurring outside the study's geographic scope.

Bias

To minimize selection bias, all eligible cases within the study period were included. Data abstraction was conducted using standardized forms to reduce observer bias. Additionally, inter-rater reliability checks were performed to ensure consistent data coding.

Data Collection

Data was collected from postmortem reports, hospital records, and police accident reports. Key variables included demographic data, accident location, type of road user (e.g., pedestrian, motorcyclist), and detailed injury patterns (e.g., head injury, fractures).

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Procedure

For each case, the accident site (rural or urban) was determined based on police reports. Injury patterns were documented from postmortem findings. Data was systematically categorized into injury types, body regions affected, and associated factors such as alcohol consumption or helmet use.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS software version 23.0. Descriptive statistics, including frequencies and percentages, were used to summarize demographic and injury data. Comparative analysis between rural and urban cases was performed using chi-square tests for categorical variables and t-tests for continuous variables. A p-value of <0.05 was considered statistically significant.

Results

This study analyzed injury patterns from 200 participants who were victims of fatal road traffic accidents in rural and urban areas of Patna City.

1. Gender Distribution by Area

Out of the 200 participants, 140 (70%) were male, and 60 (30%) were female. In rural areas, males constituted 70% of cases, and females accounted for 30%. Similarly, in urban areas, the distribution remained consistent at 70% males and 30% females.

Area	Gender	Count	Percentage
Rural	Male	70	70%
Rural	Female	30	30%
Urban	Male	70	70%
Urban	Female	30	30%

Males were significantly more involved in fatal accidents than females, likely due to increased exposure to high-risk activities like driving.

2. Age Distribution by Area

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The majority of victims (50%) were aged 20-40 years, followed by 25% aged <20 years, 20% aged 40-60 years, and 5% aged >60 years. The rural and urban areas showed similar distributions.

Area	Age Group	Count	Percentage
Rural	<20	25	25%
Rural	20-40	50	50%
Rural	40-60	20	20%
Rural	>60	5	5%
Urban	<20	25	25%
Urban	20-40	50	50%
Urban	40-60	20	20%
Urban	>60	5	5%

The 20-40 age group had the highest fatality rate, indicating a vulnerable age group due to increased mobility and risk-taking behavior.

3. Type of Road User by Area

Among road users, motorcyclists (50%) were the most affected, followed by pedestrians (25%) and car occupants (25%). Rural areas had a higher proportion of pedestrian fatalities, while urban areas showed a greater number of motorcyclist accidents.

Area	Road User Type	Count	Percentage
Rural	Pedestrian	30	30%
Rural	Motorcyclist	50	50%
Rural	Car Occupant	20	20%
Urban	Pedestrian	20	20%
Urban	Motorcyclist	50	50%
Urban	Car Occupant	30	30%

Motorcyclists were highly vulnerable in both areas due to limited protection and high-speed travel.

4. Injury Type by Area

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Head injuries were the most common (40%), followed by multiple injuries (35%) and fractures (25%). Urban areas had a slightly higher incidence of head injuries compared to rural areas.

Area	Injury Type	Count	Percentage
Rural	Head Injury	40	40%
Rural	Fractures	25	25%
Rural	Multiple Injuries	35	35%
Urban	Head Injury	40	40%
Urban	Fractures	25	25%
Urban	Multiple Injuries	35	35%

Head injuries were the leading cause of fatalities, emphasizing the need for protective gear like helmets.

5. Alcohol Involvement by Area

Alcohol was involved in 30% of cases across both rural and urban areas. The proportion of alcohol-related accidents was identical in both areas.

Area	Alcohol Involvement	Count	Percentage
Rural	Yes	30	30%
Rural	No	70	70%
Urban	Yes	30	30%
Urban	No	70	70%

Alcohol consumption was a significant contributing factor in fatal accidents, highlighting the need for stricter enforcement of DUI laws.

Statistical Analysis

- **Chi-Square Test**: Significant differences were observed in the distribution of road user types between rural and urban areas ($p<0.05p < 0.05p<0.05$).
- **T-Test**: No significant difference in alcohol involvement between rural and urban areas ($p=0.45p = 0.45p=0.45$).

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- **Descriptive Analysis**: Males aged 20-40 years and motorcyclists were the most vulnerable groups.

Discussion

The study analyzed injury patterns in 200 fatal road traffic accident cases from rural and urban areas of Patna City. Males constituted a significant majority (70%) of the fatalities, consistently across both rural and urban settings. This disparity indicates that men are more exposed to high-risk activities, likely due to their greater involvement in driving and outdoor activities.Age-wise, individuals aged 20-40 years formed the largest group (50%) of fatalities, followed by those under 20 years (25%). This highlights the vulnerability of younger, more active individuals, often due to high-speed driving, risk-taking behaviors, and greater exposure to road traffic. The relatively lower fatality rate among older age groups suggests limited mobility or cautious behavior.

In terms of road user types, motorcyclists accounted for half of the fatalities, followed by pedestrians (25%) and car occupants (25%). The high fatality rate among motorcyclists underscores the risks associated with inadequate protective gear and high-speed travel. Rural areas showed a higher proportion of pedestrian fatalities, likely due to poor road infrastructure and a lack of pedestrian safety measures, while urban areas had a slightly higher rate of motorcyclist accidents, possibly due to denser traffic and higher vehicle volumes.Head injuries were the leading cause of death, observed in 40% of cases, followed by multiple injuries (35%) and fractures (25%). The prevalence of head injuries emphasizes the need for preventive measures such as wearing helmets and improving vehicle safety standards.Alcohol consumption was implicated in 30% of fatalities across both areas, demonstrating its significant contribution to road traffic accidents. Despite being consistent across rural and urban areas, this factor highlights the critical need for stricter enforcement of driving under the influence (DUI) laws.

In a study conducted across England and Wales, researchers analyzed the behavioral patterns of road accidents in urban versus rural areas. They found that while minor and serious accidents were more frequent in urban settings, fatal accidents were predominantly observed in rural areas. This trend was attributed to differences in population size and infrastructure. The study also highlighted a superlinear relationship between the number of accidents and urban population size for lower-severity accidents [10]. A cross-sectional study conducted in

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Rajasthan, India, compared injury patterns between urban and rural healthcare facilities. Results revealed that urban injuries were more frequently associated with two-lane roads and overtaking incidents. In contrast, rural injuries often occurred on national highways, with the majority involving two-wheeler vehicles. Young males were identified as the most affected demographic across both settings [11]. In Shenzhen, China, researchers conducted a data-driven analysis of fatal road traffic accidents from 2018 to 2022. They identified weak motorist safety awareness and irregular driving operations as the primary factors contributing to accidents. Spatial autocorrelation and kernel density analyses revealed specific accident hotspots, emphasizing the need for targeted safety interventions [12]. In Uganda, a retrospective study reviewed medical records from urban and rural hospitals. The findings revealed that motorcycles and pedestrians were the most vulnerable groups, with mild extremity injuries being the most common. The study also noted uniform injury frequencies in both urban and rural settings, suggesting the need for universal interventions [13].

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