DESCRIPTIVE STUDY OF DIFFERENT TYPES OF ROAD TRAFFIC ACCIDENTS AT A TERTIARY CARE CENTRE IN KATHMANDU CITY

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ABSTRACT

Road traffic accidents (RTAs) pose a major public health issue worldwide, resulting in over 3,000 fatalities each day across the globe. Low- and middle-income nations account for roughly 85% of these deaths and 90% of the annual disability-adjusted life years lost. Nepal is ranked 79th in the world for RTA-related fatalities, making it the 11th leading cause of death in the nation. Factors such as difficult terrain, adverse weather, insufficient infrastructure, and poor traffic management significantly contribute to the elevated accident rates. The purpose of this study was to examine the epidemiological features of road traffic accidents in Kathmandu, with an emphasis on demographic trends, temporal distribution, types of vehicles involved, and patterns of injury. A retrospective hospital-based study was carried out at Nepal Medical College Teaching Hospital from January 1, 2021, to December 31, 2021. All cases of RTA in Kathmandu who presented to our hospital were included in this study. All complete RTA cases within the city of Kathmandu were included in the analysis. Data were gathered concerning age, sex, injury locations, time of occurrence, and day of the week. Statistical analysis was conducted using SPSS version 21. During the study period, a total of 296 RTA cases were documented. Males accounted for 219 cases (73.99%) compared to 77 females (26.01%), resulting in a male-to-female ratio of 2.84:1. The age group most affected was 20-29 years (217 cases, 73.31%). Friday had the highest number of accidents (113 cases, 38.18%), with peak occurrences during daytime hours (143 cases, 48.31%). Two-wheelers were involved in 244 cases (82.43%), making them the most prevalent type of vehicle. Extremity injuries were the most common (290 cases, 97.97%), followed by head injuries (113 cases, 38.18%). Young males aged 20-29 years using two-wheelers are at highest risk for RTAs. The predominance of extremity and head injuries emphasizes the critical need for helmet use and improved road safety measures. Targeted interventions including strict traffic law enforcement, infrastructure improvements, and public awareness campaigns are essential to reduce RTA incidence and severity.

KEYWORDS

Epidemiology, injuries, Nepal, road safety, road traffic accidents

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INTRODUCTION

Road traffic systems represent one of the most perilous environments in our everyday lives, significantly contributing to global morbidity and mortality. The World Health Organization (WHO) indicates that over 3,000 people lose their lives each day due to road traffic injuries worldwide.[1]This issue disproportionately impacts low- and middle-income nations, which account for roughly 85% of fatalities and 90% of annual disability-adjusted life years lost as a result of road traffic injuries. [2]

The WHO designated "Safe Roads" as the theme for World Health Day 2004, highlighting the vital importance of preventing road traffic accidents. Nepal encounters specific challenges regarding road safety due to its distinct geographical and infrastructural features.[3] The country's steep terrain, mountainous areas, roads affected by monsoons, insufficient traffic control systems, and poor visibility caused by pollution create a high-risk environment for road users.

The road safety statistics in Nepal are alarming, with the nation ranking 79th globally for deaths related to road traffic accidents. Road traffic accidents are the 11th leading cause of death in Nepal.[4] The national road network extends over 26,900 kilometers, accommodating around 1,995,400 registered vehicles. According to statistics from the Nepal Traffic Police for 2018-2019, there were 8,918 vehicle accidents, resulting in 254 fatalities. In the first four months of the fiscal year 2019-2020, Nepal experienced 4,171 accidents that claimed 69 lives.[5]

Road traffic injuries pose a significant public health challenge that necessitates a thorough epidemiological analysis. Most accidents occur not due to ignorance but rather due to carelessness, recklessness, and overconfidence.[6] Human factors, vehicle conditions, and environmental circumstances interact before, during, and after traumatic incidents. The healthcare system faces a considerable burden from road traffic injuries due to increased hospital admissions and the treatment of severe injuries.[7,8]

Comprehending local epidemiological trends is essential for formulating effective prevention strategies. This study was carried out to find out the RTA and its demographic pattern, along with the vehicle type and injury types in Kathmandu. This research seeks to delineate road traffic accidents in Kathmandu City, examining demographic patterns, temporal distribution, vehicle participation, and injury characteristics to guide evidence-based intervention strategies.

MATERIALS AND METHODS

This was a retrospective hospital-based study where analysis of data was included from January 1st 2021 to December 31st 2021. Ethical approval was obtained from Nepal Medical College Institutional Review Committee (Ref. No.: 28-081/082). Informed consent in writing was acquired from all participants or their legal guardians.

All cases of road traffic accidents that presented to Nepal Medical College Teaching Hospital during the study period, those with availability of complete medical records and accidents that occurred within the metropolitan area of Kathmandu city, specifically including all areas under Kathmandu Metropolitan City administration were included in the study. While the ones with incomplete medical records, accidents that took place outside the city limits of Kathmandu and cases lacking essential demographic or clinical information were excluded from this study. Thorough data were gathered for each case, which included, demographic details (age, sex), temporal factors (time of day, day of the week), type of vehicle involved, anatomical locations of injuries and severity and patterns of injuries.

The data were coded and entered into SPSS -21. Descriptive statistics were computed, with results presented as frequencies and percentages. Chi-square tests were conducted to evaluate associations between categorical variables, with statistical significance established at $p < 0.05$. The Chi-square test was specifically utilized to compare the distribution of gender across various age groups, analyze the relationship between vehicle type and injury severity, examine temporal patterns and their correlation with accident characteristics, and assess the connection between the day of the week and the frequency of accidents.

RESULTS

Overall demographics: During the one-year study period, 296 road traffic accident cases were registered at the tertiary care center. The demographic analysis revealed significant gender disparity and age-specific patterns.

Gender distribution: Male victims significantly outnumbered females, comprising 219 cases (73.99%) compared to 77 females (26.01%). The male-to-female ratio was 2.84:1, indicating

Table 1: Gender distribution of RTA victims			
Gender	**n (Cases)**	**%**	**P-value**
Male	219	73.99	< 0.001*
Female	77	26.01	< 0.001*
Total	**296**	**100.00**	

males were nearly three times more likely to be involved in road traffic accidents. The gender distribution was statistically significant (P <0.001).

Age group analysis: The age distribution showed marked concentration in young adults. The 20-29 years age group was most affected, representing 217 cases (73.31%), which was statistically significant (P <0.001). Combined with the 30-39 years group, individuals aged 20-39 years comprised 249 cases (84.12%) of all victims. Notably, no victims under 10 years were recorded, while those over 60 years represented only 2.70% of cases. The concentration of cases in the 20-29 age group was statistically significant compared to other age groups.

Table 2: Age Distribution of RTA Victims			
Age (years)	**n (Victims)**	**%**	**P-value**
<10	0	0.00	<0.001*
10-19	9	3.04	<0.001*
20-29	217	73.31	<0.001*
30-39	32	10.81	0.842
40-49	19	6.42	0.156
50-59	11	3.72	0.023*
≥ 60	8	2.70	0.001*
Total	**296**	**100.00**	

Temporal distribution

Time of Day: Daytime hours showed the highest accident frequency with 143 cases (48.31%), which was statistically significant (P <0.001). This was followed by nighttime with 71 cases (23.99%, P =0.892), evening hours recorded 67 cases (22.64%, P =0.341), while morning hours showed the lowest incidence with only 15 cases (5.07%, P <0.001).

Day of the week: Friday emerged as the most dangerous day with 113 accidents (38.18%), which was statistically significant (P <0.001), followed by Saturday with 66 cases (22.30%, P <0.001). Sunday recorded 47 cases (15.88%, P <0.001), while Monday showed the lowest incidence with only 13 cases (4.39%, P <0.001). All daily distributions showed statistical significance when compared to expected equal distribution across weekdays.

Table 3: Time distribution of RTAs			
Time Period	**n (Accidents)**	**%**	**P-value**
Morning	15	5.07	< 0.001*
Daytime	143	48.31	< 0.001*
Evening	67	22.64	0.341
Night	71	23.99	0.892
Total	**296**	**100.00**	

Table 4: Daily distribution of RTAs			
Day	**n (Accidents)**	**%**	**P-value**
Sunday	47	15.88	< 0.001*
Monday	13	4.39	< 0.001*
Tuesday	19	6.42	0.002*
Wednesday	17	5.74	< 0.001*
Thursday	21	7.09	0.008*
Friday	113	38.18	< 0.001*
Saturday	66	22.30	< 0.001*
Total	**296**	**100.00**	

Table 5: Vehicle types involved in RTAs			
Vehicle type	**n (Accidents)**	**%**	**P-value**
Two-wheelers	244	82.43	< 0.001*
Three-wheelers	5	1.69	< 0.001*
Heavy vehicles	47	15.88	< 0.001*
Total	**296**	**100.00**	

Vehicle type analysis: Two-wheelers dominated accident statistics, involved in 244 cases (82.43%), which was statistically significant (P <0.001). Heavy vehicles accounted for 47 cases (15.88%, P <0.001), while three-wheelers were least commonly involved with only 5 cases (1.69%, P <0.001). The predominance of two-wheeler involvement was statistically significant compared to other vehicle types.

Table 6: Anatomical distribution of injuries			
Site of Injury	**Total (n)**	**%**	**P-value**
Head	113	38.18	< 0.001*
Face	32	10.81	0.023*
Chest	79	26.69	0.008*
Spine	57	19.26	0.045*
Abdomen	88	29.73	0.003*
Extremities	290	97.97	< 0.001*

Injury pattern analysis: Extremity injuries were overwhelmingly common, occurring in 290 cases (97.97%, P <0.001), which was statistically significant. Head injuries followed

with 113 cases (38.18%, P <0.001), then abdominal injuries with 88 cases (29.73%, P =0.003). Chest injuries occurred in 79 cases (26.69%, P =0.008), spinal injuries in 57 cases (19.26%, P =0.045), and facial injuries in 32 cases (10.81%, P =0.023). All injury patterns showed statistical significance in their distribution.

DISCUSSION

This comprehensive analysis of road traffic accidents at a tertiary care center in Kathmandu reveals several critical epidemiological patterns that have significant implications for public health policy and injury prevention strategies.

Gender and age demographics: The notable male predominance (73.99% vs 26.01%) with a male-to-female ratio of 2.84:1 is in agreement with earlier studies conducted in Nepal and other developing nations. This observation aligns with the research conducted by Bhandari *et al*[9] at Nepalgunj Medical College, which indicated a comparable gender distribution (67.8% male vs 32.2% female). The male predominance can be explained by various sociocultural factors: increased male participation in outdoor activities, greater engagement in income-generating jobs that necessitate travel, cultural norms that favor male driving, and possibly more aggressive or risk-taking driving behaviors among males.

The high concentration of accidents within the 20-29 years age group (73.31%) signifies a demographic crisis, as this segment represents the economically productive workforce. The susceptibility of this age group arises from several factors, including inexperience in driving, a propensity for risk-taking behaviors, a higher likelihood of substance use, peer pressure that leads to reckless driving, and increased exposure to traffic due to work and social engagements. The almost complete absence of pediatric cases (0% under 10 years) likely indicates limited independent mobility in this age group, while the low representation of elderly individuals (2.70% over 60 years) may suggest reduced driving exposure or potentially higher fatality rates within this vulnerable demographic.

Temporal patterns and risk factors: The prevalence of accidents during the day challenges the widely held belief that nighttime driving poses greater risks. The peak hour of RTA in our study showed day time i.e.48.31% followed by night time i.e.23, 99 % This result was similar to the result shown by Nepalgunj Medical College, Kohalpur which showed the peak hour of RTA was 6PM to 10PM.[9] This trend implies that the high volume of traffic during peak hours, rather than issues related to visibility, could be the main temporal risk factor. The surge in activity during daytime aligns with commercial operations, school schedules, and office hours, resulting in heightened vehicle and pedestrian traffic. Nevertheless, the significant number of accidents occurring at night (23.99%) is still alarming, likely due to factors such as diminished visibility, driving under the influence, and insufficient street lighting infrastructure.

The peak in accidents on Fridays (38.18%), followed by Saturdays (22.30%), suggests a weekend effect, which may be linked to increased leisure travel, social events, and possibly elevated levels of alcohol consumption. This result somehow shows similar results of the RTA during weekend the result of which was conducted by department of National medical college and teaching hospital, Birgunj from August 2022 to July 2023 by Sanjay and his team.[21] This trend has been documented in numerous international studies and indicates that interventions tailored for weekends, such as intensified traffic enforcement and public awareness initiatives, could be particularly beneficial.

Vehicle-specific risk analysis: The significant prevalence of two-wheelers (82.43%) is a crucial observation that contrasts with findings from some earlier research. Sah *et al*[21] noted similar results in central-southern Nepal, whereas Bhandari *et al*[9] indicated a higher involvement of four-wheelers (65.4%). This variation may indicate regional disparities in transportation habits, economic influences on vehicle ownership, and the characteristics of local traffic infrastructure.

The notable involvement of two-wheelers can be ascribed to various factors: motorcycles and scooters are the most accessible and economical means of transport for the population of Nepal; their inherent instability compared to four-wheelers renders them more prone to accidents.[10] Their ability to maneuver through traffic encourages risky overtaking practices; younger, less experienced riders frequently choose two-wheelers as their initial vehicles; and the absence of protective barriers increases the risk of injury for riders during accidents.

The comparatively low participation of three-wheelers (1.69%) likely mirrors their limited speed capabilities and specific usage patterns. The involvement of heavy vehicles (15.88%) raises significant concerns due to the heightened

risk of severe injuries and fatalities associated with accidents involving these vehicles.

Injury pattern analysis and clinical implications: The nearly universal prevalence of extremity injuries (97.97%) highlights the precarious situation of two-wheeler riders and the frequent occurrence of being ejected from vehicles during collisions.[8] This observation carries important implications for emergency medical services and the readiness of hospitals. The elevated incidence of head injuries (38.18%) is especially alarming, as these types of injuries pose the greatest risk of lasting disability and mortality.

The pattern of injuries observed diverges markedly from earlier research. Malhotra *et al*[11] identified head and neck injuries as the most prevalent (57.3%), whereas our investigation indicates that extremities are the primary areas affected. This discrepancy may be attributed to differences in the mechanisms of accidents, helmet usage trends, vehicle velocities, or the characteristics of the study population.

The significant rates of abdominal (29.73%) and chest injuries (26.69%) underscore the multi-faceted nature of road traffic injuries, necessitating robust emergency response capabilities and interdisciplinary treatment strategies. Although spinal injuries (19.26%) are less common, they represent particularly severe complications that can lead to permanent disability.[14]

Healthcare system implications: The identified patterns carry significant consequences for the allocation of healthcare resources and the preparedness for emergencies. The high incidence of cases among young males highlights the necessity for focused prevention initiatives aimed at this specific demographic. The prevalence of accidents involving two-wheelers underscores the urgent need for specialized trauma protocols tailored to motorcycle-related injuries. [15]

The elevated occurrence of extremity injuries calls for sufficient orthopedic surgical resources, whereas the considerable rates of head injuries necessitate the availability of neurosurgical expertise and intensive care facilities. The complex, multi-system nature of these injuries requires well-coordinated trauma teams and comprehensive emergency services.[16]

Limitations and future research directions: This research has various limitations that must be recognized. Being a single-center study, the results may not be applicable to other areas of Nepal or nations with differing traffic patterns. The hospital-based approach may lead to selection bias, as more serious cases are likely to be referred to tertiary care facilities, while less severe injuries may be treated in other locations or remain unreported.

The retrospective nature of the study restricts the thoroughness of the analysis concerning causative factors such as alcohol consumption, specific road conditions, weather influences, or detailed circumstances surrounding accidents. Future prospective research that includes these variables would yield more comprehensive insights.

Moreover, the study did not evaluate long-term outcomes, rates of disability, or the socioeconomic effects of injuries, which are significant areas for future investigation. Population-based studies would offer more accurate estimates of actual accident incidence rates and associated risk factors.

Additionally, the statistical analyses, particularly Chi-square tests for temporal distributions (e.g., evening and night periods) and injury patterns, showed minor discrepancies in p-values, likely stemming from the use of specific expected frequencies derived from population data or prior studies rather than a uniform distribution, or adjustments in SPSS software. For injury patterns, the percentages exceeding 100% (totaling 222.64%) indicate multiple injuries per case, rendering standard Chi-square tests assuming mutually exclusive categories inappropriate; instead, the study appears to have employed binomial or individual Chi-square tests for each injury type (presence vs. absence), which may introduce variability if expected frequencies are not explicitly detailed.

Public health and policy implications: The results of this research carry significant implications for public health policy and intervention strategies:

1. Targeted prevention programs: The high incidence of accidents among young males operating two-wheelers calls for demographic-specific intervention initiatives, which should include mandatory safety training, stricter licensing regulations, and age-appropriate educational campaigns.
2. Infrastructure improvements: The observed temporal patterns indicate a necessity for enhancements in traffic management during peak hours and improved lighting for safety at night. Modifications to road infrastructure, such as the addition of

dedicated motorcycle lanes and upgraded traffic signals, could lead to a reduction in accident rates.

3. Legislative measures: The rigorous enforcement of helmet laws, speed limits, and licensing requirements could have a substantial effect on the injury patterns noted. The elevated incidence of head injuries in two-wheeler accidents highlights the critical need for helmet usage.
4. Emergency medical system enhancement: The identified injury patterns necessitate corresponding advancements in pre-hospital care, emergency department protocols, and specialized treatment capabilities.
5. Public awareness campaigns: Awareness programs tailored to specific weekends and demographics could effectively address the temporal and population-specific risk patterns identified.

This research offers essential baseline data for comprehending road traffic accident patterns in Kathmandu and acts as a foundation for formulating evidence-based prevention strategies. The findings underscore the pressing need for comprehensive, multi-sectoral approaches to road safety that tackle the specific risk patterns identified within Nepal's distinct context.

This research uncovers concerning trends regarding road traffic accidents in Kathmandu, where young males aged 20-29 years constitute the demographic at the highest risk. The significant involvement of two-wheelers (82.43%) and the almost universal incidence of extremity injuries (97.97%) underscore particular vulnerabilities within Nepal's transportation framework.

The concentration of incidents on Fridays and during daytime hours indicates potential opportunities for focused interventions. The elevated occurrence of head injuries among two-wheeler riders highlights the urgent need for helmet usage and its enforcement.

Key recommendations include:

1. Strict enforcement of helmet laws with severe penalties for violations
2. Improved driver education initiatives aimed at young males
3. Upgrades to infrastructure, such as enhanced lighting and traffic management systems
4. Targeted traffic enforcement on weekends during peak risk times
5. Public awareness initiatives that address risk-taking behaviors
6. Strengthening of emergency medical services to effectively manage the specific injury patterns identified

The healthcare system must be equipped to address the prevalent injury patterns while society adopts comprehensive prevention measures. Only through collaborative efforts that encompass traffic management, public education, legislative enforcement, and healthcare readiness can Nepal successfully tackle its road traffic accident crisis.

The results highlight that road traffic accidents are not merely a transportation concern but a significant public health crisis that necessitates immediate, evidence-based intervention strategies tailored to local epidemiological trends.

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