ORIGINAL ARTICLE

Exploring the pattern of Road Traffic Accidents over the highways: A study from western Uttar Pradesh, India

Urfi, Najam Khalique, Anees Ahmad

Department of Community Medicine, Jawaharlal Nehru Medical College, Aligarh Muslim University, Aligarh, Uttar Pradesh, India

CORRESPONDING AUTHOR

Dr. Urfi, Assistant Professor, Jawaharlal Nehru Medical College, Aligarh Muslim University, Aligarh, Uttar Pradesh, India 202001

Email: urfiislam@yahoo.com

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ABSTRACT

Background: By the year 2019, road traffic accidents (RTAs) became the leading cause of death among children and young individuals between the ages of 5 and 29 years. **Aim & Objective:** To explore the pattern and severity of road traffic injuries (RTIs) over the national highways and connecting bypass roads in the district Aligarh of Uttar Pradesh. **Methods and Material**: The study included all the individuals who met RTA over the selected stretches of roads and availed treatment at the identified hospitals over these roads. **Results:** The study finally had 1126 patients. The mean age was 31.89+13.81 years. 937 (83.2%) were males and 189 (16.8%) were females. The most common mode of transport used was two-wheelers (74.40%) followed by pedestrians (11.20%). More than half of the patients were driving the vehicles. 682 (60.60%) and 301 (26.70%) RTAs were recorded on NH91 and NH93 respectively. More than 95% of RTAs recorded had moderate to severe injuries. The severity of RTIs varied significantly with the type of transport and road user, the time and place of the crash, the collision type, and the body part primarily injured. **Conclusions:** Young males driving motorized two-wheelers are most vulnerable to moderate to severe RTIs.

KEYWORDS

Road Traffic Accident; Road Traffic Injuries; Two-Wheeler; Pedestrian; National Highway

INTRODUCTION

In 2021 alone, there were around 1.19 million road traffic deaths (1). By the year 2019, road traffic accidents (RTAs) became the leading cause of death among children and young individuals between the ages of 5 and 29 years. Putting all ages together, RTA is the 12th leading cause of death. (2,3)

In India, 4,61,312 RTAs were reported in 2022, an 11.9 percent increase compared to the previous year, killing 1,68,491 persons and injuring another 4,43,366 persons. Fatal accidents also increased during this period, with Uttar Pradesh, with 22,595 (13.4 %) deaths, accounting for the highest number of fatalities (4).

Despite contributing only 5 percent to the road networks in India, highways are predominantly involved in RTAs in more than 55 percent of total cases and 60 percent of total fatalities

due to RTAs (4). Thus the fatality rate is highest over the national highways, with the average fatality per km of road being 0.67 deaths per km annually (5).

The distribution of fatalities among road users varies significantly globally, from 30% among four-wheelers to 23% among pedestrians (6). However, in India, the highest number of RTA and fatal accidents were recorded among the two-wheelers in 2022. This was followed by occupants of four-wheelers followed by pedestrians (4).

Aim & Objective(s):

To explore the pattern and severity of road traffic injuries (RTIs) over the national highways and connecting bypass roads in the district Aligarh of Uttar Pradesh.

Material & Methods

The study included the two National highways, NH91 and NH93, passing through Aligarh district and the connecting bypass roads. Stretches of roads on NH-91, NH-93, and bypass roads were earmarked for the study. Ten hospitals comprising 08 government and 02 private hospitals were identified between the selected stretches of roads and included for data collection. The data was collected from October 2018 to November 2020. This period included 02 months of lockdown due to the COVID-19 pandemic, where data collection had to be stopped.

The study included all the individuals who met RTA over the selected stretches of roads and availed treatment at the identified hospitals over these roads. The study subjects comprised all admitted patients kept under observation or had visited the Outpatient Department (OPD).

Informed Consent: Informed verbal consent was obtained from the patients, concerned attendants, or relatives. The study subjects were assured of the confidentiality of their data. Convenience sampling was used to include the individuals.

Ethical Consideration: Ethical approval was sought from the Institutional Ethics Committee, Faculty of Medicine, Aligarh Muslim University.

Data Collection: The study tool comprised (i) standardized, prestructured, pretested, and validated proforma and (ii) the Epicollect5 mobile app.

The definition of RTA used for operational purposes in the study was: A collision involving at least one vehicle in motion on a public or private road, which results in at least one person being injured or killed (7,8). Data was entered and analyzed in IBM SPSS 20.0. Age was summarised using the mean and standard deviation, and categorical variables were summarised using percentages. The chi-square test was used to determine the association between the different variables.

Results

Table-1 Distribution of RTA cases according to the selected hospitals

Name of hospital	N (%)
Jawaharlal Nehru Medical College and Hospital (JNMC)	445 (39.5)
Malkhan Singh District Hospital	415 (36.9)
Pandit Deen Dayal Upadhyay Joint Hospital	17 (1.5)
CHC, Akrabad	84 (7.5)
CHC, Sasni	113 (10)
CHC, Gabhana	----
CHC, Jawan	20 (1.8)
PHC, Cherrat	----
Private Hospital 01	----
Private Hospital 02	32 (2.8)
Total Cases	1126

A total of 1126 patients were included in the study. (Table 1).

Age and Gender:

The minimum age recorded was 01 year, while the maximum age recorded was 85 years, with a mean age of 31.89±13.81 years.

Table-2. Distribution of the study population according to age and gender

Age Group (Yrs)	Gender		
	Male N (%)	Female N (%)	Total N (%)
<15	34 (61.8)	21 (38.2)	55 (100)
15-24	281 (88.1)	38 (11.9)	319 (100)
25-34	288 (89.4)	34 (10.6)	322 (100)
35-44	165 (83.3)	33 (16.7)	198 (100)
45-54	103 (78.6)	28 (21.4)	131 (100)
>=55	66 (65.3)	35 (34.7)	101 (100)
Total	937 (83.2)	189 (16.8)	1126 (100)

Out of a total of 1126 patients, 83.2% were males, and only 16.8% were females. The age

group of 25-34 years recorded the highest number of patients. (Table-2).

Table-3. Distribution of study population according to socio-demographic characteristics

Socio-Demographic Variable	N (%)
A. Religion	
Hindu	839 (74.5)
Muslim	270 (24.0)
Total	1126
B. Marital Status	
Married	735 (65.3)
Unmarried	389 (34.5)
Separated	1 (0.1)
Widow/ Widower	1 (0.1)
Total	1126
C. Residence	
Urban	364 (32.3)
Rural	762 (67.7)
Total	1126
D. Education	
Illiterate	354 (31.7%)
Primary	128 (11.4%)
Middle	150 (13.4%)
Highschool	199 (17.8%)
Secondary	186 (16.6%)
Graduate/Post-graduate	101 (9.0%)
Total	1118*
E. Occupation	
Unemployed	271 (25.9%)
Unskilled	326 (31.1%)
Semi-skilled	89 (8.5%)
Skilled	130 (12.4%)
Clerical/shopowner/farmer	172 (16.4%)
Semi-professional	32 (3.1%)
Professional	28 (2.7%)
Total	1048*
F. Socio-economic status	
Class I	23 (2.0%)
Class II	205 (18.2%)
Class III	424 (37.7%)
Class IV	460 (40.9%)
Class V	14 (1.2%)
Total	1126

*Note: * Not applicable*

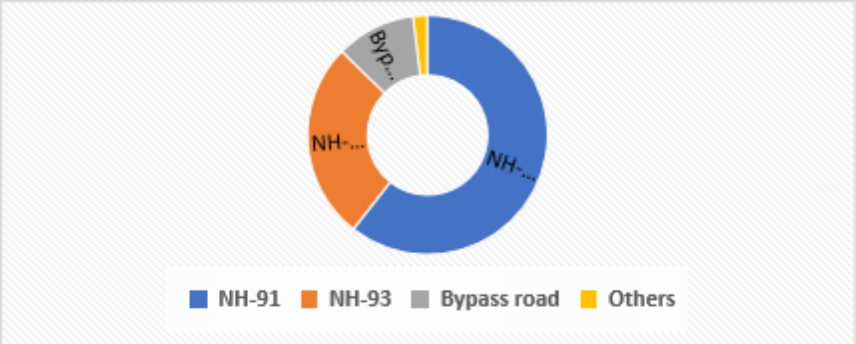
Almost 75 percent of patients were Hindus by religion, and the majority were married. The majority of the patients came from rural backgrounds. Less than a third of patients were illiterate and unskilled workers. More than three-fourths of the study subjects belonged to either class III or class IV (Table-3). The mean family income of the study population was Rs.9921.57±7233.28, ranging from Rs.1000 to Rs.1,24,000.

Type of transport used and type of road user:
838 (74.40%) of the patients used two-wheelers followed by pedestrians with 126 (11.20%). Only 34 (3.0%) patients used a car as a mode of transport. 608 (54.0%) of the patients were driving the vehicle, while 385 (34.2%) were passengers, including the pillion rider of two-wheelers.

Day and time of accident:
As far as the day of the accident is concerned, a higher number of accidents were noted during the weekdays. More than half of the accidents occurred between 4.00 pm and 12.00 am in the night.

Place of Injury:

Figure-1. Distribution of RTA cases with the roads involved



Among all the roads included in the study, 682 (60.60%) and 301 (26.70%) RTAs were recorded on NH91 and NH93, respectively (Figure 1).

Type of collision and body part injured:
The collision was noted in 954 (84.7%) of all RTAs. Collisions occurred with motorized vehicles in 867 cases, and more than half were

head-on collisions. The most frequent body part injured primarily was the lower limb, noted in 479 (42.5%) cases, followed by injury to the head in 245 (21.8%) RTAs. The most common type of injury was sprain or strain (989; 87.8%) followed by cut/open wound and fracture.

Severity of Injury:

Among the 1126 recorded RTA cases, only 63 (5.6%) had a mild grade of injuries. 505 (44.8%) and 558 (49.6%) patients had moderate and severe grades of injuries respectively.

Table-4: Distribution of severity of road traffic injuries with type of transport

Type of road transport	Severity of Injury			
	Mild	**Moderate**	**Severe**	**Total**
Pedestrian	1 (0.8%)	61 (48.4%)	64 (50.8%)	126 (100%)
2 Wheeler Motorized Vehicle	47 (5.6%)	371 (44.3%)	420 (50.1%)	838 (100%)
Car & <10 seater Vehicle	8 (14.8%)	20 (37.0%)	26 (48.1%)	54 (100%)
Bus & Truck	6 (10.2%)	28 (47.5%)	25 (42.4%)	59 (100%)
Others	1 (2.0%)	25 (51.0%)	23 (46.9%)	49 (100%)
Total	63 (5.6%)	505 (44.8%)	558 (49.6%)	1126 (100%)

chi-square value: 19.165; p-value: 0.014

More milder forms of injury were seen among those who used cars and less than ten-seater vehicles. Similarly, the proportion of milder injuries was higher among those who used buses and trucks (Table-4).

Almost all injuries among pedestrians and maximum among drivers were of moderate to severe grade (Table-5).

Table-5: Distribution of severity of road traffic injuries with type of road user

Type of road user	Severity of Injury			
	Mild	Moderate	Severe	Total
Pedestrian	1 (0.8%)	61 (48.4%)	64 (50.8%)	126 (100%)
Driver/operator of transport	27 (4.4%)	268 (44.1%)	313 (51.5%)	608 (100%)
Passenger including motorcycle	34 (8.8%)	173 (44.9%)	178 (46.2%)	385 (100%)
Total	62 (5.5%)	502 (44.9%)	555 (49.6%)	1119 (100%)

chi-square value:15.762; p-value: 0.003

Table-6: Distribution of severity of road traffic injuries with time of crash

Time of crash	Severity of Injury			
	Mild	Moderate	Severe	Total
00.00 to 03.59	8 (15.4%)	22 (42.3%)	22 (42.3%)	52 (100%)
04.00 to 07.59	4 (4.5%)	32 (36.4%)	52 (59.1%)	88 (100%)
08.00 to 11.59	7 (3.6%)	105 (53.6%)	84 (42.9%)	196 (100%)
12.00 to 15.59	12 (6.9%)	83 (47.4%)	80 (45.7%)	175 (100%)
16.00 to 19.59	19 (6.1%)	130 (41.8%)	162 (52.1%)	311 (100%)
20.00 to 23.59	13 (4.3%)	133 (43.8%)	158 (52.0%)	304 (100%)
Total	63 (5.6%)	505 (44.8%)	558 (49.6%)	1126 (100%)
Chi-square: 23.127; p-value: 0.010				

More severe accidents were noted during the early hours of 04.00 to 08.00 AM and between 04.00 to 08.00 PM and 08.00 to 11.59 PM (Table-6).

Table-7: Distribution of severity of road traffic injuries with place of injury

Place of injury	Severity of Injury			
	Mild	Moderate	Severe	Total
NH-91	40 (5.9%)	331 (48.5%)	311 (45.6%)	682 (100%)
NH-93	22 (7.3%)	112 (37.2%)	167 (55.5%)	301 (100%)
Bypass road	1 (0.8%)	50 (41.3%)	70 (57.9%)	121 (100%)
Others	0 (0.0%)	12 (54.5%)	10 (45.5%)	22 (100%)
Total	63 (5.6%)	505 (44.8%)	558 (49.6%)	1126 (100%)
Chi-square: 20.637; p-value: 0.002				

More severe injuries occurred during accidents that took place either on NH-93 or bypass road. However, all injuries occurring over other roads were of moderate to severe grade (Table-7).

Table-8: Distribution of severity of road traffic injuries with type of collision

Type of collision	Severity of Injury			
	Mild	Moderate	Severe	Total
Head on	22 (4.0%)	217 (39.0%)	317 (57.0%)	556 (100%)
Sideways	22 (12.5%)	78 (44.3%)	76 (43.2%)	176 (100%)
From behind	7 (3.3%)	116 (55.2%)	87 (41.4%)	210 (100%)
Not known	2 (8.3%)	12 (50.0%)	10 (41.7%)	24 (100%)
Total	53 (5.5%)	423 (43.8%)	490 (50.7%)	966 (100%)
Chi-square: 39.942; p-value: 0.000				

Most severe grades of injuries were seen during head-on collisions, while the most moderate grade of injuries were noted when collision occurred from behind (Table 8).

Table-9: Distribution of severity of road traffic injuries with part of body primarily injured

Part of the body primarily injured	Severity of Injury			
	Mild	Moderate	Severe	Total
Head	6 (2.4%)	42 (17.1%)	197 (80.4%)	245 (100%)
Maxillo-facial	13 (8.0%)	90 (55.2%)	60 (36.8%)	163 (100%)
Upper limb	17 (9.4%)	84 (46.4%)	80 (44.2%)	181 (100%)
Lower limb	14 (2.9%)	265 (55.3%)	200 (41.8%)	479 (100%)
Others	13 (22.4%)	24 (41.4%)	21 (36.2%)	58 (100%)
Total	63 (5.6%)	505 (44.8%)	558 (49.6%)	1126 (100%)
Chi-square: 165.318; p-value: 0.000				

More than four-fifths of all head injuries were severe grade injuries, followed by lower limb, where more than 97% of injuries were moderate to severe (Table-9).

DISCUSSION

1126 patients were included in the study**.** Young adults aged 18 - 45 accounted for 66.5 per cent of RTA victims during 2022 (4). Overall, both fatal and non-fatal RTAs predominantly affect men, with male to female fatality ratio being 3 to 1 (1,3).

Both RTAs and fatal road accidents are more of a rural phenomenon, with more than two-thirds of RTA deaths taking place in rural areas in India in 2022 (4). Seasonality and patterns in social activities, economic obligations, and travel on a daily and yearly basis tend to affect road traffic and, eventually, the occurrence of RTA (4).

Two-wheelers comprised the largest mode of transport in RTAs and fatalities as well during 2022. On national highways, too, a similar pattern was observed with regard to the number of deaths in 2022. Regarding road-user categories, two-wheeler riders were involved in the highest number of fatal accidents (44.5%) during 2022, followed by pedestrians involved in 19.5 percent (4). Most of the road users were drivers, while the proportion of other road users, comprising pedestrians and two-wheeler pillion riders, ranged from 11% to 14%. The proportion of pedestrians reported from urban facilities (14.4%) was higher than that of rural facilities (6.3%) (9).

The maximum number of RTAs (20.4%) were recorded between 18:00 and 21:00 hrs in India in 2022. This was followed by the time interval between 15:00 and 18:00 hrs, accounting for another 17.3 percent of total RTAs. This follows the pattern over the preceding five years. Afternoon and evening hours have the maximum risk for RTA. Between 0.00 AM and 6:00 AM, minimal accidents are recorded (4,10).

National Highways (NH) and Expressways accounted for 32.9% of total RTA cases in India in 2022. 23.1% of RTAs occurred over State Highways (SH). while the remaining (43.9%)

took place on other roads. The pattern of fatalities on Indian roads also follows similar trends (4).

Hit from back or rear-end collisions (21.4%) formed the largest share among the collision types. Head-on collisions are the second most common type of collision with 16.9% (4). Rear-end and head-on collisions (19%) are also common on all highways, including the four-lane highways. Rear-end collisions also occur with vehicles parked over the roads (5).

Conclusion

Young aged males driving motorized two-wheelers are at the greatest risk of meeting a road traffic crash and getting a moderate to severe grade of injury

Recommendation

Targeted interventions are needed for the motorized two-wheelers to decrease the overall burden of the RTA over the National highways and also prevent severe grade of injuries.

Limitation of the Study

The present study was conducted over the two National highways of western Uttar Pradesh. There are many other National highways in this part of the state, so including those would have made the results more generalizable.

Relevance of the Study

Every year more than 1.5 lac people die in RTAs. In 2022, Uttar Pradesh recorded the highest number of fatalities due to RTAs. Among all the RTAs, one-third took place on National highways. Therefore, exploring the pattern of RTAs on National highways in part of the state of Uttar Pradesh, which has a significant burden of fatal RTAs, is very much pertinent for research.

Authors Contribution

All authors have contributed equally.

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Conflict of Interest

There are no conflicts of interest.

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Declaration of Generative AI and AI Assisted Technologies in the Writing Process

The authors haven't used any generative AI/AI assisted technologies in the writing process.

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