Research Article

An epidemiological study on road traffic injury in East Sikkim

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ABSTRACT

Background: Road traffic injuries (RTIs) are a large and rapidly evolving public health burden. RTIs are projected to rise to the third leading cause of disability-adjusted life years lost worldwide by 2020. In India, rapid motorization and increasing road traffic burden and underreporting of RTI are serious problems. **Objectives:** The objective of this study was to determine the burden and type of injuries sustained by victims of RTIs in East Sikkim and its correlates. **Materials and Methods:** Cases with an alleged history of RTIs reporting either to Central Referral Hospital or Sir Thutop Namgyal Memorial during June 1, 2012–May 31, 2013. After taking consent from victim or caregiver, a pre-designed semi-structured pretested schedule was used to collect information. **Results:** A total of 467 cases of RTI were reported, in which the majority were males of productive age group. Most RTIs occurred on the highway, pedestrians were affected most, and maximum RTIs occurred in mid-week with a peak incidence in October month. Use of alcohol and mobile was reported. **Conclusion:** RTIs are on increase due to rapid motorization. Sikkim being a hilly state, RTI incidence is high, although minor injuries were more common. Morbidity in RTI victims can be reduced by use of safety measures, strengthening of Information, Education, and Communication activities for prevention of RTI, and imparting the importance of first aid on time.

KEY WORDS: Road Traffic Injuries; Disability-adjusted Life Years; Pedestrians, Motorization

INTRODUCTION

The WHO estimates that over 1.2 million people pass away every year on the world's roads, and between 20 and 50 million fall victims to non-fatal injuries. The WHO projects that, unless immediate action is taken, traffic crashes will increase from the ninth to the fifth leading cause of death by 2030 and will then cause around 2.4 million deaths per year.[1] Road traffic injuries (RTIs) are also projected to rise to the third leading cause of disability-adjusted life years lost worldwide by 2020.[2]

The epidemiological triad of pandemic of RTI comprises of a hazardous agent, a susceptible host, and an unfriendly environment. A number of factors ranging from vehicle design, maintenance, speed, road environment, driver's skill and/or impairment, driver's behavior, pedestrian's behavior, defective traffic control system, and many more confounding variables may contribute to the risk of traffic collision; multiplicity of factors are often involved in the same event. After spectacular advancement in health sciences, it is unfortunate that we are losing lives on road. Globally, RTIs have become a significant public health problem, more so in the low- and middle-income countries.[3] RTIs have also become epidemic in South-East Asia where almost 306,000 people are dying yearly.[4]

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The burden of traffic crashes is increasing fastest in developing countries due to rapid motorization associated with economic growth.[5] Road traffic fatalities in India increased by about 5% per year from 1980 to 2000 and then by about 8% per year to reach 105,725 in 2006, with the mortality rate increasing from 36/million persons in 1980 to 95/million persons in 2006.[6] Non-fatal injury is a more common consequence of road crashes than death, and injuries sustained are often severe. The incidence of RTI remains poorly measured in India, though the number of people injured in road traffic crashes in 2006 was estimated to exceed 450,000. Cautious interpretation is necessary, as previous studies have found traffic crashes to be underreported in India by 5% for deaths and more than 50% for serious injuries. Underreporting of RTI is a serious problem not only in India but world over. A working committee of the Planning Commission of India estimated that for each registered death due to RTI, there occurs 15 serious injuries and 70 minor injuries.[7]

The hilly state of Sikkim is geographically diverse with elevations ranging from 280 to 8585 m with no flat surfaces. Transportation in the state is entirely by roads. Incidentally, Sikkim has the third highest per capita intake of alcohol and the rate of accidental deaths per thousand vehicles is 1.1 compared to the national level of 1.0.[8] The cascade of events following injury depends on the severity of injury, host factors, adequate pre-hospital care, and time elapsed before definite treatment is initiated. Upgrading the existing health-care settings at all the levels probably will be a cost-effective option than establishing lots of new health facilities.[9]

The gaps in information result both in underestimation and inadequate understanding of the burden of injury, restraining the capacity to inform policy development and capacity building for medical management, rehabilitation, and support services. Given the potentially catastrophic effects of injuries on families and communities in such settings, particularly among those of low socioeconomic status, there is a need to study non-fatal outcomes in LMIC settings in order to inform the public health response to RTIs. Hence, the present study was conducted with an aim to determine the burden and the type of injuries sustained by victims of RTI in East Sikkim and its correlates.

MATERIALS AND METHODS

Study Setting

This study undertaken on RTIs was carried out at the two major tertiary care units, namely the Central Referral Hospital (CRH) of SMIMS and Sir Thutop Namgyal Memorial (STNM) Hospital at Gangtok in the East district of Sikkim.

Study Population

The study population constituted all cases with an alleged history of RTIs occurring within the east district of Sikkim and reporting either to CRH or STNM during the study period.

Study Period

The study was conducted for 1 year.

Study Duration

The study duration ranged from June 1, 2012, to May 31, 2013.

Study Design

This is a hospital-based, descriptive, cross-sectional study conducted at CRH and STNM hospitals, Gangtok.

Sample Size

All the victims of RTI during the study period were included who fulfilled the inclusion criteria.

Inclusion Criteria

1. All alleged RTIs reporting to the two hospitals under study at Gangtok and consented to be interviewed were included.

Exclusion Criteria

1. Any RTI case where the road traffic crash occurred outside the district of East Sikkim but the victim was brought for treatment to CRH or STNM was excluded.
2. All the victims brought dead or who died before being interviewed by the investigator were excluded from the study because the state government denied permission to include such cases.

Parameters Studied

- Risk factors: Day, time, and month of injury; type of vehicle involved; type of crash; and alcohol and mobile phone usage.
- Injury burden: Medicolegal classification of injury, class of injury, site of body involved, ICD-10 code of the crash, and place of incidence
- Safety measures: Use of seat belts and helmets
- Subsequent events: Accompanying person, mode of transport, delay to care, first care provider, pre-hospital care, and duration of hospital stay.

Study Tool

A pre-designed, semi-structured, pretested schedule in English served as the study tool, with case sheets and medicolegal case register.

Validity of the Schedule

The schedule was developed after review of relevant literatures and the manual on data collection by the WHO regarding road safety so as toidentify data requirements for establishment of comprehensive road safety data systems.

Ethical Clearance

RTI involves medicolegal issues which include multiple facets such as insurance claim and legal proceeding. Ethical approval was taken from the Institutional Ethics Committee of SMIMS, the Medical Superintendent, CRH, Secretary, Health Care, Human Services, and Family Welfare, Government of Sikkim, through the Office of the Dean, SMIMS, for interviewing the victims of RTIs at STNM Hospital; the permission to include death involving RTI was not approved. Hence, all deaths were not included in the study.

Data Collection Procedure

Identification of injury victims was done on a regular basis as and when they reported at the emergencies of the two hospitals. Informed consent was obtained from the victim or care provider in case victim was not able to give consent, prior to study participation. For medicolegal and ethical reasons, the identification of the victims was not documented.

Statistical Analysis

The collected data were entered in Microsoft Excel spread sheet (Microsoft Corporation, Redmond, Washington) and analyzed. Chi-square test was applied wherever applicable using InStat-GraphPad version 3 (GraphPad Software Inc, San Diego, United states of America), and $P < 0.05$ was considered statistically significant.

RESULTS

A total of 467 cases of RTIs were reported during the study period from June 1, 2012, to May 31, 2013. The number of cases reported to CRH was 302, while STNM received 165 victims. Among all victims who reported to CRH, 213 (70.53%) were male and 89 (29.47%) were female. Similarly, at STNM Hospital, male and female representation was 105 (63.64%) and 60 (36.36%), respectively. All the victims were included in the study. Majority of victims (36.19%) belonged to 21–30 years' age group followed by 11–20 years' age group (21.41%). The male:female ratio was 2.13:1.

Nearly 51.39% injuries happened on highway, males were more hurt on the highway (52.86%), while females were injured more on the other roads (52.35%). Table 1 summarizes the vulnerability of different types of road users to RTIs; most (38.12%) of the victims were pedestrians (male: 32.08%; female: 51.01%). Figure 1 shows the distribution of pedestrians injured according to the vehicle involved. Nearly two-thirds of the victims had simple injuries. The ICD-10 classification of RTI injuries of the study population is summarized in Table 2.

Mid-week reported most injuries (35.33%); this distribution was found to be statistically significant ($\chi^2 = 7.834$, df = 1, $P = 0.0051$). Evening (28.27%) had statistically significant ($\chi^2 = 62.443$, df = 1, $P = 0.0001$) injuries compared to forenoon (25.05%). A majority of crashes occurred in the month of October ($n = 68$; 14.56%) followed by December ($n = 45$; 9.64%).

Males were mostly involved in crashes in the month of October (14.15%) followed by May (11.01%). Similarly, females were mostly injured in crashes occurring in October (15.44%) followed by December (12.08%) [Figure 2]

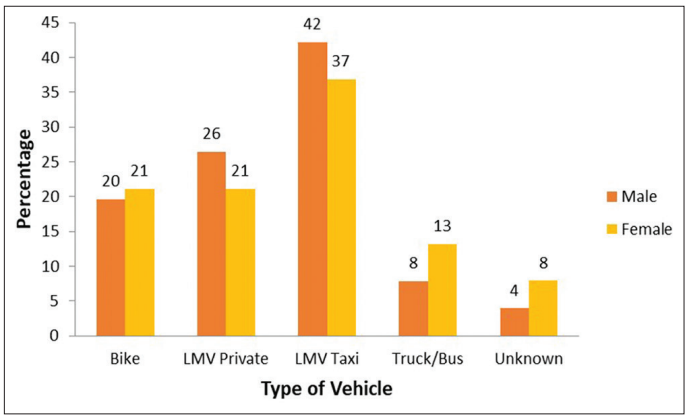

Figure 1: Distribution of Pedestrian injured according to the vehicle involved

Table 1: Vulnerability of different types of road users to RTI

Road user category	*n* (%)		Total, *n*=467
	Male, *n*=318	Female, *n*=149	
Walking/ pedestrian	102 (32.08)	76 (51.01)	178 (38.12)
Motorized two-wheeler	64 (20.13)	14 (9.40)	78 (16.70)
Four-wheeler private	38 (11.95)	14 (9.40)	52 (11.13)
Four-wheeler taxi	85 (26.73)	42 (28.19)	127 (27.19)
Truck	28 (8.81)	3 (2.01)	31 (6.64)
Bus	1 (0.31)	0 (0.00)	1 (0.21)

Table 2: Distribution of RTI victims as per classification of crashes by International Classification of Diseases code

International Classification of Diseases-10 codes	Male, *n*=318 (%)	Female, *n*=149 (%)	Total, *n*=467 (%)
Pedestrian with bike (V02)	20 (6.29)	16 (10.74)	36 (7.71)
Pedestrian with car (V03)	70 (22.01)	44 (29.53)	114 (24.41)
Pedestrian with truck (V04)	8 (2.52)	10 (6.71)	18 (3.85)
Pedestrian with unknown vehicle (V09)	4 (1.26)	6 (4.03)	10 (2.14)
Bike with bike (V22)	6 (1.89)	Nil	6 (1.28)
Bike with car (V23)	20 (6.83)	2 (1.34)	22 (4.71)
Bike with truck (V24)	9 (2.83)	2 (1.34)	11 (2.36)
Bike with fixed object (V27)	4 (1.26)	2 (1.34)	6 (1.28)
Bike fall off (V28)	24 (7.55)	8 (5.37)	32 (6.85)
Car with bike (V42)	1 (0.31)	Nil	1 (0.21)
Car with car (V43)	16 (5.03)	8 (5.37)	24 (5.14)
Car with truck (V44)	13 (4.09)	4 (2.68)	17 (3.64)
Car with fixed object (V47)	43 (13.52)	17 (11.41)	60 (12.85)
Car fell down (V48)	52 (16.35)	27 (18.12)	79 (16.92)
Truck with fixed object (V67)	11 (3.46)	1 (0.67)	12 (2.57)
Truck fell down (V68)	17 (5.35)	2 (1.34)	19 (4.07)

RTI: Road traffic injuries

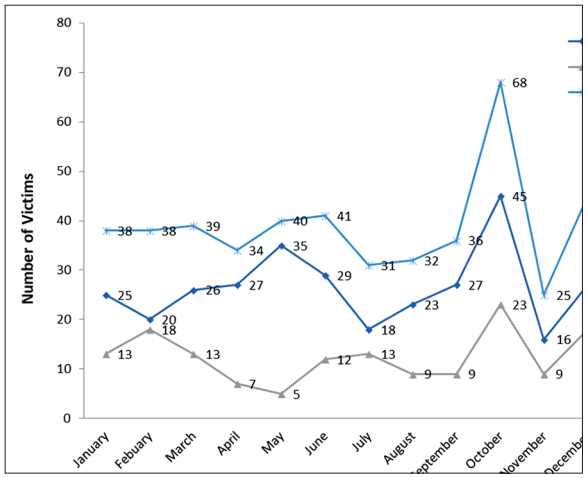

Figure 2: Line graph showing distribution of RTI crashes in relation to Months of the year

Nearly 10.71% of road users were under the influence of alcohol. Nearly 40% of the drivers and 34.78% of the riders of motorized two-wheel vehicle (MTV) were under the influence of alcohol.

Almost 2.99% of the road users admitted the use of a mobile phone at the time of crash, whereas 6.18% of the pedestrians and 4.35% of MTV riders admitted the use of mobile phone at the time of the crash.

Majority of victims arrived in hospital directly from the trauma site (70.45%), and a majority of the victims were taken to hospital in a light motor vehicle (LMV) – taxi (44.11%) followed by LMV – private (20.56%), police vehicle brought 8.57% of the victims, while ambulance carried 14.35% of victims to care. Hospital care was provided to 3.85% of the victims within the Platinum hour (<10 min). Nearly 54.6% of the victims reached hospital within the Golden hour.

Table 3: Findings from different studies

Study	Male:female	Age group most affected	Victim (%)
Jha *et al.*[11]	4.9:1	20–29	Pedestrians (22)
Singh *et al.*[22]	4.2:1	15–45 years	Drivers (44.9)
Monga *et al.*[23]	6.7:1	11–50	Driver (46.6)
Singh *et al.*[10]	2.8:1	20–30	Pedestrians (29)
Our study	2.1: 1	15–40 years	Pedestrians (38.12)

Almost 68.95% of the RTI victims were treated as outpatients; 145 victims were admitted for indoor care.

DISCUSSION

"Road sense is the offspring of courtesy and the parent of safety," Australian traffic rule quoted in quotations for special occasions by Maud van Buren, 1938, sums aptly the importance of road safety and road traffic crash.

Out of a total of 467 cases reported to the two hospitals of the study, 318 were male and 149 were female, giving a male:female ratio of 2.1:1. Over two-thirds of victims belonged to the active and economically productive age group of 15–40 years. A comparison of findings from earlier studies is depicted in Table 3. A majority of male involvement is as per expectation since males are more exposed to road traffic accidents because they venture out of houses more than females for the purpose of livelihood and otherwise. However, the ratio in this study was less compared to other

studies; this may be attributed to the fact that women in Sikkim have a greater freedom of movement and are more exposed to traffic more than in other parts of India. More crashes occur on the National Highway (NH) 31-A (51.39%) compared to other roads. This may be due to heavy traffic on the highways compared to other roads. This is similar to a study from National Capital Region (NCR), India, by Singh *et al.* which also reported most cases (69.45%) occurring on highways.[10] Most victims (38.12%) were pedestrians followed by occupants of four-wheeler taxi (27.19%). There were no bicyclists, three-wheelers, or animal-driven vehicles in East Sikkim due to the steep hilly terrain. The LMV taxis were the most common offending vehicle (39.89%) injuring a pedestrian followed by LMV-private (24.16%) and MTV (20.22%). However, studies from India by Patil *et al.* and Jha *et al.* reported more instance of an MTV (31.9% and 24.4%, respectively) hitting a pedestrian followed by a four-wheeler (29.8% and 21.2%, respectively).[11,12] This may be because MTVs are the largest category of vehicles (71%) on Indian roads.

Injuries sustained by victims in the present study have been classified as simple or grievous as per Section 320 of the Indian Penal Code. In this study, 65.31% of the RTI victims sustained simple injuries and 34.69% had grievous injuries. Studies done by other authors have not classified RTI using this medicolegal classification. Using the "Trauma Index," a study by Singh *et al.* from rural Haryana found mild, moderate, and severe injuries at 55.6%, 31.4%, and 13%, respectively.[13] Classification of the crash burden according to the ICD-10 [Table 2] in this study reported pedestrian–car conflict (24.41%) as the most common type of road traffic crash followed by falling of the car off the road (16.92%) into the valley. Car hitting a stationary object was observed in 12.85% of the cases. Due to paucity of study data on ICD classification of crashes, comparison with other studies could not be made. Mid-week (Wednesday–Thursday) had the most number of crashes (n = 165, 35.33%) with least in week-end (Saturday–Sunday; n = 105, 22.48%), most crashes occurred in the evening (n = 132, 28.26%) followed by forenoon (25.05%) and afternoon (25.62%), and this distribution was statistically significant ($\chi^2 = 62.443$, df = 1, $P = 0.0001$). The National Crime Record Bureau NCRB (2012) data mentioned that most deaths are reported from 3 pm to 6 pm (16.7%) followed by 6 pm to 9 pm (16.6%).[14] On the contrary, Novoa *et al.* in a time series study from Spain reported over 36% injuries on weekends which would likely be due to fatigue, careless driving, or alcohol.[15] The authors of a review article on RTIs from developing world found 36–74% of the crashes occurring over the weekend.[16]

In the present study, most cases (14.56%) occurred in the month of October [Figure 2]. This may be attributed to the fact that the festival of Dasain and Tika is celebrated in this month. This finding was similar to the study conducted by Lahiri *et al.* in Bengal where too most cases of RTI were reported in October (14.9%).[17] A study from JIPMER, India, reported most cases in January (12.9%) followed by October (9.0%).[11] Another study from South India reported most cases (13.9%) in January.[18] At the national level, most deaths are reported in the months of May (8.8%), April (8.74%), and January (8.72%).[14] Alcohol and mobile phone have been proven to compromise road safety. In the present study, 40% of drivers and 34.78% of MTV riders had consumed alcohol prior to RTI, which is an alarming situation. A review article on alcohol-related RTI in India found that up to 40% of night-time crash victims are under the influence of alcohol.[19] Data on alcohol use by the victim at time of crash are not available with the NCRB and Ministry of Road Transport and Highway.[20] The use of mobile phones was admitted by 2.99% of RTI victims who reported to the hospital for care; there is no relevant Indian literature found on this problem but studies done in Australia have documented that talking on mobile phone increased the reaction time in drivers by over 40%.[21]

Strength of this study is that it provides baseline data for planning future research and creating injury prevention plans in Sikkim. We used ICD-10 to classify the type of traffic crash and IPC 320 classification to classify the type of injury sustained by the victims

The limitation of this study is that deaths and referred cases to other states were not included as well as cases attended by hospital other than study institutions were not included.

CONCLUSION

Rapid urbanization and industrialization had resulted in continuous flow of vehicles on to the roads. We recommend for the identification of a lead and nodal agency in Sikkim to guide road traffic safety effort, implementation and enforcement of speed limits, promotion of seat belt use, universal use of helmet along with strict enforcement for all occupants of motorized vehicle, and random roadside alcohol concentration check. By setting up a universal help-line number, taxi driver associations should be involved to sensitize the taxi drivers to help bring all crash victims to the nearest health-care facility quickly. The drivers can be trained in the basic first aid skills. Pedestrian facility such as zebra crossing should be introduced at strategic locations on NH so that pedestrians refrain from crossing road at any point.

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