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Pattern and Determinants of Non-Fatal Major Injuries in Road Traffic Accidents: A Hospital Based Study from Northern India

Dr. Baljeet Singh[1], Dr. Narender Mahajan[2], Dr. D.S. Dhadwal[3], Dr. Devender[4*], Dr. Amit Sachdeva[4], Dr. Prem Lal[4], Dr. Ankit Chaudhary[1], Dr. Neeraj Kanwar[5]

[1]Junior Resident, Department of Community Medicine, IGMC, Shimla, India
[2]Associate Professor, Department of Community Medicine, IGMC, Shimla, India
[3]Professor, Department of Community Medicine, IGMC, Shimla, India
[4]Senior Resident, Department of Community Medicine, IGMC, Shimla, India
[5]Medical Officer, Psychiatry, District Hospital, Bilaspur Chhattisgarh, India

***Corresponding author:** Dr. Devender
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Abstract **Original Research Article**

Introduction: Injuries due to RTAs are significant contributor to the hospital admissions, taking out a huge amount of lives as well as health resources. Pattern of injuries and the circumstances in which these injuries occur depends a lot upon different factors. Necessary information, about pattern and severity of the injuries, and where, exactly preventive measures are urgently needed, is required. Objectives of the study were to determine the pattern and determinants of non-fatal major injuries in road traffic accidents. ***Methods:*** Analytical cross sectional study has been conducted among the victims of non-fatal RTA reporting at emergency department during the year 2017-18. ***Observations:*** Most common major injury in current study was lower limb fracture (16.6%) followed by head injury (16.3%). Rural area, heavy transport vehicles, foggy/rainy /snowy conditions, uphill drive, rolling down accident were associated with significantly higher major injuries. Use of protective gears and metalled road were associated with lower odds of having major injuries during RTAs. ***Conclusion:*** Circumstances leading up to the accidents, if timely recognized, and acted upon, can reduce injury incidence and severity.

Keywords: Road traffic accidents, non-fatal injuries, road traffic injuries, injuries.

INTRODUCTION

Road traffic accidents (RTAs) are a major cause of disability and death globally, with a disproportionately higher number occurring in developing countries [1, 2]. Global urbanization and industrialization has led to rapid expansion of roads and motorization accompanied by a rise in road accidents. Today RTAs are one of the leading causes of deaths, disabilities, and hospitalizations with severe impacts on the economy, public health and the general welfare of the people [3].

Road traffic injury (RTI) is major but neglected public health problem especially in developing countries like India [1]. The Global status report on road safety highlights that the number of annual road traffic deaths has reached 1.35 million. Road traffic injuries are now the leading killer of people aged 5-29 years [4]. According to World Health Organization (WHO) data, deaths from road traffic injuries account for around 25% of all deaths from injury. WHO expected it to be the 5th leading cause of death, overtaking diabetes and human immunodeficiency virus infection/ acquired immunodeficiency syndrome by 2030 [5]. It has been predicted that by 2020, RTAs will rank as high as third among causes of disability adjusted life years lost [6, 7].

India has one of the highest road accident rates in the world. During 2015, a total of 4, 64, 674 cases of 'Road Accidents' were reported in India, which rendered 4, 82, 389 persons injured and 1, 48, 707 deaths. Deaths due to 'Road Accidents' in the country have increased by 5.1% during 2015 over 2014. 53 cases of road accidents took place every one hour during 2015, wherein 17 persons were killed. Significant variations also arise between different states of India [8].

In Himachal Pradesh, a hilly state situated in the north-west Himalayas with hilly terrains, a total of 3010 road traffic accidents had been reported in year

2015 [8]. According to social welfare council of India, Himachal Pradesh witnesses average 3,000 road accidents each year, killing over 1000 people and leaving 5000 injured [9].

Injuries due to RTAs are significant contributor to the hospital admissions at Medical College, taking out a huge amount of lives as well as health resources. Pattern of injuries and the circumstances in which these injuries occur depends a lot upon different factors i.e agent, host & Environment (Haddon Matrix) [10]. Necessary information, about pattern and severity of the injuries, and where, exactly preventive measures are urgently needed, is required. Risk factors for major injuries could be identified by interviewing victims of RTAs with nan-fatal injuries. Keeping in mind all these facts, the present study has been conducted in emergency department of IGMC Shimla, Himachal Pradesh in year 2017-18. Objectives of the study were to determine the pattern and determinants of non-fatal major injuries in road traffic accidents during the study period.

METHODS AND MATERIALS

Study setting

The Study was conducted among the victims of non-fatal RTA reporting at emergency department of Indira Gandhi Medical College (IGMC), Shimla.

Study design

Analytical cross sectional

Study duration

One-year w.e.f. 1st September 2017 to 31st August 2018.

Study population

All consecutive cases of non-fatal road traffic accident (RTA) reporting at IGMC Shimla, hospital and required admission.

Inclusion criteria

- Non-fatal road traffic accident victims fulfilling the case definition visiting the emergency department were included in the study.
- People giving consent were included in study.

Exclusion criteria

- Injury on road occurring without involvement of a vehicle.
- Critically injured victims in RTA.
- Cases referred to this hospital for tertiary care management from others health institutions.

Case definitions

Road traffic accident (RTA) is defined (for the purpose for this study) as an accident which took place on the road between two or more objects one of which had been in any kind of a moving vehicle and the other the human being.

Major injury: - Major injury was taken as fracture of bones and abdominal injuries, such as visceral injuries, vascular injuries and collection of blood in the abdominal cavity.

Minor injuries: – included abrasions, contusions, lacerations etc.

Human error: - Overtaking, over speed, driver's fatigue, misjudgment by driver, sleep related factors like: driving after inadequate rest and sleep, after consuming alcohol and drugs, unexpected demands or break downs etc.

Study tool

A structured, pretested, self-designed questionnaire schedule was used for interviewing RTA victims in the emergency department IGMC. This questionnaire includes information regarding socio-demographic characteristics, pattern of injury, determinants of RTA i.e. person related, vehicle related and environment related and any delay in management.

Data collection

A pre-tested semi structured interview schedule was used for interviewing RTA victims in emergency department of IGMC Shimla, after satisfying for the eligibility criteria. Interview was carried out after taking written informed consent from victims and in case of minor (age <18 years), written consent was taken from parents/ legal guardian. Where the conditions of the victims would not warrant the interview, the relatives, or attendants were interviewed. Detailed information was collected comprising of socio-demographic data, time, date, day and types of vehicles involved in RTA, weather or road condition etc. The medico-legal records and case sheets were referred for collecting additional information for necessary cross-checking. Information was gathered regarding associated characteristics of the RTA like weather condition, category of road user, road characteristic at the site of accident, use of cell phones at the time accidents and any protective gear used by the vehicle occupants.

Statistical analysis

Data was entered in Microsoft excel spread sheet, collated and analyzed using Epi info version 7.2.2.software. We have used chi-square test for univariate association analysis. Odd's ratios of association between different variables and major injuries were also calculated. A two-sided *P*-value of less than 0.05 was considered statistically significant.

OBSERVATIONS

A total of 410 Road Traffic accidents Victims have been studied in current study sustaining non-fatal injuries. Most common major injury in current study was lower limb fracture (16.6%) followed by head

injury (16.3%) and abdominal injury (15.4%). 22.3% had only superficial injuries while 11.4% had lacerations and open injuries (Table 1).

Table-1: Pattern of injuries among RTA victims (n - 410)

Natures of injuries		Frequency (n)	Victims (%)	Confidence Limit (95%)
Major	Skull fracture	9	2.20	1.16 – 4.12
	Spine fracture	19	4.63	2.99 – 7.12
	Upper limb fracture	41	10	7.46 -13.29
	Lower limb fracture	68	16.59	13.30 -20.49
	Head injury	67	16.34	13.08 – 20.23
	Pelvis fracture	9	2.20	1.16 – 4.12
	Abdominal injury	63	15.37	12.20 – 19.18
Minor	Laceration & open injury	45	11.4	8.30 – 14.37
	Superficial injury	89	21.27	17.94 – 25.95

Table-2: Severity of injuries among RTA victims according to their demographic profile

	Severity of Injuries		OR	95% CI	p- value
	Major Injury	Minor Injury			
Age Groups (Years):					
<15	18	21	1		
16 – 30	94	104	1.05	0.53 - 2.10	0.88
31 – 45	48	76	0.73	0.35 - 1.52	0.40
>45	18	41	0.51	0.20 - 1.18	0.11
Gender:					
Male	170	137	1		
Female	62	41	1.21	0.77 – 1.91	0.39
Area:					
Rural	112	49	1		
Urban	120	129	0.40	0.26 – 0.61	<0.01
Education Status:					
Illiterate	5	3	1		
Primary	14	9	0.93	0.17 – 4.9	0.93
Middle	29	9	0.9	0.38 – 9.7	0.4
Matriculation	64	34	1.13	0.25 – 5.01	0.87
Higher secondary	59	80	0.44	0.10 - 1.92	0.27
Graduate	54	33	0.98	0.22 – 4.32	0.98
PG & above	7	10	0.42	0.07 – 2.32	0.32

Victims from urban area were found to have lower odd's of major injuries (OR-0.4). Victims in the age group 16-30 years and age group > 45 years had highest and lowest odd's of having major injuries in RTAs respectively but the difference is not statistically significant. Similarly female had higher non-significant odd's of major injuries. Educational status did not found to be significantly associated with major injuries.

Table-3: Distribution of Agent Risk factors for Severity of injuries

Agent Risk factors	Major Injury	Minor Injury	OR	95% CI	p- value
Vehicle Type					
Motorized Two wheeler	39	67	1		
Light Motor Vehicle(Car)	75	150	0.85	0.53 – 1.39	0.53
HTV (Bus, truck)	17	2	14.61	3.21- 66.59	<0.01
Age of vehicles during accidents					
<5years	102	64	1		
5-10 years	54	31	1.09	0.6 – 1.87	0.74
>10 years	76	82	0.58	0.37 – 0.90	0.01
Mode of Accident					
Side impact	52	66	1		
Rolling down	99	36	3.49	2.06 – 5.91	<0.01
Head on collisions	74	71	1.32	0.81 – 2.15	0.26

Odds of having major's injuries were significantly higher (OR-14.61) among HTV victims in comparison to MTW victims in current study. Victims travelling in vehicle with bad condition had higher odds of having major injuries in RTAs. Victims involved in rolling down accident had higher odds (OR- 3.49) of having major injuries in comparison to simple side impact accidents (Table 3).

Table-4: Distribution of Host risk factors for Severity of injuries in victims

Host Risk factors	Major Injury	Minor Injury	Odd Ratio	95% CI	P value
Risk factor of Drivers					
Consumed alcohol	24	13	1.13	0.53 – 2.39	0.74
Mobiles used	32	1	25.81	3.44 - 193	<0.01
Talking	21	17	0.68	0.33 – 1.40	0.30
Music	69	21	3.28	1.76 – 6.13	<0.01
Smoking	4	0	---	-----	-----
Victim Category					
Driver	120	72	1		
Passenger	86	75	0.68	0.44 – 1.05	0.08
Pedestrian	26	31	0.50	0.23 -0.91	0.02
Protective gear					
Not wearing Helmet	23	9	9.23	3.59 –3.92	<0.01
Not using Seat-belt	166	63	5.85	2.53 – 3.54	<0.01
Valid driving license (n-192)					
Yes	102	54	1		
No/ learner	18	18	1.89	0.91 – 3.92	0.08

Mobile use during driving had been found significantly associated with major injuries in current study. Odds (OR-5.85) of having serious injuries were significantly higher among those who were not wearing protective gears (Helmet or Seat belt) at the time of accident (p-value <0.05).

Table-5: Distribution of Environmental Risk factors for Severity of injuries in RTAs

Environmental Risk factors	Major Injury	Minor Injury	Odd's Ratio	95% CI	p- value
Weather Condition on the day Accident					
Clear	198	170	1		
Foggy/ Raining/snowing	34	8	3.65	1.64 – 8.09	<0.01
Location of RTA on Road					
National Highway	108	91	1		
State Highway	89	50	1.49	0.96 – 2.34	0.07
Local road	32	37	0.72	0.42 – 1.26	0.26
Road condition					
Metalled	196	173	1		
Non-metalled	36	5	0.15	0.06 – 0.4	<0.01
Level of road					
Straight	44	35	1		
Curved	116	74	1.25	0.73 – 2.12	0.41
Intersection	16	8	1.59	0.61 – 4.14	0.34
Up-hill	20	3	5.30	1.45 – 9.30	0.01
Down-hill	36	58	0.49	0.26 – 0.90	0.02
Overcrowding during RTA					
No	196	143	1		
Yes	10	3	2.43	0.65 – 8.31	0.27

Major injuries were found significantly higher in foggy/rainy /snowy conditions and on non-metalled roads (p value < 0.05). Major injuries were higher during RTA in uphill drive in comparison to downhill drive in current study (Table 5).

DISCUSSION

A total of 410 Road Traffic accident victims sustaining non-fatal injuries have been studied in current study. Most common major injury was lower limb fracture (16.6%) followed by head injury (16.3%) and abdominal injury (15.4%). (Table 1) Mahajan *et al*. reported lower limb fractures as most common major injury following RTAs in Shimla City [11]. Ganveer *et al.* from Nagpur, Patil *et al.* from Maharashtra also observed lower limb fractures as the most common major injury from RTA victims [12, 13]. In contrast, Singh *et al.* in their study from Haryana reported

abdominal injuries to be the most common form of major injuries followed by limb fractures [14]. Multiple injuries followed by injuries to the lower limbs have been reported by Bayan et al in their study from Pune, Maharashtra [15]. In our study as well as from the studies in other parts of country, RTAs leads to multiple set of injuries which need medical and surgical care from different specialties. Accredited trauma centers must be prepared to treat serious life threatening and disabling injuries. These trauma centers though should not be intended to replace the traditional hospital and its emergency department for minor injuries.

Victims from rural area were found to have higher chances of sustaining major injuries (OR-0.4). Victims in the age group 16-30 years had highest odds but the difference was not statistically significant (Table 2). Odds of having major's injuries were significantly higher (OR-14.61) among HTV victims in comparison to MTW victims. Victims travelling in vehicle with bad condition had higher odds of having major injuries in RTAs. Victims involved in rolling down accident had higher odds (OR- 3.49) of having major injuries in comparison to simple side impact accidents (Table 3).

The interior roads in the region from where most of the rural victims belong are not double lane and it is difficult for two vehicles to cross or overtake smoothly. Difficult hill terrain (where most of the time vehicle ended up in deep gorges), bad road conditions, poor vehicle maintenance and almost no road safety regulation in some of these areas are the possible reasons for significantly higher major injuries. A review article done on road traffic accidents in India reported majority of the victims as young adults, with a significant male predominance. Same review reported pedestrians and two wheeler riders as the most vulnerable group in road traffic accidents [16]. Some of the contrasting findings in our study actually highlight the difference that is needed to be addressed in making local road safety regulations for the state.

Mobile use while driving, not wearing protective gears (Helmet or Seat belt), foggy/rainy /snowy conditions and on non-metalled roads and uphill drive are the other factors which has been significantly associated with major injuries in this study. These are mostly in accordance with documented risk factors addressed in general road safety regulation [17, 18].

The hill roads are narrow, often poorly maintained and the increasing numbers of vehicles have brought a big pressure on the limited infrastructure. Lack of co-ordination between departments like PWD, Forest, Police and Transport, deficiency of funds for developing infrastructure (repairing roads and replacing the old buses, recruiting manpower) has been talked for a while after every major road accident but then again ignored after sometime.

An accident is often described as unintentional, undesirable, and unplanned event but there are always some circumstances leading up to the accident, which if timely recognized, and acted upon, can reduce injury incidence and severity. Current study was an effort to highlight determinants of major injuries in RTAs. These findings in collaboration with results of other studies [11, 19] conducted on road traffic accidents should be considered for formulating as well as reframing road safety regulations in the state.

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