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Pattern And Severity Of Injuries In Victims Of Road Traffic Crashes Attending A Tertiary Care Hospital Of Delhi

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Background

The study was conducted to find out the socio-demographic profile, pattern and severity of injuries sustained in road traffic crashes.

Methods

It was a cross-sectional study conducted on 185 road traffic crash victims at the casualty of Lok Nayak Hospital from May 2003 to December 2003. The patients were interviewed regarding their socio-demographic profile and the severity of injuries was judged using the Injury Severity Scale.

Results

Majority of subjects were between 15 to 44 years (63.8%) and males (77.8%). Maximum number of cases were pedestrians (37.3%). Head and Neck injuries were most common (57.3%) followed by lower extremity (52.4%). Fracture, dislocation, sprain or strain was the most common pattern of injury among all the age groups, both sexes, all the three types of road users, in all modes of accident and in all types of vehicles. About 92% of the subjects had an injury severity score less than 25. Severity of injuries was greater among pedestrians and in accidents involving an over speeding vehicle.

Conclusion

Pedestrians were the most common category of road users injured. They were also the ones who were most severely injured. Therefore, urgent steps are required for pedestrian safety.

Keywords

Traffic Accidents , Injury Severity Score

Introduction

Road traffic crashes (RTCs) are a growing problem worldwide accounting for around 1.2 million deaths and over 50 million injuries annually[1]. It is expected that by the year 2020 they will rank third in the Global Burden of Diseases[2]. To emphasize on the growing importance of preventing RTCs, World Health Organization had declared "Safe Roads"[1] as the theme for World Health Day 2004.

India has just 1% of the total vehicles in the world but it contributes to 6% of the global RTCs[3]. Estimates suggest that Delhi has the highest number of road crash fatalities in India[4]. Data regarding the socio-demographic and injury profile of victims of RTCs in Delhi may therefore, help policy makers to evolve programmes aimed at prevention of RTCs and provision of immediate care for victims of RTCs. Therefore, this study was conducted to study the socio-demographic profile of victims with road traffic injuries and pattern of injuries sustained.

Methods

This was a cross-sectional study conducted at the casualty of Lok Nayak (LN) Hospital, a 1700-bed tertiary care government hospital situated in central Delhi. For the purpose of the study, Road Traffic Crash was defined as "Any vehicle accident occurring on the road (i.e. originating on, terminating on, or involving a vehicle partially on the road) and resulting in injury or death to road users (i.e. driver, passenger and pedestrian)." The patients attending the casualty of Lok Nayak Hospital during May 2003 to December 2003, who were injured in a RTC as per this definition, were included in the study.

After initial enrollment, the study subjects were further classified into pedestrians, drivers and passengers using International Classification of Diseases (ICD-10) classification.[5] A pre-tested semi-structured schedule was used to collect information regarding socio-demographic profile, after taking informed consent. The condition of road, visibility status and overspeeding were classified based on the perception of respondent. The information was collected, by the investigator (CM), from the injured person, if found conscious and oriented to time, place and person. However, if the patient was brought dead, was unconscious or disoriented, an attempt was made to collect the information from the patient's attendant. If there was no attendant or if consent was not given, the victim was excluded from the study. The patients were interviewed after they had received immediate first aid treatment. The specialist clinician on duty made the final diagnosis after relevant investigations and it was noted for final analysis.

The severity of injuries was judged using a trauma chart developed by Greenspan[6], based on the Injury Severity Score (ISS) of Baker et al.[7] This chart divides the body into seven regions: 1) external; 2) head (including the face); 3) neck; 4) thorax; 5) abdomen/pelvic contents; 6) spine and 7) extremities. In each region, each individual injury is given a severity score, using the

Abbreviated Injury Scale (AIS) whose value ranges from 1 to 6. An individual's ISS is then determined by adding together the squares of the highest AIS score for each of the three most severely injured body areas. The value of ISS ranges from 1-75. ISS has also been used to calculate LD_{50} [6] i.e. the injury severity which is a lethal dose for 50% of the patients so injured. Severity score of 40 is lethal for the age group 15-44 years, 29 for 45-64 years and 20 for over 65 years.

The collected data was entered in MS Excel. For the purpose of analysis of pattern of injuries, the injury classification as per ICD-10 was used. Data was analyzed using EpiInfo 2002 version. Chi-square and Fishers exact test were used to find any significant difference for qualitative data and Mann-Whitney test was used to find significant difference for quantitative data. $p<0.05$ was considered statistically significant. The ethical committee of Maulana Azad Medical College had approved the study protocol.

Results

A total of 204 patients with road traffic injuries were contacted during the study period out of which 19 (9.3%) were excluded since complete information could not be obtained for them. So, the final sample consisted of 185 subjects. The total number of accidents was 176. Majority of subjects were between 15 to 44 years (63.8%) (Table I), males (77.8%), Hindus (76.8%), illiterates (27.0%) and laborers (35.1%) (skilled or unskilled) (Table II). The age and sex profile for the excluded patients was similar to the study subjects. The study subjects comprised of 69 pedestrians (37.3%), 57 drivers (30.8%), and 59 passengers (31.9%).

Maximum number of injuries were sustained in head and neck region (55.7%) followed by lower (52.4%) and upper extremities (40.5%). (Table III). In pedestrians, lower extremity was most commonly involved followed by head and neck region whereas in drivers, upper extremity was most commonly involved followed by lower extremity. In passengers, maximum injuries were sustained at head and neck region followed by upper extremity. The proportion of injuries in thorax, abdomen and spinal cord was lesser as compared to injuries on head, neck, upper and lower extremities.

The pattern of injuries among the study subjects is shown in Table IV. The most common pattern of injury was Intracranial injury (18.9%) followed by fractures of lower leg, including ankle (17.8%) and fractures of forearm (10.8%). Fracture, dislocation, sprain or strain was the most common pattern of injury among all the age groups, both sexes, all the three types of road users, in all modes of accident and in all types of vehicles. (Table V) There was no significant relationship between the use of protective equipment and the occurrence of intracranial injury.

On assessment of severity of injuries using Injury Severity Score, it was found that 67.6% of the injuries had a severity score less than 10. Only one subject had a maximum score of 75. Maximum number of pedestrians had a severity score between 6-10 (36.2%) whereas maximum number of drivers (42.1%) and passengers (42.4%) had a severity score between 1-5. (Table VI) The study shows that 1.7% of the subjects aged 15-44 years had a score greater than 40 which is lethal for this age group. This included 1 driver and 1 passenger. One injured driver aged 51 years had ISS> 29, which is considered lethal for that age. 25% of the subjects aged >65 years, including 1 pedestrian and 1 passenger, had a score >20 which is lethal for that age.

Table VII shows that accidents occurring on weekends and at night had a higher injury severity score. Also, at a cut off level of ISS 9, the subjects injured in accidents involving two wheelers and

four wheelers, those occurring on ill maintained roads and those occurring when visibility was poor, had a higher severity of injuries. ISS showed no significant relationship with day and time of injury, type of vehicle, condition of road, visibility status and use of protective equipment. A higher injury severity score (>9) was associated with pedestrians, accidents that occurred outside Delhi, and those involving an overspeeding vehicle. None of the subjects using a protective equipment had ISS>20.

Using Mann-Whitney test, the mean injury severity scores of victims whose accidents involved an overspeeding vehicle (13.1+12.6) was significantly higher than those victims that did not involve an overspeeding vehicle (9.2+6.7). (p=0.002)

Discussion

In the present study, maximum number of RTC victims were between 15 to 44 years of age (63.8%) with a lesser number among those less than 15 years (10.8%) and above 60 years (6.5%). Similar age distribution of RTC victims has been reported in other studies from developing countries.[8-13] Considering the maximum involvement of individuals in the economically productive years, RTCs may have an important economic impact. It also implies that interventions should be designed so as to target these individuals. Lower proportion of RTCs below 15 years and above 60 years could be explained by the fact that children are usually taken care of by elders during travel and lesser mobility of geriatric people.

Majority of those injured in the present study were males (77.8%) with a male: female ratio of 3.4:1. This is in conformity with other studies in India [8,11-16] and abroad[17]. Preponderance of males implies that men are at higher risk of RTC injuries than women. This may be attributed to their greater exposure to traffic and more risky behaviour than females such as hanging on the side of bus, running to catch a bus, aggressive driving, impatience, lack of attention and drinking alcohol prior to driving.[18-23]

This study shows that maximum number of injured persons were illiterates (27%). This could be due to their lack of awareness about traffic rules and safety measures. Several other studies have shown that people with lower levels of education are more involved in road traffic accidents.[15,24] Therefore, educational programs on road traffic safety should give special attention to those who have little or no education. However, a case control study in Mexico showed that there is no significant difference between the educational level of drivers involved in accidents, as compared to those who were not.[25]

In this study, maximum number of injured were working (65.4%) which was similar to a study in Ghana (64.0%)[26] but lower than a Mexican study (84%).[25] This difference could be due to the use of different criteria for classifying working status. This indicates that those who go for work are more exposed to the risk of accident.

In the present study, the regions most commonly affected were head and neck (55.7%) and lower extremity (52.4%). Head and neck region was injured in 49% cases in Saudi Arabia[9], 34.1% in Pondicherry[8], 31% in Delhi[12] and 25.3% cases in Nigeria[27]. Lower extremity was injured in 64% cases in Ghana[28], 50% in Delhi[12] and 13.7% in Pondicherry[8].

On analyzing the body region injured by type of road user, it was observed that in pedestrians, lower extremity (63.8%) and head and neck region (59.4%) were most commonly involved. This is comparable to findings of previous studies from USA, Sweden and India where lower limb and

head injuries were reported to be most common injury sites for pedestrians[8,29,30,31] . The extremities, both upper (61.4%) and lower (56.1%) were most commonly involved regions among drivers in the present study. A similar pattern of higher involvement of the extremities has been reported by Wick et al[17] and Sharma et al[14] among drivers.

The most common pattern of injury was observed to be fractures, dislocations, sprains and strains (39.2%), similar to the findings of other Indian studies viz. 34.7% in Agra[32] and 30% in Delhi[12].

The pattern of injury also showed differences according to the different type of road users. In this study, the most common pattern of injury among pedestrians was fractures, dislocations, sprains and strains (36.3%). The data is comparable to that reported from USA where more pedestrians suffered from fractures (37%) than any other single injury type[33]. Again, 45.6% of the drivers had superficial injuries, 31.6% had open wounds and 61.4% had fractures. In comparison to this, in USA, nearly a third of the bicyclists suffered lacerations and/or contusions, and 29% had fractures[33].

The differences in the pattern of injuries in various studies could be due to selective nature of different studies. Some studies have focused on deaths due to road traffic accidents.[13,14,31] and few only on children involved in RTCs.[27,32]

In this study, 67.6% of the subjects had ISS less than 10 and 92.4% less than 25. This is comparable to a study from Nigeria, where in 94.4% cases, ISS was less than 25.[27] On the other hand, in Sweden[31], only 12% of the victims had ISS less than 25. In the current study, drivers using protective equipment had a lower ISS than those who were not (7.93 vs. 11.59). This is comparable to figures from Bangalore, where helmeted patients had lower injury severity scores than non-helmeted (7.02 vs. 11.9)[34]. But, the ISS did not show any significant relationship with use of protective equipment at score of 9 (p=0.87). None of the subjects who were using a protective equipment had an ISS >20.

The severity of injuries was more among persons injured in RTC outside Delhi. This may be because outside Delhi, especially on highways, vehicles ply with greater speed and the severity of injuries was found to be significantly more when an accident was associated with an overspeeding vehicle (p=0.004). The severity of injuries was also greater among pedestrians than among other road users (p=0.04). This shows that pedestrians are most vulnerable to severe injuries

The findings of the study highlight the need for taking urgent steps for safety of people especially pedestrians. It emphasizes on the need of providing proper care to the injured by having specialists trained to deal with the multitude of injuries sustained during RTCs.

List of Abbreviations

AIS- Abbreviated Injury Scale

ICD-10 - International Classification of Diseases-10

ISS - Injury Severity Score

RTC - Road Traffic Crashes

Tables

Table I. Distribution of age and sex of study subjects by manner of using the road

Characteristic	Pedestrian N=69 n(%)	Driver N=57 n(%)	Passenger N=59 n(%)	Total N=185 n(%)
Age (in years)				
<14	14 (20.3)	1 (5.0)	5 (8.5)	20 (10.8)
15-24	14 (20.3)	14 (24.6)	12 (20.3)	40 (21.6)
25-34	11 (15.9)	19 (33.3)	15 (25.4)	45 (24.3)
35-44	8 (11.6)	13 (22.8)	12 (20.3)	33 (17.8)
45-59	16 (23.2)	8 (14.0)	11 (18.6)	35 (18.9)
>60	6 (8.7)	2 (3.5)	4 (6.8)	12 (6.4)
Sex				
Male	51 (73.9)	57 (100.0)	36 (61.0)	144 (77.8)
Female	18 (26.1)	0(0.0)	23 (39.0)	41 (22.2)

Table II. Distribution of socio-economic characteristics of study subjects by manner of using the road

Characteristics	Pedestrian N=69 n(%)	Driver N=57 n(%)	Passenger N=59 n(%)	Total N=185 n(%)
Religion				
Hindu	54 (78.3)	41 (71.9)	47 (79.7)	142 (76.8)
Muslim	15 (21.7)	16 (28.1)	12 (20.3)	43 (23.2)
Education				
Illiterate	22 (31.9)	12 (21.1)	16 (27.1)	50 (27.0)
Upto primary	16 (23.2)	12 (21.1)	8 (13.6)	36 (19.5)
Upto middle	8 (11.6)	5 (8.8)	13 (22.0)	26 (14.1)
Upto secondary	9 (13.0)	9 (15.8)	8 (13.6)	26 (14.1)
Upto senior secondary	8 (11.6)	5 (8.8)	3 (5.1)	16 (8.6)
Upto graduate	3 (4.3)	12 (21.1)	7 (11.9)	22 (11.9)
Post-graduate/ professional degree	3 (4.3)	2 (3.5)	4 (6.8)	9 (4.9)
Occupation				
Unemployed				
Housewives	9 (13.0)	2 (3.5)	4 (6.8)	15 (8.1)
Business	6 (8.7)	0 (0.0)	15 (25.4)	21 (11.4)
Student	7 (10.1)	15 (26.3)	7 (11.9)	29 (15.7)
Service	16 (23.2)	3 (5.3)	9 (15.3)	28 (15.1)
Laborer	7 (10.1)	9 (15.8)	8 (13.6)	24 (13.0)
Retired	23 (33.3)	27 (47.4)	15 (25.4)	65 (35.1)
	1 (1.4)	1 (1.8)	1 (1.7)	3 (1.6)

Table III. Distribution of body regions injured in the accident by manner of using the road

Body region*	Pedestrian (N=69) n (%)	Driver (N=57) n (%)	Passenger (N=59) n (%)	Total (N=185)* n (%)
Head and neck	40 (58.0)	29 (50.9)	34 (57.6)	103 (55.7)
Lower extremity	43 (62.3)	31 (54.4)	23 (39.0)	97 (52.4)
Upper extremity	20 (29.0)	32 (56.1)	23 (39.0)	75 (40.5)
Thorax	4 (5.8)	2 (3.5)	4 (6.8)	10 (5.4)
Abdomen	1 (1.4)	2 (3.5)	1 (1.7)	10 (5.4)
Spinal cord	4 (5.8)	0 (0.0)	4 (6.8)	8 (4.3)

*Not mutually exclusive

Table IV. Pattern of injury among the study subjects as per ICD-10 classification (N=185)

ICD-10 Code	Injury	n	%
S00	Superficial injury of head	7	3.8
S01	Open wound of head	15	8.1
S02	Fracture of skull and facial bones	9	4.9
S06	Intracranial injury	35	18.9
S07	Crushing injury of head	2	1.1
S09	Other and unspecified injuries of head	28	15.1
S12	Fracture of neck	2	1.1
S13	Dislocation, sprain & strain of joints and ligaments at neck level	2	1.1
S20	Superficial injury of thorax	2	1.1
S22	Fracture of rib(s), sternum and thoracic spine	6	3.2
S29	Other and unspecified injuries of thorax	3	1.6
S32	Fracture of lumbar spine and pelvis	4	2.2
S33	Dislocation, sprain & strain of joints & ligaments of lumbar spine & pelvis	1	0.5
S37	Injury of pelvic organs	2	1.1
S39	Other and unspecified injuries of abdomen, lower back and pelvis	5	2.7
S40	Superficial injury of shoulder and upper arm	8	4.3
S41	Open wound of shoulder and upper arm	2	1.1
S42	Fracture of shoulder and upper arm	10	5.4
S43	Dislocation, sprain & strain of joints & ligaments of shoulder girdle	6	3.2
S49	Other and unspecified injuries of shoulder and upper arm	1	0.5
S50	Superficial injury of forearm	7	3.8
S51	Open wound of forearm	2	1.1
S52	Fracture of forearm	20	10.8
S53	Dislocation, sprain & strain of joints & ligaments of elbow	1	0.5
S60	Superficial injury of wrist and hand	7	3.8
S61	Open wound of wrist and hand	1	0.5
S62	Fracture at wrist and hand level	7	3.8
S69	Other and unspecified injuries of wrist and hand	1	0.5
S71	Open wound of hip and thigh	3	1.6
S72	Fracture of femur	16	8.6
S73	Dislocation, sprain & strain of joints & ligaments of hip	1	0.5

ICD-10 Code	Injury	n	%
S79	Other and unspecified injuries of hip and thigh	1	0.5
S80	Superficial injury of lower leg	8	4.3
S81	Open wound of lower leg	1	0.5
S82	Fracture of lower leg, including ankle	33	17.8
S89	Other and unspecified injuries of lower leg	2	1.1
S90	Superficial injury of ankle and foot	7	3.8
S91	Open wound of ankle and foot	5	2.7
S99	Other and unspecified injuries of ankle and foot	2	1.1
T00	Superficial injuries involving multiple body regions	12	6.5
T01	Open wound involving multiple body regions	1	0.5
T04	Crushing injuries involving multiple body regions	2	1.1

Table V. Distribution of pattern of injury in relation to certain factors

Factors	Pattern of injury*	Pattern of injury*	Pattern of injury*	Pattern of injury*	Pattern of injury*	Pattern of injury*
Factors	**A**	**B**	**C**	**D**	**E**	**F**
Sex						
Male(N=144)	58(40.3)	41(28.5)	94(65.3)	5(3.5)	4(2.8)	33(22.9)
Female(N=41)	15(36.6)	14(34.1)	26(63.4)	3(7.3)	0(0.0)	13(31.7)
Manner of road user						
Pedestrian(N=69)	27(39.1)	26(37.7)	45(65.2)	5(7.2)	1(1.4)	20(29.0)
Driver(N=57)	26(45.6)	18(31.6)	35(61.4)	2(3.5)	2(3.5)	11(19.3)
Passenger(N=59)	20(33.9)	11(18.6)	40(67.8)	1(1.7)	1(1.7)	15(25.4)
Mode of accident						
With collision(N=112)	27(24.1)	14(12.5)	39(34.8)	3(2.7)	2(1.8)	7(6.3)
Without collision(N=73)	17(23.3)	12(16.4)	30(41.1)	0(0.0)	1(1.4)	15(20.5)
Type of vehicle						
Two-wheeler(N=89)	41(46.1)	28(31.5)	48(53.9)	5(5.6)	3(3.4)	23(25.8)
Three-wheeler(N=33)	10(30.3)	7(21.2)	27(81.8)	0(0.0)	0(0.0)	6(18.2)
Four-wheeler(N=65)	19(29.2)	15(23.1)	45(69.2)	7(10.8)	1(1.5)	17(26.2)
Protective equipment**						
Yes(N=30)	16(53.3)	11(36.7)	17(56.7)	1(3.3)	0(0.0)	6(20.0)
No(N=69)	19(27.5)	14(20.3)	35(50.7)	1(1.4)	2(2.9)	13(18.8)

*A-Superficial injury, B-Open wound, C-Fracture, dislocations, sprains, strains, D-Crushing injury, E-Injury to internal organs, F-Intracranial injury

** Only for driver and passengers of two-wheelers

Table VI. Assessment of severity of injuries among the study subjects using Injury Severity Score (ISS)

ISS	Pedestrian (N=69) n (%)	Driver (N=57) n (%)	Passenger (N=59) n (%)	Total (N=185) n (%)
1-5	18 (26.1)	24 (42.1)	25 (42.4)	67 (36.2)
6-10	25 (36.2)	16 (28.1)	17 (28.8)	58 (31.4)
11-15	11 (15.9)	5 (8.8)	6 (10.2)	22 (11.9)
16-20	12 (17.4)	8 (14.0)	4 (6.8)	24 (13.0)
21-25	2 (2.9)	2 (3.5)	2 (3.4)	6 (3.2)
26-30	1 (1.4)	0 (0.0)	4 (6.8)	5 (2.7)
>31	0 (0.0)	2 (3.5)	1(1.7)	3 (1.6)

Table VII. Distribution of Injury Severity Score (ISS) in relation to certain factors

Factors	ISS	ISS	Total	χ2 value, d.f.	'p' value
Factors	**1-8**	**>9**	**Total**	**χ2 value, d.f.**	**'p' value**
Day					
Weekday	60(40.0)	94(61.0)	154(83.2)	0.03*,1	0.87
Weekend	11(35.5)	20(64.5)	31(16.8)		
Time					
Day (6.00-17.59 hrs)	53(40.4)	78(59.5)	131(70.8)	0.55*,1	0.45
Night (18.00-5.59 hrs)	18(33.3)	36(66.7)	54(29.2)		
Place					
In Delhi	65(41.7)	91(58.3)	156(84.3)	4.55,1	0.03
Outside Delhi	6(20.7)	23(79.3)	29(15.7)		
Manner of road user					
Pedestrian	20(29.0)	49(71.0)	69(37.3)	4.11,1	0.04
Others	51(44.0)	65(56.0)	116(62.7)		
Type of vehicle					
Two wheeler	39(37.9)	64(62.1)	103(55.7)	2.84,2	0.24
Three wheeler	20(51.3)	19(48.7)	39(21.1)		
Four wheeler	43(36.4)	75(63.6)	118(63.8)		
Condition of road					
Well maintained	42(47.2)	47(52.8)	89(76.7)	1.10*,1	0.29
Ill maintained	9(33.3)	18(66.7)	27(23.3)		
Overspeeding					
Yes	14(22.6)	48(77.4)	62(47.7)	12.48*,1	0.004
No	37(54.4)	31(45.6)	68(52.3)		
Protective equipment					
Yes	14(48.3)	15(51.7)	29(63.0)	0.03*,1	0.87
No	7(41.2)	10(58.8)	17(58.6)		
Visibility status					
Good	66(40.5)	97(59.5)	163(88.1)	1.21*,1	0.27
Poor	5(25.0)	15(75.0)	20(10.8)		

*Fisher's exact test applied

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