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Fatal Road Traffic Injuries in Northern India: Can They Be Prevented?

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Abstract: Road-traffic injuries are recognized as a major public health problem all over the world accounting for maximum morbidity and mortality following trauma. The objective of this study was to analyze the trends of fatal road traffic crashes and to find measures for the prevention of their causative factors. We examined the pattern of fatal injuries among road traffic crash victims in 1109 cases subjected to medicolegal autopsy during 1996 to 2005 at the department of forensic medicine, in Government Medical College and Hospital Chandigarh. Young adults of the age-group 16 to 30 years constituted the majority of the victims, 608 (55%), while the number decreased with the advancing age. The overall male: female ratio was 5:1. Pedestrians 429 (39%) and motorized two wheeler users 378 (34%) constituted the majority. Motorized heavy vehicles were responsible for 386 (35%) deaths. Head injury in 676 (61%), followed by hemorrhagic shock in 266 (24%) were the main causes of death. 729 (66%) victims died within 24 hours while 307 (28%) had a survival of 2 to 7 days.

Key words: Road-traffic injuries, road traffic crashes, road safety

INTRODUCTION

Reports reveal that road traffic crashes cause over one million deaths while 50 million are injured worldwide each year. Although, often considered to be a problem of countries with high income, 90% of deaths due to road traffic injury occur in countries with low or middle incomes. Moreover, rates of mortality caused by road crashes have been reported to be increasing rapidly in most low and middle income countries; during 1975-1998, mortality attributed to road traffic injuries increased by 79% in India, 237% in Colombia, 243% in China and 384% in Botswana (Mock *et al*., 2005). An estimated 82,700 people died and 4,04,800 were injured in road traffic crashes in India in the year 2002 (Anonymous, 2003).

Road traffic injuries are reported as the ninth leading cause of burden of disease and the third leading cause of death among people between 5 and 44 years of age (Dandona, 2006). Clearly, death in the economically productive age group results in a huge economic burden to society, even though road traffic injuries are estimated to constitute 3.5% of the total disease burden in India (Ghaffar *et al*., 2004). The Working Group on road safety setup by the Goverument of India in 2000 had estimated the annnal economic cost of road crashes at INR 550 billion (US$ 13 billion) and the social cost at 3% of the gross domestic product for 1999-2000 (Dandona, 2006). The numbers of people killed in the country in road crashes were 79,000, 81,000 and 83,000 whereas the numbers of people injured were 3,99,000, 4,04,000 and 4,05,000 in the years 2000, 2001 and 2002, respectively (Dandona, 2006). Pedestrians, motorcyclists and cyclists being the most common road users in India, are affected the most because affordable transport poses a higher risk of road traffic injury than private car use (Ojha, 2002; Dandona and Mishra, 2004), as in many other developing countries (Nantulya *et al*., 2003; Evans and Brown, 2003; Odero *et al*., 1997).

The human factor has been reported in the literature as being the most prevalent contributing factor of road traffic crashes (Lewin, 1982; Farland and Moore, 1957; US General

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Accounting Office, Website:http://www.gao.gov./new.items/do3730t.pdf; Evans, 2003). This includes both driving behavior (e.g., speeding, drinking and driving, traffic law violations) and impaired skills (e.g., inattention, fatigue, physical disabilities, impaired sensory perception etc.). Among the individual variables suspected to increase the risk of road traffic accident, cognitive failure (Larson and Merritt, 1991), sensation seeking, many personality traits, such as locus of control (Montag and Comrey, 1987) and type A behavior pattern characterized by impatience, time urgency and hostility (Nabi *et al*., 2005) have been suspected to be related to unsafe driving behavior and involvement in road traffic accidents. Other contributing factors include increased pace of mechanization, woefully inadequate road area and encroachment of roads by shopkeepers, hawkers and stray animals in typical Indian road conditions (Sharma *et al*., 2001). Yet more significant area of concern, increasing number of motor vehicles on the already over congested Indian roads as a major factor in the causation of road traffic crashes needs to be explored and taken care of.

Road safety in India is the responsibility of Ministry of Road Transport and Highways and the police department, with the role of the Ministry of Health and Family Welfare being limited to trauma care following road crashes (Anonymous, 2002; www.morth.nie.in/actrsc.htm). The world report on road traffic injury prevention (Peden *et al*., 2004) calls for governments to make road safety a political priority and highlights recommendations with regard to policy legislation and enforcement and development of institutional capacity to improve road safety. The report also makes specific recommendations for road safety interventions and provides guidance to various stakeholders in road safety. There is little that a health professional can contribute to the elucidation of factors leading to the accidents, however, the doctor's role in detecting compatibility/incompatibility of the injuries with those usually sustained in traffic accidents (to detect any which are atypical, for example: focal depressed fracture of skull), distinguishing antemortem from postmortem injuries, demonstrating presence of any disease capable of creating sudden incapacity and analyzing samples for alcohol/drugs etc., can go a long way in assigning role to the human and to some extent vehicular and enviroumental factors. This warrants a meticulous examination of the victim in the emergency department or autopsy (as the case may be) to be conducted and not merely a catalogue of injuries. It must be appreciated that all vehicular accidents are likely to result in litigation and the extent of any litigation cannot be anticipated at the time of examination/autopsy. The doctor concerned must, therefore, aim at the close study of any road crash victim and a careful assessment of the case.

The present study aims at examining the pattern of fatal RTIs in different road user groups and the causes thereof and to analyze as to how far can they be prevented keeping in mind the road traffic conditions in the developing countries like India.

MATERIALS AND METHODS

This retrospective study was conducted in the Department of Forensic Medicine and Toxicology, Government Medical College Hospital, Chandigarh; during the period from January 1996 to December 2005. The reports of 1109 cases of fatal vehicular accidents subjected to medico-legal autopsy and the hospital treatment records of those who were admitted to the hospital and treated before death, were thoroughly scrutinized to ascertain the age and sex of the deceased, type of road user(s) and vehicle(s) involved, survival period and cause of death, etc. Motorized two-wheeler crash victims were divided into two categories: those wearing crash helmet (helmeted) and those not (non-helmeted) at the time of vehicular accident, to estimate the usefulness of crash helmets as protective gear.

RESULTS

During the period under study, a total of 3178 medicolegal autopsies were conducted by the department, of which 1109 (35%) had sustained fatal RTIs in different types of vehicular accidents.

Table 1: Annual distribution of fatal road crashes in relation to total nnnatural deaths

Year nnder study	Year-wise distribution of unnatural deaths	No. fatal vehicular crashes	Fatal vehicular crashes (%)
1996	226	121	53.54
1997	264	106	40.15
1998	287	96	33.45
1999	303	102	33.66
2000	352	113	32.10
2001	372	94	25.27
2002	288	111	38.54
2003	338	108	31.95
2004	369	126	34.15
2005	379	132	34.83
Total	3178	1109	34.90

Table 2: Age and Gender distribution of fatal road traffic crashes

	Males (n = 930)		Females (n = 179)	
Age Groups	No.	%	No.	%
0 to 10 years	15	01.61	6	03.35
11 to 15 years	30	03.23	17	09.50
16 to 20 years	144	15.48	27	15.08
21 to 25 years	212	22.80	37	20.67
26 to 30 years	162	17.42	26	14.53
31 to 40 years	151	16.24	22	12.29
41 to 50 years	97	10.43	19	10.61
51 to 60 years	68	07.31	15	08.38
> 61 years	51	05.48	10	05.59

Table 3: Types of road users involved in road traffic accidents

Types of road user	No. (n = 1109)	%
Pedestrians	429	38.68
Motorized two-wheelers	378	34.08
Cyclists	66	05.95
Light motor vehicles	115	10.37
Bus occupants	33	02.98
Others	88	07.94

The study revealed a steady decrease in the percentage of RTI deaths during the period from 1996 to 2001, 54, 40, 33, 34, 32 and 25%, respectively. There was an abrupt increase to 39% in 2002, followed by a gradual increase from 32 to 34 and 35% during the period 2003 to 2005 (Table 1).

Majority of the victims were young adults of the age group 21-30 years, 437 (39%); of which the 21-25 years age group accounted for 249 (57%) victims. The 31-40 years age group and the 16-20 years age group, 16 and 15% victims, respectively, followed this. The above 60 years age group accounted for 6% while the least number of cases 2%, belonged to the 0-10 years group. Males far outnumbered the females, the male: female ratio being 5:1 (Table 2).

Pedestrians (429) were the most common victims of the RTIs, followed by motorized two-wheeler users (378), occupants of light motorized vehicles (115) and bicycle users (66). Occupants of buses accounted for the least number of victims (33) while other means of conveyance that included auto-rickshaws, cycle-rickshaws, bullock-carts etc were responsible for 88 cases (Table 3).

Of the offending vehicles, public transport buses were responsible for the maximum number of RTIs (254), followed by light motorized vehicles (212), motorized two-wheelers (177), trucks (132) and others that included auto-rickshaws, cycle-rickshaws, bullock-carts etc (150), respectively. In 184 of hit and run cases, the offending vehicle could not be identified (Table 4).

Majority of the victims (348) succumbed to their injuries at the spot of RTI or while being transported to the hospital. 169 victims had a survival period of 1 to 6 h, 212 survived for 6 to 24 h while 185, 122 and 73 cases had a survival period of 1 to 3 days, 3 to 7 days and more than one week, respectively (Table 5).

Table 4: Types of offending vehicles in road traffic accidents

Types of offending vehicle	No. (n = 1109)	%
Buses/Mini buses	254	22.90
Trucks	132	11.90
Unknown vehicles (Hit and Run Cases)	184	16.59
Light motor vehicles	212	19.12
Motorized two-wheelers	177	15.96
Others	150	13.53

Table 5: Survival periods of the injured

Survival periods	No. (n = 1109)	%
Died on spot or before reaching ED	348	31.38
1 to 6 h	169	15.24
6 to 24 h	212	19,12
1 to 3 days	185	16.68
3 days to 1 week	122	11.00
> 1 Week	73	06.58

Table 6: Causes of death in road traffic injuries

Causes of death	No. (n = 1109)	%
Head injury with skull fracture	581	52.39
Head injury without skull fracture	95	08.57
Head injury with hemorrhage and shock	124	11.18
Hemorrhage and shock	266	23.99
Septicemia	33	02.98
Other complications	10	00.90

Head injury, with skull fracture in 581 cases and without skull fracture in 95 cases was the cause of death, followed by hemorrhage and shock in 266 cases, while head injury, in combination with hemorrhage and shock, accounted for 124 more deaths, thereby making head injury the cause of death in approximately 3/4th of fatal RTIs. Septicemia and other complications accounted for 33 and 10 deaths, respectively (Table 6).

DISCUSSION

Every day as many as 140,000 people are injured on the world's roads. More than 3,000 die and some 15,000 are disabled for life. Each of those people has a network of family, friends, neighbors, colleagues or classmates who are also affected, emotionally and otherwise. Families struggle with poverty when they lose a breadwinner or have the added expense of caring for disabled family members (WHO, 2004).

The large number of head injuries in the present study (61%), is consistent with other studies, as is also expected given the fact that head injury is often severe enough for the person to seek treatment and is one of the most common causes of hospital-based death in traffic-related trauma. Traumatic brain injuries have been reported to account for a large number of patients registered in hospitals and road traffic injuries constitute 45-60% of these (Gururaj, 2002).

The majority of RTIs victims was male (84%). This is consistent with the literature and is due to the differential exposure among the two genders. In India, males are more often the breadwinners of the family and are hence more likely to commute. In addition, the majority, if not all, of the two-wheeler drivers and commercial vehicle drivers are males. The majority of victims being young (39% in the 21-30 years age group) is again consistent with the literature and one reason why road traffic injuries lead to great economic losses. The studies have also reported that the effects of road crashes, however, are not limited to the urban young (Sitaraman *et al*., 1985).

The vast majority of those injured on the road in India are pedestrians (39%) and motor-cyclists (34%) since these are the most common modes of transport, especially for the poor. Lack of adequate pedestrian walking spaces, lack of speed control and poor recognition of their right to safety are contributing factors, as in other developing nations (Peden *et al*., 2004; Mock *et al*., 1998). The large numbers of automobile occupants in autopsy studies, however, reflect a mix of factors, such as the lethality of crash, as captured by studies and the legal implications of unnatural deaths. All unnatural deaths in India have to be registered and taken for autopsy to public hospitals. The particular susceptibility of two wheeler drivers and riders to head injuries is due to non-enforcement of helmet laws in many parts of the country, especially for pillion (rear seat) riders.

Road Traffic Injuries (RTIs) are reported to be responsible for 1.2 million global deaths and rank 9th as cause of death in both the high and low income countries (Peden *et al*., 2002a). The impact of road traffic injuries is greater in the 5-29 years age group. In this age group, these injuries are the leading cause of mortality in high-income countries and second leading cause in low-income countries (Peden *et al*., 2002a). Road traffic injuries were responsible for more than 38 millions Disability Adjusted Life Years (DALYs) lost worldwide and accounted for 2.6% of the total DALYs lost in the year 2002 (WHO, 2003). The greatest tragedy associated with injuries from road traffic crashes is the fact that most of these deaths are preventable.

India is a rapidly developing nation in the South Asian region with a population of more than 1 billion per capita GNP of US$ 370 and life expectancy at birth of 63 years (Census Bureau of India, Website:http://www.censusindia.net). It has all the problems faced by rapidly developing nations, especially increasing motorization, however, despite such developments; there are limited data in the literature addressing the problem of road traffic injuries.

The number of vehicles in India is rapidly increasing, with about 6 million new motor vehicles sold every year (Society of Indian Automobile, Website:http://siamindia.com/General/domestic-sales-trend.aspx). According to the WHO, India has the second highest reported mortality rate of 29.2 per 100,000 people, from road traffic injuries (Peden *et al*., 2002b). Injuries are reported to be the seventh leading cause of death (11% of all deaths) in India, with RTIs making up to 78% of them (WHO, 1999).

The cost of road traffic injuries in India is estimated to be more than 322 billion rupees (US$ 7.4 billion), 3.2% of the national GDP (Mohan, 2002) and India has one of the highest road crash death rates per 1,000 vehicles in the world (Mohan, 1984). Even in rural India, traffic injuries are one of the leading causes of potential years of life lost and contribute to almost 6 years of life lost per 1,000 people (Indrayan *et al*., 2002). In spite of the rising burden of road traffic injuries in India, there has been a limited amount of research dedicated to this problem. This paucity of data is evidenced by the small number of studies found in a population of more than a billion people. The results reflect a preponderance of facility-based case-series and a lack of population-based published studies in India. The heterogeneity in the data generated by various studies is also noteworthy. Most of the reviewed articles had a different terminology, classification and approach for gathering data.

Injuries contribute to a large proportion of hospital visits and deaths, thereby representing a significant burden on the healthcare system. The average 8-10% case fatality ratio is an indication of the severity of injuries and sub-optimal treatment facilities. These rates do not reflect the high rate of outside or pre-hospital deaths among crash victims reflecting the severity of injuries. Victims often neither receive any first aid nor are transported in time by ambulances/emergency responders to hospitals (Maheshwari and Mohan, 1989). The widespread lack of emergency medical services across India is an important factor leading to poor outcomes in road traffic injury victims. In other developing countries also, the majority of deaths occur in the pre-hospital time period (Mock *et al*., 1998). An emergency medical system, which can transport a large proportion of victims to a hospital in metropolitan cities, will allow proper medical care to be delivered on time and many of the deaths can be prevented (Sahdev *et al*., 1994).

Heavy vehicle drivers in India are required to adhere to strict travel times and so rely on speed, as well as use of alcohol and drugs, especially those commuting long distances on highways

(Sharma *et al*. 2001; Mohan and Bawa, 1985). The large number of single vehicle crashes, leading to injuries and deaths, reflects a difference from road crashes in high-income countries (Sood, 1988). The rising number of incidents at night might also represent the influence of alcohol (Mohan and Bawa, 1985) although only one of the studies, on two-wheeler injuries, provided an estimate of alcohol involvement in crashes (Mishra and Mohan, 1984).

The presence of data in India on standardized severity scores for injury is important for injury assessment as it reflects severity of road traffic injuries and lends support to their use as markers of prognosis and triage in low resource conditions (Sharma, 2005). However, the practice needs to be implemented in letter and spirit.

CONCLUSIONS

Road safety, although often misunderstood to merely provide admonitions to be careful, is a part of the broader field of injury control that deals with unintentional and intentional injuries. It is a scientific field like that used to control any other health problem that involves the use of surveillance and research to understand the extent and nature of the problem, the determination of risk factors and targeting of these factors using scientifically based prevention strategies and finally, assessment of the outcome of such interventions. Road safety comprises three interacting components: infrastructure (roadways), vehicle design and human behavior, each of which demands scientifically based, organized approaches to decrease the incidence of road traffic injuries. The most important research gap identified was the lack of common focus and hence variable terminology, methodology and reporting. Most research is focused on post mortem analysis, which is not the best source to estimate overall injury patterns. Hospital-based studies fail to capture victims who do not seek treatment and a specific determination of the population at risk cannot be made. It has been reported from time to time that many medically preventable deaths caused by road traffic injuries occur in countries with low or middle incomes and that the number of these could be decreased by low-cost improvements in treatment services.

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