



## Pattern of injury in fatal road traffic accidents in a rural area of western Maharashtra, India

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### RESEARCH

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### Abstract

#### Background

Fatal road traffic accidents (RTA) are a major cause of concern all over the world. The outcome of injuries sustained in an RTA depends on various factors including but not limited to: the location of the event, type of vehicle involved, nature of the roads, the time of accident, etc.

#### Aims

This study aims to investigate and evaluate prospectively the socio-demographic profile and pattern of injuries in victims of RTA in the rural area of the Ahmednagar district of Maharashtra state.

#### Method

This prospective study included all victims of RTA that presented to our emergency room from 1 June 2007 to 31 May 2009 and were either found dead on arrival or died during treatment. All the victims were autopsied at the post-mortem centre of Rural Medical College, Loni.

#### Results

Ninety-eight RTA victims were studied during the period. The most commonly affected age group was 20-39 years. Men died in RTA more than women. Fatal RTA were more prevalent on the secondary road system (47.97 per cent) and especially involved pedestrian and two wheeler vehicle users. Large numbers (n=63, 64.28%) of victims either died on the scene or during transportation. Numbers of skeletal injuries (199) and internal organ injuries (202) exceeded the total number of victims (98) clearly indicating the multiplicity of injuries. The majority of RTA victims (n=46, 46.93%) died due to head injury. The study showed that most deaths in RTA, brought to a tertiary care rural hospital, took place either on the spot or within 24 hours of injury which is very alarming and highlights the need to take urgent steps to establish good pre-hospital care and provision of trauma services at site.

#### Conclusion

A computerised trauma registry is urgently needed to highlight risk factors, circumstances and chains of events leading to accidents. This would be extremely helpful in policy making and health management in India.

#### Key Words

Road traffic accidents, injuries, vehicles, rural

#### What this study adds:

1. Fatal RTA are a major cause of concern all over the world.
2. The study investigates and evaluates the socio-demographic profile and pattern of injuries in victims of fatal RTA in a rural area.
3. The results can be helpful in policy-making, keeping in view the distinction between rural and urban areas for road safety management.



## Background

Injuries cause the death of over five million people around the world each year despite no longer being perceived as unavoidable but largely preventable events.<sup>1</sup> Out of this huge number, 1.2 million are due to road traffic accidents (RTA), 90 per cent of which take place in low and middle income countries.<sup>2,3</sup> It is predicted that by 2020, RTA will become a major culprit in the total disease burden.<sup>2,4</sup>

About 60 per cent of the world's total vehicular concentration is seen in highly motorised countries; however they witness only 14 per cent of total road fatalities.<sup>5</sup> On the contrary, with just 16 per cent of total vehicular possession and 54 per cent of the world's population, the Asia/Pacific region experiences 44 per cent of road fatalities.<sup>6</sup>

In India, though the rate of deaths per thousand vehicles has come down to 1.4 per cent (2009) compared to 1.5 per cent in 2005, deaths resulting from RTA have risen by 7.3 per cent from 2008 to 2009. Fatal RTA share 37.9 per cent amongst all deaths due to unnatural causes in the country in 2009 showing a rise from 36.2 per cent in 2005.<sup>7</sup> Amongst the developed states of India, Maharashtra, the third largest province area-wise, ironically happens to be the second most populous state. As a leading industrial region, it has witnessed a 45 fold rise in the number of vehicles on the road from 1961 to 1997. However, the length of road has not grown at the same proportion and saw a meager five-fold rise. This has directly resulted in an over-burdening of these roads by up to four to five times their original capacity.<sup>8</sup> The spectrum of RTA is immense with a resultant subset of varied types of injuries possible due to it. This study is aimed at ascertaining the socio-demographic profile and pattern of injuries in victims of fatal RTA in the rural area of the Ahmednagar district of Maharashtra.

## Method

A prospective study was carried out under the auspices of the Department of Forensic Medicine and Toxicology of Rural Medical College (RMC) and Pravara Rural Hospital, Loni, Taluka Rahata, District Ahmednagar. It is a tertiary level health care and medical training institute, serving the rural community of central and western Maharashtra. The institute is located on State Highway 10 (Ahmednagar – Nashik), 22 kilometres from Shirdi, the religious abode of Shri Saibaba, a world renowned pilgrimage centre which attracts Hindu devotees from across the world. In addition to a well-equipped emergency department with prompt ambulatory services, its vicinity to the National Highway 50 (Nashik-Pune), makes it one of the busiest emergency care providers to the victims of road traffic mishaps from the

surrounding areas. Indian roads are divided into three main systems depending on connectivity; the major cities being connected by national highways (primary system), small districts by state highways (secondary system) and town and villages by small roads (tertiary system).

Ninety-eight RTA victims that presented and/or were referred to our hospital from 1 June 2007 to 31 May 2009, and subsequently died during treatment and those who were found dead on arrival at our emergency room formed the sample size of the study. It also included dead bodies brought by investigating agencies that presumably had died due to a direct result of injury following RTA. Inclusion was irrespective of the age, gender, ethnicity and severity, location or mode of injury. A detailed medical history was obtained from the relatives of the deceased and/or other alive victims injured in the same accident and/or eye witnesses available at the time of post-mortem examination. Thorough perusal of case papers including investigation, medicolegal register and police records viz. "panchanama" were carried out to collect other relevant information. Post mortem examination (autopsy) was carried out and all external and internal injuries over the body were recorded. While noting injuries, if one type of multiple injuries were present over a body part, it was considered as one injury. Victims of RTA, who died after 30 days of hospitalisation following the accident, decomposed dead bodies, victims with a dubious history, victims of collision with animals and RTA involving immersion or incineration were excluded. Ethical approval was obtained from the Institutional Ethical Committee of Pravara Institute of Medical Sciences, Loni. Data analysis was done using statistical packages Microsoft Excel 2007 and StatistiXL 1.4.

## Results

Of the 98 victims that fulfilled our inclusion criteria, 74 were male, with male to female ratio being 3.08:1. The age range of the autopsied victims was from 3 to 85 years. The highest numbers of deaths (39.79 per cent) were recorded in the 20-39 years age group. It was observed that almost one-quarter (24.48 per cent) of victims were uneducated while 29.59 per cent were part of the dependent population (unemployed/housewife/retired people/children less than five years old). The socio-demographic characteristics of the study victims are depicted in Table 1.

Forty-seven per cent (47.97%) of cases were from accidents occurring on secondary systems i.e. state highways and major district highways, followed by 27 (27.55 per cent) on rural and village roads. The maximum number i.e. 38 (38.77 per cent) of accidents took place between the hours of 12.00pm and 18.00pm followed by 32 (32.67 per cent)



occurring between 18.00pm–00.00am hours (Table 2). Most injuries, 122 (32.44 per cent) were found on the head, neck and face, followed by the upper extremities (n=79, 21.01 per cent) and the lower extremities (n=74, 19.68 per cent). Among the total number of external injuries (n=376) abrasions were found to be the commonest type (56.38 per cent). Contusion and laceration were found to occur almost equally (Table 3). The skull was the most common bone to be fractured in an RTA (n= 59, 29.64 per cent). The spine and pelvis remained the least affected bones (Table 4). Autopsies revealed the brain to be the most frequently injured internal organ (Table 5). The overall numbers of skeletal injuries (199) and internal organ injuries (202) exceeded the total number of victims (98) clearly indicating the multiplicity of injuries (Table 4, 5).

**Table 1: Socio demographic characteristics of the victims**

	n	%
<b>Age</b>		
00 – 09	05	5.10
10 – 19	08	8.16
20 – 29	13	13.26
30 – 39	26	26.53
40 – 49	13	13.26
50 – 59	17	17.34
>60	16	16.32
<b>Gender</b>		
Male	74	75.51
Female	24	24.48
<b>Occupational status</b>		
Farmer	13	13.26
Labourer	19	19.38
Student	09	9.18
Govt. employee	07	7.14
Business	19	19.38
Private employee	12	12.24
Dependant	29	29.59
Unknown	02	2.04
<b>Educational status</b>		
Primary school	19	19.38
High school	22	22.44
Junior college	14	14.28
Graduation & above	16	16.32
Uneducated	24	24.48
Unknown	03	3.06

**Table 2: Distribution of RTA victims according to type of road network and time of accident (n=98)**

Road type	Time of accidents					Total
	0-6 am	6-12 am	12-18 pm	18-24 pm	Not known	
Primary system <sup>a</sup>	2 (2.04)	6 (6.12)	10 (10.2)	6 (6.12)	-	24 (24.48)
Secondary system <sup>b</sup>	6 (6.12)	6 (6.12)	18 (18.4)	16 (16.32)	1 (1.02)	47 (47.97)
Tertiary system <sup>c</sup>	3 (3.06)	4 (4.08)	10 (10.2)	10 (10.2)	-	27 (27.55)
<b>Total (%)</b>	11 (11.22)	16 (16.32)	38 (38.77)	32 (32.67)	1 (1.02)	98 (100)

<sup>a</sup>National highways, <sup>b</sup>State highways and major district highways, <sup>c</sup>Other district roads, rural and village roads  
Data in parenthesis indicates percentage

**Table 3: Distribution of external injuries in victims of fatal RTA over different part of the body, N (%)**

Part of the body	Abrasion	Contusion	Laceration	Total
Head, Neck & Face	48 (12.76)	40 (10.36)	34 (9.04)	122 (32.44)
Upper extremity	56 (14.89)	12 (3.19)	11 (2.92)	79 (21.01)
Thorax	43 (11.43)	11 (2.92)	1 (0.26)	55 (14.62)
Abdomen & pelvis	26 (6.91)	12 (3.19)	8 (2.12)	46 (12.34)
Lower extremity	39 (10.37)	9 (2.39)	26 (6.91)	74 (19.68)
<b>Total (%)</b>	<b>212 (56.38)</b>	<b>84 (22.34)</b>	<b>80 (21.27)</b>	376 (100)

**Table 4: Distribution of fracture in RTA victims**

Part of the body	N (%)
Skull	59 (29.64)
Face	24 (12.06)
Spine	7 (3.51)
Thorax	39 (19.59)
Pelvis	7 (3.51)
Upper extremities	31 (15.57)
Lower extremities	32 (16.08)
<b>Total (%)</b>	<b>199 (100)</b>



**Table 5: Distribution of visceral injuries amongst RTA victims**

Part of the body	N (%)
Brain	78 (38.61)
Spine	7 (3.46)
Lungs	25 (12.37)
Heart & major blood vessels	16 (7.92)
Liver	24 (11.88)
Spleen	12 (5.94)
Kidneys	17 (8.41)
Stomach	5 (2.47)
Intestine	14 (6.93)
Diaphragm	4 (1.98)
<b>Total (%)</b>	<b>202 (100)</b>

The majority of the RTA victims (n=46, 46.93 per cent) died due to head injury. Poly trauma and haemorrhagic shock were the reasons in 34 (34.69 percent) and 14 (14.28 per cent) individuals respectively. Spinal cord injury and complications as a result of RTA took the life of two victims each (Table 6). A large number (n=63, 64.28%) of victims either died on the scene or during transportation. Only 11 (11.22 per cent) individuals survived for 2-6 hours following the RTA while just one (1.02 per cent) survived for more than two weeks of hospitalisation. All types of road users were involved in RTA. The group consisting of pedestrians and two wheelers were equally affected, 28.56 per cent each. Bullock cart and tractors were seen as the mode of transportation of 5.10% per cent and 4.08 per cent of victims respectively. Others included cyclists (28, 28.5 per cent), three wheelers (8, 8.1 per cent), light motor vehicles (15, 15.3 per cent) and heavy motor vehicles (6, 6.1 per cent).

**Table 6: Distribution of RTA victims according to cause of death (n=98)**

Cause of death	N (%)
Polytrauma	34 (34.69)
Head injury	46 (46.93)
Hemorrhagic shock	14 (14.28)
Spinal cord injury	2 (2.04)
Complications	2 (2.04)
<b>Total (%)</b>	<b>98 (100)</b>

### Discussion

During the study period, 349 autopsies were carried out in the Department of Forensic Medicine and Toxicology, of which 98 (28 per cent) were of RTA. The highest number of deaths (26.53 per cent) was in the 30-39 year age group. A study conducted by Kochar et al. in 2002 had similar statistics.<sup>9</sup> Almost 53 per cent of victims were in the 20-49

years age group, which is in accordance with other studies.<sup>10-20</sup> The average age of male and female RTA victims was 40.5 years and 37 years respectively. The young and middle age groups largely consisted of students and the working populace who travel using their own vehicles, use public transport or walk. In comparison to other age groups, the younger demographic seem more liable to meet an RTA, presumably because their activities require them to travel more than the older demographics.<sup>13</sup>

The male predominance in our study also fits well with the reporting of other research of a similar nature.<sup>9-11,13,16,21,22</sup>

This gender bias could be due to the fact that more males work outdoors and therefore are more commonly exposed to traffic accidents. Many of them were likely to have been the sole bread winner of their families, which causes an adverse economic impact on the family.<sup>20</sup> The largest number of victims i.e. 29 (29.59 per cent) were from the dependant demographic which constitutes mainly of housewives, geriatric and paediatric (less than five years) . It is presumed that they have a poorer sense of traffic safety rules leading to increased fatalities. The proximity of rural community residences to highways, associated with undivided traffic streams and roadsides without guardrails increased their chances of meeting with a fatal RTA. However, this was in contrast with studies which reported labourers, working people and businessmen being the most affected group.<sup>10,11</sup>

Among the victims, nearly half of the studied sample (44 per cent) were either uneducated or had a primary level of schooling. The relationship between education and RTA may not be casual.<sup>10</sup> Studies from other parts of India<sup>10</sup>, Malaysia<sup>11</sup> and Iran<sup>14</sup> also report a similar level of education of RTA victims. Not surprisingly in rural parts of India, it is expected that the child starts earning at an early stage which makes them leave home and compels their discontinuation of education. Most of the accidents in our study occurred between afternoon and evening (12-18 hours) followed by early duration of night hours (18-24 hours). The findings of our study coincide reasonably with other studies.<sup>10,12,13,23</sup> As per Aygenel et al<sup>12</sup> these hours correspond to the time range that people actively work and travel, and then go back to their homes after finishing work. An increased number of vehicles in the traffic, and reduced attention of drivers and pedestrians related to the fatigue of the day; failures to follow traffic rules, associated with improper infrastructure like the absence of footpaths were the greatest cause of accidents.<sup>13</sup>

In rural regions, the tertiary system of roadways directly merges with either state or national highways. The primary



occupation of most of residents of rural communities is related to agriculture with their mode of transport being bullock carts or walking along with their animals. This kind of transportation requires more space, and they usually move in an undisciplined manner which makes them a high-risk group for RTA. Most of the victims were affected on secondary system of roads i.e. the ones that connect two districts. This is primarily because a state highway runs through the location of our study area, which is then further connected to national highways and other state highways.

Sixty-four per cent (64.28%) of victims died on the scene or died during transportation. This was a common observation among different researchers.<sup>13,14,16,21,22</sup> A delay in emergency services, the shortage of pre-hospital teams and absence of nurses or doctors at the scene of accident<sup>24</sup> were the possible reasons. A study by Sahdev et al<sup>25</sup> conducted in Delhi showed that the majority of victims were brought to hospital alive. Being the capital of the country, Delhi has better road safety mechanisms in place with prompt emergency services to cater to the needs of common people as well as the VIP motorcades that frequently use the its roads.

Pedestrians and two wheeler users equally constitute the largest group (28.5 per cent each). The choice of mode of transport was often influenced by the working pattern of that particular demographic. Ours being a rural area, the majority of the road users were either pedestrians or two-wheeler users. The lack of a transport medium between rural roads to state or national highways compels commuters to either walk or use their personal vehicles to reach the nearest point of accessibility. While in Iran<sup>14</sup>, pedestrian and car occupants and in Sri Lanka,<sup>20</sup> pedestrians and cyclists were common victims. Other studies from different parts of the country showed pedestrians being the commonest victims.<sup>9,17-19</sup>

Most of the external injuries were found on the head, neck and face, followed by upper extremity and lower extremity. In the study conducted by Verma et al<sup>23</sup> limbs followed by head were commonly affected. Abrasions were the commonest type of external injury. The total numbers of external injuries amongst 98 victims of RTA were 376, which shows the multiplicity of injuries amongst victims. The external injuries per case were 3.8 per victim, while Chaudhary et al<sup>17</sup> recorded it to be 1.66 per victim. The majority (29.64 per cent) of fractures were observed in the skull in all type of road users. Other studies also report a similar nature of fracture.<sup>17,20</sup> The average number of fractured bones per case amounts to approximately two. Out of 98 victims, a total of 202 visceral injuries were found

which also shows the multiplicity of internal injuries. The majority had brain injuries, followed by injuries to the lungs and liver. A high incidence of brain injury was due to the fact that two wheeler users were not using helmets while light motor vehicle users were travelling without safety measures like seat belts causing dash-board or wind screen injury. The average number of visceral injuries was two per victim. Head injury was the most common cause of death which has also been documented by other researchers.<sup>13,14,17,19-21.</sup>

Many different types of risk factors may contribute to the increased injury fatality rate on rural roads. If crashes or crash injuries are more severe on rural roads, then fatalities are likely to be more common. The factors that contribute to this higher risk of fatalities include poor accessibility of early medical aid, pick up services, bad roads and lack of communication, for example, the absence of mobile networks in rural roads. Increased crash severity on rural roads may occur because crash characteristics are different on rural than urban roads. For example, rural drivers may be more likely to have head-on crashes because traffic streams are not divided. Rural drivers may also be more likely to have single vehicle collisions with stationary objects because roadsides do not have guardrails.<sup>24</sup> To reduce mortality due to RTAs, monitoring, launching health education campaigns for preventing road accidents, encouraging people to use seat belts and helmets, restricting the issue of driver's licenses, raising road safety standards, training the general public in first aid, and improving emergency services are all necessary. However, the first priority is for users to obey the law, and to respect other people's rights as drivers and pedestrians.<sup>14</sup>

The results of the study will help predict the pattern of RTA injuries and may subsequently help reduce mortalities by narrowing the time delay in diagnosis and subsequent management of patients. It will also help policy makers in implementing effective emergency services. The outcome of the findings may also guide the autopsy surgeon in a court of law towards reconstruction of the accident. However, a few limitations of the study like small sample size, non-inclusion of urban population may limit the generalisation of the results. Beside, risk factors like alcohol or drug intoxication, seating position of the victim in the vehicle and histo-pathological examination of organs of all cases could not be ascertained.

## Conclusion

The study showed that most RTA deaths, brought to a tertiary care rural hospital, took place either on the spot or within 24 hours of injury which is indeed very alarming. It



warrants the urgency to establish good pre-hospital care and provision of efficient and prompt trauma services at site. Head injuries remain the most common and serious type of trauma in RTA and demand good neurosurgical care for such patients. The establishment of a nationwide computerised trauma registry to highlight risk factors, circumstances, chain of events leading to the accidents should be extremely helpful in policy making and health management decisions at a national level.

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### **PEER REVIEW**

Not commissioned. Externally peer reviewed

### **CONFLICTS OF INTEREST**

The authors declare that they have no competing interests.

### **ETHICS COMMITTEE APPROVAL**

The ethical approval was obtained from the Institutional Ethical Committee of Pravara Institute of Medical Sciences (Deemed University), Loni.