Abstract

Introduction
In low- and middle-income countries, road traffic injuries are one of the main leading causes of mortality and morbidity. Due to lack of awareness and mixed traffic, the risk of road traffic injuries is increasing on a daily basis. Identification of these risk factors is important for planning and improvement of potential safety measures. The objective of this study was to elucidate the risk factors in survivors of road traffic accidents.

Materials and methods
A prospective study on road traffic accidents was conducted from 1 March 2012 to 30 May 2012 at the Trauma Centre of King George’s Medical University, Lucknow, India. Questions were asked to survivors of road traffic accidents using a pretested questionnaire after they received pre-medical care. If the patient was unconscious, then questions were asked in Hindi as well as English to the attendant or accompanying person at the time of reporting to the Trauma Centre. When the patient became conscious and was stable, he/she was also asked the same questions for retesting the collected data. Any issues were resolved by arriving at a consensus in between the answers of the patient and guardian.

Results
In the present study, the majority of the victims were male (247 victims; 87.6%) and were in the age group of 16–25 years (111 victims; 39.4%). This study revealed that out of 282 road traffic accident victims, most were injured on main/major roads (135 victims; 47.9%) and motorcyclists were more in number (111 victims; 39.4%). Most collisions occurred from the front (142 victims; 50.4%), having a mean angle of 165.08 ± 32.92 with an average speed of less than 50 km/h (159 victims; 56.4%). Of 282 victims, 47.1% (134 victims) received pre-hospital care. Majority of road traffic accident victims were injured on working days (200 victims; 70.9%), followed by school holidays (16.0%) and public holidays (13.1%). Of 111 motorcycle riders, 45.0% were non-helmet users (50 victims). Penetrating type of injuries were common (64 victims; 22.7%), followed by blunt injuries (53 victims; 18.8%), polytrauma (52 victims; 18.4%), fracture (48 victims; 17.0%), cut/open wounds (46 victims; 16.3%), haematoma (10 victims; 3.5%) and sprain (9 victims; 3.2%).

Conclusion
The risk factors play a crucial role in aggravating the severity and burden of injury. The development of policies and their strict implementation based on these risk factors can reduce the severity and burden of injuries in India.

Introduction
Road traffic injury (RTI) is the tenth leading cause of death worldwide as stated in June 2009 by the World Health Organization (WHO) in its Global Status Report on Road Safety. India has 1% of total vehicles in the world, but it accounts for 6% of total road accidents\(^1\), approximately 65 billion US dollars are spent on these accidents every year\(^1\). With a moderate increase of 0.35% in 2009, the number of accidents reported in 2010 was 499,628, showing a growth of 2.72%. It is estimated that up to 2020, road accidents will be a major killer in India, accounting for 546,000 deaths and loss of 15,314,000 disability-adjusted life-years\(^2,3\). The number of accidents per 100,000 population has increased from 21.2 in 1970 to 42.5 in 2010, which is two times greater\(^2,3\). WHO in its international conference at Geneva in 2007 discussed the importance of various data regarding road traffic accidents (RTAs), concluding that gathered information could prove to be the basis of major policy decisions regarding their prevention and management in a coherent manner\(^4\). The aim of this study was for survivors to discuss risk factors involved in traffic accidents.

Status of traffic in Lucknow
Uttar Pradesh (UP) is situated in the north-eastern part of India, with Lucknow being the capital city. It is a city of Nawabs, and it has a complex architectural blend of old and modern era. It is situated between 26.50° North and 80.50° East, at an elevation of 123 m above the sea level, with an estimated population of 2,815,033 as per the 2011 Census\(^5\). It is traversed by one of the busiest highways in the country, having a fatality risk of more than 20 per 100,000 people\(^5\).

UP, the most populous state in the country with a population share of 16.8%, on the other hand, has accounted for 7.9% of accidental deaths and stood at fifth position after Maharashtra (16.7%), Madhya Pradesh (9.3%), Tamil Nadu (8.4%) and Andhra Pradesh (8.2%)\(^6\). The number of registered vehicles during

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2009 was 7989, but the incidence and rate of deaths reported were 21,985\(^6\).

Amongst the various fatalities in India, 33% are due to RTI; likewise, it is 82% in Agra, 78% in Lucknow, 53% in Varanasi, 47% in Meerut and 42% in Kanpur; which are the major cities of UP. There are 10 fatalities per week (Road Accident Statistics of India; 1997–2007), which accounts for an average of 23 fatalities per 100,000 people—more than twice than that of the metropolitan cities of India\(^6\).

Despite this, there is little recognition of the health and economic burden of this problem. Studies on the RTAs are far and few in UP\(^5\); however, road safety is a political priority in UP, but death/injury due to RTAs are increasing on a daily basis. The reasons behind the high incidence appear to be inadequate and unmanaged traffic infrastructure, lack of effective road safety policies, missing traffic signs, mixed type of traffic pattern, inexperienced/untrained drivers, less attention given towards the provision for pedestrians and cyclists who are more prone to RTAs.

In major roadways, where the traffic is intense, the pavements of junctions are encroached upon by hawkers and dwellers, which in turn give rise to the parking of vehicles on the road. As a consequence, the available deficient space for the movement of vehicles is further reduced, thereby worsening the situation. The problem of traffic accidents gets aggravated due to a wide variety of slow and fast-moving vehicles all moving at the same time without following any traffic rules\(^6\).

A mandatory road safety law such as the Motor Vehicles Act, 1988 stating simple safety measures such as the use of seat belts and helmets is rarely enforced or followed, aggravating the deficiency in road safety. The allotment of a driving licence is also a very casual affair and can be obtained even with little incomplete training\(^6\).

According to the projected survey in 2008, the population of Lucknow will be doubled in 2013\(^3\), leading to an enhancement of various risk factors that are responsible for RTI.

We had conducted a cross-sectional survey to provide precise information on RTI risk factors with the type of injury among road crash victims admitted to the Trauma Centre of King George’s Medical University, Lucknow and to determine the factors associated with the severity of injury among these patients.

**Materials and methods**

Informed consent was obtained from the patients above the age of 12 years at the time of admission. If the patient was unconscious or disoriented, consent was taken from his/her attendant or blood relative and questionnaires were filled on the basis of information given by the attendant/relative. Consent was taken and information was retested by interviewing the patient when conditions permitted.

Information was gathered using a pretested questionnaire regarding the road crash based on perception of the victim. Assessment of alcohol was based on a self-report and odour of the breath.

Clinical information on injury type was recorded from the medical charts, radiographs and doctor’s assessment. Additional details concerning the accident were also obtained from the police and medical staff, wherever available.

**Hospital participation and characteristics**

The study was conducted at the Trauma Centre, King George’s Medical University, Lucknow after obtaining ethical clearance. It houses 2424 beds with an occupancy rate of 90–100% and 10 operation theatres; 12 cost-free ambulances provide transport for patients around the campus. The Hospital and Medical School is the cheapest hospital and provides free treatment to patients below the poverty line. This hospital is easily approachable from different areas of Lucknow and allied districts.

**Data collection**

RTI victims reaching the hospital within 24 h of the road accidents between 1 March 2012 and 15 May 2012 were included in the study. Patients presenting beyond 72 h after RTAs and those who refused to provide consent were excluded. Road crash victims, who did not seek medical treatment at King George’s Hospital and Medical School including those who died on-site or before arrival to the hospital, were also excluded. A total of 282 patients were questioned to elucidate the risk factors and injury pattern among RTA victims.

Accidents were defined as any crash involving at least one or more than one moving vehicle. Vehicles were classified as motorbikes, bicycles, three wheelers, four wheelers and six wheelers. Pedestrians and those riding two wheelers such as bicycles and motorcycles were identified as vulnerable road users because of less safety and being more prone to accidents. Non-vulnerable users included vehicle occupants, including those travelling in cars, vans, buses or trucks. Road crash victims were consecutively recruited, and the data were collected using precise pretested interviewer-administered questionnaires after the patient’s pre-medical care.

**Results**

A total of 282 road crash victims were recruited, consented and interviewed; 99% of those recruited agreed to participate. Bio-social profiles of the subjects involved in the road traffic accidents are summarized in Table 1. Males were more involved (247 victims; 87.6%) than females (35 victims; 12.4%). Most of them were illiterate (69 victims; 24.5%) followed by those with primary (46 victims; 16.3%) and middle education (46 victims; 16.3%). The majority of them were young adults in the age group of 16–25 years (111 victims; 39.4%) and had an average income of Indian Rupees...
5,000–10,000. The maximum number of patients belonged to other categories (93 victims; 33.0%) because of diversified professions followed by labourers (63 victims; 22.3%). A total of 163 victims (57.8%) were married having family responsibilities.

Table 2 provides details of those affected by RTI. Most hospitalized victims were drivers (163 victims; 50.4%); motorcyclists were more in number.
(111 victims; 39.4%), followed by passengers (54 victims; 19.1%), pillion riders (48 victims; 17%), pedal cyclists (19 victims; 6.7%), light motor vehicle (LMV) drivers (19 victims; 6.7%), pedestrians (16 victims; 5.7%) and heavy motor vehicle (HMV) drivers (14 victims; 5%). Most of them were injured on main/major roads (135 victims; 47.9%), followed by state highways (111 victims; 39.4%), national highways (13 victims; 4.6%) and streets (13 victims; 4.6%); they collided with vehicles travelling at a speed of <50 km/h (159 victims; 56.4%) from the front (142 victims; 50.4%), having an angle of impact (165.08 ± 32.92) with two wheeler motorbikes (55 victims; 19.5%), followed by four wheelers (41 victims; 14.5%), six wheelers (39 victims; 13.8%) and three wheeler tempos (28 victims; 9.9%). The majority of RTAs occurred on working days (200 victims; 70.9%), followed by school (45 victims; 16.0%) and public holidays (37 victims; 13.1%).

Figure 1 presents the day of accidents. Most victims were injured on Thursday (23% victims), followed by Wednesday (16% victims), Monday (14% victims), Tuesday (14% victims), Sunday (12% victims) and Saturday (10% victims).

Safety measures undertaken and distractions while driving are summarized in Table 3. While driving, 45% (50 victims) of the injured victims had not used helmet, and if used (14 victims), 12.6% (11 victims) had an open helmet, 9.9% (11 victims) had a helmet without a screen and 9.9% (11 victims) had a helmet without a chin guard. The reasons for driving without a helmet were that the rider was not habituated to wearing one (22 victims; 44%), the rider was travelling for a short distance (16 victims; 32.0%), the rider had forgotten to wear a helmet (7 victims; 14%) or the rider was in a hurry (2 victims; 4.0%). In non-vulnerable users, of 33 victims, 66.7% (22 victims) did not use seat belts because they were in a hurry (9 victims; 40.9%) or were not habituated to wearing seat belts (5 victims; 22.7%).

Table 4 exhibits pre-hospital medical care. Of 282 victims, only 134 victims (47.1%) got pre-hospital care,
Table 4  Time of receiving pre-hospital medical care

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>No. (n = 134)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30</td>
<td>39</td>
<td>29.1</td>
</tr>
<tr>
<td>30–60</td>
<td>83</td>
<td>61.9</td>
</tr>
<tr>
<td>&gt;60</td>
<td>12</td>
<td>9.0</td>
</tr>
</tbody>
</table>

Table 5  Nature of injury

<table>
<thead>
<tr>
<th>Nature of injury</th>
<th>No. (n = 282)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blunt</td>
<td>53</td>
<td>18.8</td>
</tr>
<tr>
<td>Penetrating</td>
<td>64</td>
<td>22.7</td>
</tr>
<tr>
<td>Cut/open</td>
<td>46</td>
<td>16.3</td>
</tr>
<tr>
<td>Polytrauma</td>
<td>52</td>
<td>18.4</td>
</tr>
<tr>
<td>Fracture</td>
<td>48</td>
<td>17.0</td>
</tr>
<tr>
<td>Sprain</td>
<td>9</td>
<td>3.2</td>
</tr>
<tr>
<td>Haematoma</td>
<td>10</td>
<td>3.5</td>
</tr>
</tbody>
</table>

of which 39 victims (29.1%) got pre-hospital care within 30 min.

Table 5 summarizes the nature of injury in RTA victims. Overall, most victims had penetrating type of injuries (64 victims; 22.7%), followed by blunt injuries (53 victims; 18.8%), polytrauma (52 victims; 18.4%), fracture (48 victims; 17.0%), cut/open (46 victims; 16.3%), haematoma (10 victims; 3.5%) and sprain (9 victims; 3.2%). Most patients were unable to recall the exact source of penetration. Some stated that the sources were stone, blemper, pointed part of a vehicle and overloading.

Discussion

Of 282 RTA victims, 247 (87.6%) were males, while the remaining were females (35 victims; 12.4%). The male-to-female ratio was 7:1. It has been stated by Moshiro et al. (2005)7 that males are at a higher risk of transport injuries as compared with females. This is because males are the breadwinners of their family and take part in travelling, driving and other outdoor activities. On the other hand, females are involved in various indoor activities mostly due to cultural background and as a precautionary measure taken by their family to keep them safe. Adolescent age is also an important risk factor for transport-related injury. Jha et al. (2004)8 in a study of RTAs at the Jawaharlal Institute of Postgraduate Medical Education & Research, Pondicherry found that 83% victims were males and 17% were females and that the highest number of victims (31.3%) was between 20 and 29 years of age. Similar results are also seen in the present study, i.e. 39.4% victims were aged between 16 and 25 years and 21.3% were between 26 and 35 years. Ganveer and Tiwari also reported that the number of male victims (85.8%) was more as compared with that of female victims (14.2%). The male-to-female ratio was 6:1, which is nearly equal to 7:1 reported in this study. The present study revealed that 24.5% victims were illiterate, followed by those who could manage to receive only primary (16.3%) or middle education (16.0%) because of the lack of industries and low potential for employment rate leading to poor literacy. Of 282 victims, 22.3% were labourers. The present study predicts that most of the accidents occurred on major roads (47.9%). This is because of heavy traffic loads, lack of proper footpath facility and careless driving. On the other hand, in streets/lanes, only 4.6% accidents occurred because of less flow of traffic, the same was also suggested by Singh and Dhattarwal in Rohtak (Haryana)9. The present study revealed that 23% victims were injured on Thursday, followed by Wednesday (16%), Monday (14%), Tuesday (14%), Sunday (12%) and Saturday (10%); this finding differs from a study conducted in Delhi10, where maximum accidents take place on Tuesday. The angle of impact in the present study was 165.08 ± 32.92, which nobody has reported to date. Our study revealed that of 282 victims, 163 were drivers, of which 111 were motorcyclists (68.9%); injury was caused due to careless driving, over-speeding, not following the traffic rules, overtaking and less stability of the vehicle. Pedal cyclists were less (6.7%) because of more consciousness while cycling. These results are similar to those reported by Patil et al. (2008)11 where 61.2% were motorized two-wheeler drivers. It was also observed that of 102 passengers/occupants, maximum injury was caused to two wheeler pillion riders (48; 47.05%). Similar findings were also reported by Patil et al. in western Maharashtra (2008)11 where 61 (35%) occupants were two wheeler riders. Maximum injury was caused to the users of two wheelers, i.e. 111 (39.4%). These results are in conformity with the findings of Sharma et al. According to their study on RTAs in Gujarat12 (2011), maximum injury was caused to two wheeler riders (52.5%). In this study, 56.4% drivers/riders/occupants collided with an average speed of <50 km/h, which is similar to the study conducted by Trivedi et al. in 2011, in which 45% drivers collided with an average speed of >50 km/h. Of 282 victims, 55 (19.5%) were hit by two wheelers followed by four wheelers (41 victims; 14.5%). A comparative study conducted by Jha et al. (2004)9 reported that pedestrians (24.4%) were mostly injured by motorized two wheelers. Only 29.9% RTA victims reached hospital in <30 min and 61.9% reached in the following 30 min. Observations by Singh and Dhattarwal (2004)9 regarding the time taken to shift RTA patients to hospitals revealed that 24% patients reached within 30 min, whereas 57% reached in the subsequent 1 h. A recent sample survey in The Times of India 2012-10-22: New Delhi (2012) by WHO in Hyderabad has sent worrying signals for road safety experts across the globe. According to the initial findings of the survey, only 18.5% two wheeler users wear a helmet in cities. In this study, of 61 (54.9%) helmets users, only 25 victims (40.0%) were wearing a helmet with a chin guard and full screen. Only one-third (33.9%) of the drivers wore seat belts. Our results were consistent
with a recent Nigerian study, where only one-third of the drivers wore seat belts and car drivers were more likely to wear them than those driving heavy vehicles. The low use of seat belts in this study reflected the poor and weak implementation of policies and law in UP. The most common type of injuries were penetrating injuries (22.7%); this was a result of poor roads and lack of necessary traffic signs, poor condition of vehicles, the driver’s attitude and comparatively high driving speed.

**Conclusion**

There is a need for implementation of law and licence procedures concerning minimum qualification along with strict training. Office hours should be revised for controlling traffic congestion. Young males are the maximum sufferers of RTAs; therefore, special education programmes should be undertaken within their work premises for imparting knowledge and its re-revisions. Protected lanes should be developed for these vulnerable road users/pedestrians to help protect them from being hit by automobiles. Severe injuries are more likely to be due to over-speeding of vehicles, not using helmets and seat belts. RTIs can be prevented by developing types of restraint, reflectors and subway trains such as the Pasmo in Japan and Metros in Delhi. There is a need for development-based laws as each area has a unique pattern of traffic.

**References**