ROAD SAFETY ON INDIAN HIGHWAYS: A CASE STUDY OF ROAD SAFETY ON HIGHWAYS IN KOLAR DISTRICT KARNATAKA, INDIA

WHO Collaborating Centre for Injury Prevention and Safety Promotion

Centre for public Health

National Institute of Mental Health and Neuro Sciences
Bangalore 560029, India
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( Opinions expressed in this report are those of the author alone )

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- Dr. Shivanna, Former District Surgeon, Kolar
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- Dr. Govinda Raju, RL Jalappa hospital, Tamaka, Kolar
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- Mr. D M Madhusudhan, Manager, EMRI, Kolar
- All police officers of Kolar district
- All hospital staff in casualty department in SNR hospital
- All hospital staff in casualty departments of RL Jalappa Medical College hospital
- EMRI -108 Karnataka
- All staff of National and state highway authority of India
- Stakeholders from Education, Transport, Welfare and other departments
- All community members

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March 2014 – March 2015
On 9 September 2014, the Kolar highway (NH 75) witnessed one of the worst road crashes that resulted in 13 deaths and injuries among 16 persons when a bus collided with a truck. This crash was one incident in the district and similar crashes have been witnessed on the highways passing through this district and also on other national and state highways of India. Identifying what are the contributing factors for such crashes and taking corrective measures to see that such events do not repeat is vital for strengthening safety on our national and state highways.
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## ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>CHC</td>
<td>Community Health Centre</td>
</tr>
<tr>
<td>CRRI</td>
<td>Central Road Research Institute</td>
</tr>
<tr>
<td>DH</td>
<td>District Hospital</td>
</tr>
<tr>
<td>ENT</td>
<td>Ear, Nose Throat</td>
</tr>
<tr>
<td>ER</td>
<td>Emergency Room</td>
</tr>
<tr>
<td>FGD</td>
<td>Focused group Discussion</td>
</tr>
<tr>
<td>GH</td>
<td>General Hospital</td>
</tr>
<tr>
<td>GVK-EMRI</td>
<td>Emergency Management and Research Institute</td>
</tr>
<tr>
<td>iRAP</td>
<td>International Road Assessment Programme</td>
</tr>
<tr>
<td>MDR</td>
<td>Major District Roads</td>
</tr>
<tr>
<td>NCRB</td>
<td>National Crime Records Bureau</td>
</tr>
<tr>
<td>NH</td>
<td>National Highways</td>
</tr>
<tr>
<td>NHAI</td>
<td>National Highway Authority of India</td>
</tr>
<tr>
<td>NHDP</td>
<td>National Highways Development Project</td>
</tr>
<tr>
<td>NIMHANS</td>
<td>National Institute of Mental Health and Neurosciences</td>
</tr>
<tr>
<td>PHC</td>
<td>Primary health Centre</td>
</tr>
<tr>
<td>PWD</td>
<td>Public Works Department</td>
</tr>
<tr>
<td>RTIs</td>
<td>Road Traffic Injuries</td>
</tr>
<tr>
<td>SH</td>
<td>State Highways</td>
</tr>
<tr>
<td>TRIPP</td>
<td>Transportation Research and Injury Prevention Programme</td>
</tr>
<tr>
<td>UHC</td>
<td>Urban Health Centre</td>
</tr>
<tr>
<td>VIP</td>
<td>Very Important Person</td>
</tr>
<tr>
<td>WHO CC</td>
<td>World Health Organization Collaborating Centre</td>
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EXECUTIVE SUMMARY

With increasing motorization, infrastructure expansion and socio-demographic transition, Road Traffic Injuries (RTIs) have emerged as a leading public health problem in India. Road crashes result in significant number of deaths, hospitalizations, disabilities and socioeconomic losses. In the last 5 years, during 2010 - 2014, nearly 8,00,000 persons have died on Indian roads and an estimated 30 million would have been hospitalized due to Road Traffic Injuries. Despite this huge burden, our understanding of RTIs in India to formulate road safety policies and programmes has been limited.

Indian highways account for a major share of travel and transport and have been increasing in recent years. It is well acknowledged that highway crashes are on the increase and are different from urban and rural crashes. Thus, an in-depth analysis and understanding of road crashes, deaths and injuries is essential to make our highways safer in the coming years.

The present report documents the burden, pattern, characteristics and outcomes of RTIs in Kolar district of India with a focus on crashes occurring on national and state highways traversing the district using combined data from police and hospital sources. The study components included comprehensive resource mapping, facilities inventory, discussion with stake holders, environmental scanning, identifying characteristics of high risk crash locations along with primary data collection from police and hospital sources using mixed method approaches. Trained research officers collected data on road deaths from police records, while data on the injured was collected from Sri Narshimha Raju (SNR) district hospital and RL Jalappa medical college hospital. Primary data collection on fatal crashes was undertaken through comprehensive review of police records and information from injured in the 2 hospitals was collected through direct interviews using pretested and validated proforma.

RTIs contributed for 39% of fatal and 34% of non-fatal injuries in the district. During the year 2014, 280 fatal road crashes were registered resulting in death of 336 persons. In the same period, 596 nonfatal crashes were registered with police resulting in injuries among 1213 persons with a ratio of 1:4 between deaths and injuries. Information from just 2 major hospitals in the district (one public sector and one private medical college hospital) informed that 2845 persons injured due to RTIs were registered in the one year period. The 2 national highways and 5 state highways contributed for 37% and 25% of total road deaths, respectively, with 32% of injured persons in the hospitals coming from both highways, indicating the greater occurrence of road crashes on the highways as compared to rural and town roads.

Males in the age groups of 16 – 45 years were affected most in both fatal and nonfatal crashes. Two wheeler riders (43%), pedestrians (19%) and three wheeler occupants (9.5%) were involved in high number of crashes and constituted major road user categories among those killed, while two wheeler riders (50%), pedestrians (13.9%) and two wheeler pillions (13.9%) constituted major road user categories among the injured. Collision patterns indicated a greater involvement of heavy vehicles like buses and trucks along with motor cars on highways in both fatal and nonfatal crashes. Nearly 43% died at the crash site and remaining deaths occurred on the way to hospital or in the hospital. Use of helmets- seat belts was extremely low (< 5 %) and drink driving was recorded among 18.5% of hospitalized RTIs. Nearly half of the involved drivers were without license, while one out of 3 vehicles were without insurance.
Discussion with police officials, stakeholders and eye witness accounts revealed that excessive speeding is a major contributor for road crashes on highways. Several high risk crash locations were identified and possible human, vehicle and road related factors have been delineated.

Injuries to head and face along with extremity injuries were the most frequent and referrals to higher centers in the neighbouring city of Bangalore were extremely common. The essential components of prehospital care like availability of first aid, communication to nearby hospital, early transportation and triage were found to be lacking. The in-hospital care in the district hospital was found to be limited due to lack of physical resources, deficient trauma care personnel and absence of defined trauma care guidelines.

The exposure, risks and outcomes in highway road crashes are different as compared to those in urban and district areas for several reasons. These include – location of villages and traffic generators alongside highways, increasing movement and mix of different types of vehicles in a heterogeneous traffic environment on the highways, collisions involving heavy vehicles and motorcars with vulnerable road users, greater contribution of speeding, total absence of safety laws and enforcement for helmets-seatbelts-drink driving and speeding, poor visibility issues and deficient trauma care.

Road crashes occur due to a complex interaction of human, vehicle and environmental factors in complex and heterogeneous traffic environments and, that too in the absence of systematic road safety policies and programmes. No simple or single solution can fix the problem. Multiple interventions based on data - evidence and integrated through policy (legislative, engineering and educational) and right type of technological interventions and monitored through national and state lead agency can provide solutions. This requires the participation of all stakeholders working with a common vision and towards an achievable goal with a greater investment in research.

As infrastructure expands and motorization increases in the coming years, safety of all road users and especially vulnerable road users should be given greater importance on Indian highways. Road safety management should be improved in all Indian states with the establishment of a lead agency run by trained professionals. This should also include highway safety aspects. Better design of highways with a focus on vulnerable road users is very much required. Well known and proven interventions like, traffic separation and calming with appropriate speeds and, laws with regard to helmets – seat belts – reducing drink driving, driver licensing systems , insurance mechanisms and others should be implemented to save lives. Undoubtedly, managing speeds on highways and improving visibility deserves the immediate attention of highway and police authorities. Strengthening trauma care and rehabilitation services in all districts is an urgent need of the hour to improve trauma outcomes among those reaching a hospital. In the long run, safety on highways need to consider the needs and requirements of people with a focus on safe roads, safe vehicles, safe people and efficient post crash care. Specific recommendations in section 14 of this report need serious attention and consideration by our policy makers urgent implementation to make our highways safer. It is time to act.
Rapid motorization along with urbanization, industrialization and migration has resulted in increasing travel among people and transport of goods and services across India. This change has brought in the need for increased infrastructure development and expansion and is accompanied with increasing number of vehicles and longer distances of travel in all parts of country. In this scenario, highways, both national and state, are the neural links resulting in increased connectivity contributing to number of positive developments. However, this change has not been accompanied by comprehensive and well defined road safety policies and programmes. Consequently, we are witnessing a continuous increase in road deaths and injuries, more so on our highways during the last 2 decades in India.

Road Traffic Injuries (RTIs) are a leading cause of morbidity, mortality, disability and socio economic losses in India. As per official reports from National Crime Records Bureau (1), 137423 persons died and 469882 persons were injured due to road accidents in 2013 in the country. Deaths are only the tip of iceberg and it is estimated that for every death, nearly 30-40 persons are hospitalized and many are discharged with varying levels of disabilities. Correspondingly, estimates indicate that nearly 5,000,000 persons are hospitalized and more than 30 million injured persons seek care for minor injuries in emergency rooms (2). Injuries and RTIs also contribute for a large share of disabilities in India. RTIs are estimated to cost about 3 % of GDP every year and losses are found to be increasing from year to year (3).

The state of Karnataka has witnessed an unprecedented motorization as in other parts of India and also an accompanying increase in road deaths and injuries. Number of vehicles has been growing at an average pace of 10.16% per annum over the last five years (4). In the state, 9044 persons died and 52793 persons were injured in 2013 as per official reports (1); however, given the underreporting of road crashes especially with regard to inured, it is estimated that nearly 3,50,000 persons were hospitalized in 2013. Road deaths are increasing at a continuous pace in the state and have been a serious issue for policy makers in the state.

2. Indian Highways

Indian road network of nearly 33,00,000 Km is the second largest in the world and consists of expressways of 200 kms, national highways of 92,852 kms, state highways of 1,31,899 kms, major district roads of 4,67,763 kms along with rural and other roads of 26,50,000 kms. About 65% of freight and 80% passenger traffic is carried by these roads (5).

Amidst this huge road network, National Highways (NH) and state Highways (SH) are the arterial roads in the country for movement of passengers and goods. They traverse the length and width of the country, connecting state capitals, major ports and rail junctions and link up with border roads and villages across the route(6). National Highways form the economic backbone of the and have often facilitated development along their routes, and many new towns have sprung up along major highways. People use these roads for business, education, health care and many other activities. With limited public transportation facilities in rural areas, the available highways are the only major connecting links. The national highways have a total length of 92,852 kms and constitute about 1.7% of the road network but carry about 40% of the total road traffic (5).
The entire highway network of India is managed by the National Highway Authority of India (NHAI), which is responsible for development and maintenance of highways. NHAI often uses a public-private partnership model for highway development, maintenance and toll-collection. An allocation of Rs. 9881.95 crores was made for national highways (51% of central road fund) for the year 2013-14 (7). It operates under the Ministry of Road Transport and Highways. The National Highways Development Project (NHDP) is a major effort to expand and upgrade the network of highways. For the construction and upgradation of NHs in India, NHAI has completed seven phases till date. Phases I and II comprise 4/6-laning standard routes of Golden Quadrilateral, North South-East West corridor, road connectivity to major ports and others. Phase III covers 4/6-laning of high density NHs and others. Phase IV consists of upgradation of NHs of 2-lanes with paved shoulders. The six-laning of four-lane NHs is covered under Phase V. Phase VI consists of fully access controlled expressways. The construction of ring roads, by-passes, underpasses, flyovers, etc. was undertaken in Phase VII (Figure 1) (6).

All NHs are surfaced. As on 31st March 2012, two-lane NHs constituted the largest share of NHs, i.e. 53.01% of the total length of NHs, followed by four lanes and above (24.86%) and the single/intermediate lane NHs (22.13%). Compared to 2010-11, there was an increase both in terms of length and proportion in two categories of NHs, viz. two-lane and four lanes and above NHs (6).

Uttar Pradesh accounted for the largest share (10.2%) of the total length of NHs as on 31st March 2012, followed by Rajasthan (9.3%), Madhya Pradesh (6.6%), Tamil Nadu (6.4%) and Rajasthan (5.9%). These five States accounted for about 38.4% of the total road length of NHs (6). The longest highway in India is NH7 which stretches from Varanasi in Uttar Pradesh to Kanyakumari in the southern most point of Indian mainland, covers a distance of 2,369 km (1,472 mi), and passes through Hyderabad and Bangalore. The shortest NH is the NH47A, which spans 6 km (3.7 mi) to the Ernakulam - Kochi Port (8).
3. Highways in Karnataka state

Karnataka has currently 26 NHs with a total road length of nearly 4000 kms. In Karnataka, Public Works Department is responsible for the maintenance & development of national highways (NH), state highways (SH) & major district roads (MDR). The total road network length of 144,130 km is comprised of 3,973 km of National Highways (NH), 17,222 km of State Highways (SH), 30,975 km of major district roads with the remaining made up of other district and village roads. NHs are maintained & developed by NH-zone with funds from Government of Karnataka, NHAI & MORT&H (9). The state PWD is responsible for a total of 52,170 km.

The 26 NHs in the state includes NH4, 4A, 7, 9, 13, 17, 48, 50 New, 63, 67, 67New, 150, 150 Ext. New, 150A New, 167 New, 169A New, 173 New, 206, 207,209, 212, 218, 234, 275 New & 367 New, 169A (4), with an average of 10.3 km road length per 100,000 population and an average road length of 32.8 km per 1000 sq. km area (10).

The longest highway is NH13 which stretches from Maharashtra Border - Horti - Bijapur - Hungund - Kushtagi - Hospet - Kulligi - Jagalur - Chitradurga - Holalkere - Channagiri - Bhadravati - Shimoga - Tirthahalli - Koppa - Sringeri - Karkala - Mubidri – Mangalore with a length of 714.66 kms. The shortest NH is the NH67, which spans 26.1 km stretching across Gundupet - Mangala - Bandipur - Tamil Nadu border. As of 31st march 2013, Uttar Kannada district accounted for major share of the length of the NH with 331 kms (Figure2) (8).

As per a survey done by PWD in 2002-03, the average traffic growth on National Highways has seen an increase of 14.95% per annum when compared to the base year 1970-71. There was an annual increase of 23.25% in heavy vehicles and 19.03% in light vehicles on NH as compared to 1970-71 (11).

4. Road crashes, deaths and injuries as per distribution of roads

In 2013, 1, 37,423 persons died on Indian roads as per reports from NCRB (Figure 3). Nearly 5, 00,000 persons were injured and had to reach a hospital for care and management. Data from WHO and other agencies indicate these numbers to be much higher due to underreporting of both deaths and injuries. There is a significant variation across different states with southern states of India contributing to nearly half of deaths and injuries.
As per NCRB 2013, among all the road deaths and injuries in the country, only 17% occurred in the 32 cities. The remaining occurred in rural areas, districts, and on national and state highways. National Highways accounted for a share of 28.1% of total road accidents and 33.2% of total number of persons killed in road accidents during 2013. The State Highways accounted for a share of 25.6% of total accidents and 29.6% in the total number of persons killed in road accidents during same period of time (Tables 1 & 2) (12). Thus, the national and state highways together contributed for 53.7% of accidents, 62.8% of deaths and 56.5% of injured persons in the country. With increasing infrastructure expansion in the states coupled with motorization and the absence of strict road safety policies and programmes, the situation is only likely to worsen, if no corrective measures are put in place.

### Table 1: Share of NH & SH in total road accidents, persons killed & injured, 2002 to 2013

<table>
<thead>
<tr>
<th>Year</th>
<th>National Highways</th>
<th></th>
<th>State Highways</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Road Accidents</td>
<td>Persons Killed</td>
<td>Persons Injured</td>
<td>Road Accidents</td>
</tr>
<tr>
<td>2002</td>
<td>32.3</td>
<td>39.7</td>
<td>32.4</td>
<td>23.5</td>
</tr>
<tr>
<td>2003</td>
<td>31.4</td>
<td>38.6</td>
<td>30.1</td>
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<td>2004</td>
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<td>37.5</td>
<td>30.8</td>
<td>23.5</td>
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<td>2005</td>
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<tr>
<td>2013</td>
<td>28.1</td>
<td>33.2</td>
<td>28.9</td>
<td>25.6</td>
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</tbody>
</table>

### Table 2: Number of accidents, persons killed & injured as per road classification (2013)

<table>
<thead>
<tr>
<th>Road Classification</th>
<th>National Highways</th>
<th></th>
<th>State Highways</th>
<th></th>
<th>Other Roads</th>
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<tbody>
<tr>
<td>No. of Accidents</td>
<td>1,36,786</td>
<td>(28.1)</td>
<td>1,24,358</td>
<td>(25.6)</td>
<td>2,25,332</td>
<td>(46.3)</td>
</tr>
<tr>
<td>No. of Persons Killed</td>
<td>45,612</td>
<td>(33.2)</td>
<td>40,768</td>
<td>(29.6)</td>
<td>51,192</td>
<td>(37.2)</td>
</tr>
<tr>
<td>No. of Persons Injured</td>
<td>1,43,107</td>
<td>(28.9)</td>
<td>1,36,790</td>
<td>(27.6)</td>
<td>2,14,996</td>
<td>(43.5)</td>
</tr>
</tbody>
</table>

Note: Figures within parentheses indicate share in total accidents, killed and injured in the respective road categories.

With increasing expansion of highway infrastructure to promote greater travel and transportation of goods, the exposure of people to fast moving vehicles has been on the increase. This scenario is likely to increase in the coming years with a greater thrust on highway development and improvement programmes. This will also be accompanied by an increase in road deaths, injuries, disabilities and economic losses for the country. In the state of Karnataka, highway (both national and state included) contributed for more than two thirds of deaths and injuries (Figures 4 & 5). With increasing infrastructure expansion and rapid motorization, road deaths and injuries are likely to increase in the coming years and it is forecast that RTIs will be the 5th leading cause of death in India by 2030 (16).

Generally, research in the area of road safety in India has been limited and even among these, information available in the public domain is further limited. Studies, studies that have focussed on national and state highway crash patterns are further limited. In recent years, the total number of fatal and nonfatal crashes on highways and the numbers of killed and injured are available in the reports of National Crime Records Bureau (http://ncrb.gov.in/) and Ministry of Road Transports and Highways (http://morth.nic.in/). Reports of some in-depth studies are also available from National Highway Authority of India (http://www.nhai.org/) and Central Road Research Institute (http://www.crridom.gov.in/). Dinesh Mohan in some critically examined reviews highlights that highway safety needs special focus as crash patterns and outcomes are different on highways since exposures and risks vary on these roads due to varying transport patterns (17). Recently, iRAP has examined safety scenario on nearly 3000 kms of highways in four states of India and highlight majority of roads score at 1 or 2 star ratings (18). Independent studies have been few and limited and have looked at specific issues based on researcher’s interest (19-21). Road safety audit reports based on the mandatory requirements...
of externally funded projects also discuss safety issues on highways (22).

All the above reports, limited data and anecdotal reports indicate that road crashes on highways are on the increase and are different compared to urban and rural road crashes (3, 17). In recent times, guidelines and manuals developed by Indian Institute of Technology (23), Central Road Research Institute (24) and National Highway Authority of India (25) are available for improving safety on highways; however, implementation has been far from satisfactory.

Detailed data on road crash patterns, characteristics and outcomes are not available in the state of Karnataka. Studies in urban (13) and rural India (14) around Bangalore in the neighbouring districts have highlighted RTI patterns and these studies have also pointed to the huge burden of road crashes on Indian highways. A recent study informed that 3 highways passing through a district account for nearly half of deaths and injuries in the district (14).

To formulate effective road safety policies and programmes, detailed information on the epidemiological characteristics of road crashes that covers road users, vehicles and roads are essential to develop general and specific countermeasures. Undoubtedly, information on the determinants of road crashes is very vital to organize preventive, promotive, curative and rehabilitation services to reduce the burden of road deaths and injuries. In India, due to paucity of research, injury registries, crash analysis and surveillance systems, this type of data is not available calling for a greater investment in research (26). Many earlier studies have focussed on road safety audits on selected roads, specific issues of road design or an engineering approach to identify problems and issues. Efforts till date have been limited in understanding crash patterns and mechanisms on highways from a comprehensive public health perspective and there have been no systematic studies that have attempted to examine highway road crashes from nature of crashes to outcomes. The present study tries to bridge this gap and has examined road safety on highways from a larger public health perspective.
2. GOALS AND OBJECTIVES

The goals of the present study were to understand the pattern and characteristics of road crashes occurring on highways traversing through a district of South India.

The specific objectives of the project were to

- Assess the burden of road crashes on national and state highways in Kolar district
- Analyze the patterns and identify determinants
- Examine availability and accessibility of trauma care (prehospital and acute hospital) services, and
- Understand the perception of stakeholders on highway safety issues in the district

3. METHODS

The study was a joint collaborative activity between WHO CC for injury Prevention and Safety Promotion at NIMHANS, Office of the District Superintendent of Police, District hospital and local RL Jalappa Medical college hospital.

The project proposal was approved by NIMHANS Ethics committee and administrative approvals were obtained from the office of the District Commissioner, District Superintendent of Police, District Surgeon and Principal of medical college for undertaking the study.

The various components of the project were - resource mapping, stakeholder consultations, data collection and analysis on highway crashes from police and hospital sources, facility inventory in health care institutions, environmental scanning for safety aspects and feedback to stakeholders.

3.1 Resource mapping

A detailed 3 level resource mapping of facilities and stake holders was undertaken and all stake holders involved in road safety, both directly and indirectly, were mapped at state and district levels.

The first level mapping included the district police facilities, health sector agencies, transport sector, national highway authority, state highway authorities, district municipal administration, education department, welfare sector, EMRI 108 ambulance service providers and others. Media professionals (both visual and print), district legal officials and prominent societal representatives in the district were also included as stake holders. Available secondary data from these agencies was classified and stored in specified data bases developed for the study. The initial reports were frequently updated on a continuous basis in consultation with local agencies at periodical intervals.

The second level resource mapping of both national and state highways was undertaken to map the length, direction and coverage within the district. Detailed maps were developed to identify villages and towns located on the highways, their population, and distance from highway. Information on traffic volumes on these highways was collected from both transport department and the lone toll concessionary in the district.

The third level of resource mapping was carried out to identify all health and police
facilities on the highways and their current level of activities. All health facilities (primary health centers, community health centers, taluka hospitals, district hospital and medical college hospital) and police stations (outposts or stations or offices) were mapped and ongoing activities were reviewed with the local authorities.

3.2 Stake holder’s consultations

An initial stake holder’s consultation was carried out in the month of May 2014 to sensitize all the stake holders and to explain the purpose of study. A second round of discussions was undertaken in November 2014 to share results and to explain the progress of study. Both meetings focused on the burden of road crashes, patterns, outcomes, locations and current mechanisms of addressing road safety in the district. As many officials were transferred and moved out of the district, the new officials were personally met and issues were discussed at different time points. The third stake holder’s meeting focussed on results and discussed counter measures that can be developed at the district level.

3.3 Facilities review

Both police and health care facilities were contacted to identify manpower position, training in road safety, physical infrastructure, supportive technology and equipment’s, coverage and implementation of road safety laws, budget availability and ongoing activities to identify specific areas of strengthening to be undertaken at these levels.. The availability and use of breathalyzers, speed cameras and current levels of enforcement was ascertained from police. Similarly, health care institutions located on national and state highways were examined for availability of manpower, equipment’s, drugs and supplies for delivering trauma care services.

4. DATA COLLECTION

4.1 Data collection teams

A team of one project coordinator (with a background in Masters of Public Health), 4 field research officers (background in social sciences and with previous research experience) and one data entry operator (qualification of Masters in Computer Sciences) were recruited for the study. The entire team was trained with regard to the – details of study, need and importance of data, working with stake holders, data collection methods, quality control issues, and other aspects. Using a pretested and validated instrument, the team was trained through class room sessions, visits to data collection agencies and discussions with local staff. They were specially trained in review and extracting information from police records and conducting interviews in hospitals. Guided and supervised interviews were done to examine reliability of data collection and a high level of inter-rater reliability was established. All required inputs were provided to the team to ensure completeness and quality in data collection activities.

4.2 Data collection instruments

Based on the nature and quality of data available, it was decided to collect fatal crash data from police and nonfatal injury data from the district hospital and the medical college hospital. One taluka hospital was included to examine the type and quality of information available in these centers.

Required formats and proforma were developed for secondary data collection purposes by the PI. For primary data collection purposes and to collect data from police, a proforma was developed and tested in the beginning of study.
This was refined after field exercises, finalized and used for the pilot study in the beginning of study. Similarly, a hospital RTI proforma was developed, field tested and adopted for data collection in district hospital and medical college hospital along with a taluka hospital. The forms were finalized after the pilot study and have been used for the entire period of study.

The focus of information gathering was on sociodemographic details, injury causes, details of RTIs in terms of road user category, location details, crash patterns, use of safety devices like helmets-seat belts and child restraints, history of alcohol consumption, speeding, environment details in terms of road conditions, vehicle details and trauma care details focusing on first aid, mode of transportation, nature and severity of injuries.

4.3 Data collection methods

Our initial reviews indicated that

- All fatal crashes are reported to police due to medico legal nature of RTIs and data had to be collected from district and taluka police offices by personal visits and records review on a fortnightly basis with regular repeat visits.
- Data quality on nonfatal injuries was not adequate in police records; hence, it was decided to collect data on nonfatal injuries on a daily basis from the district hospital and medical college hospital.

In the police stations, the research officers reviewed accident records in the beginning. Areas that were not clear were discussed with the local staff to obtain clarity in information. Following this, information was transferred to the proforma and cross checked in the end for completeness of information. Wherever difficulties were experienced or information not available, the corresponding police official was contacted to cross check and obtain information. The completed forms were checked finally before transmission to the central unit. It was observed that for complete investigation to be over, the average time period varied between 0 – 2 months and this required continuous follow-up on the records to get complete data from each fatal crash.

In the hospitals, direct interviews were undertaken with the injured person or accompanying family member after obtaining consent. Wherever written consents were difficult, verbal consent was obtained. Supplementary information was obtained from medical records of the patient. Copies of proformas used are available on request.

Spot mapping of crash locations was done in consultation with police staff at taluka level to obtain as much details as possible about location. Top 30 crash locations (with more than 10 crashes at the location) were personally visited by the research officers and an environmental scanning was done to identify factors contributing for crashes in consultation with key local witnesses.

The highways were also visited repeatedly to identify travel and road safety information signages in terms of location, content, visibility and understanding by local people.

4.4 Qualitative data methods

The qualitative data was collected at 2 levels through focused group interviews and stake holder’s consultations. In order to strengthen quantitative data obtained from records and interviews, Focused Group Discussions were conducted at district level to examine nature and patterns of crashes at local level, opinion of local community leaders, ongoing interventions and challenges encountered in road safety interventions. General principles of conducting FGDs were applied for the present study with probes for different items. Further, this was strengthened with discussions in stake holder consultations.
4.5 Data management

All data collected from both fatal and nonfatal crashes was examined and looked for completeness, quality and any missing information. The final data was entered into the computer by the data entry operator using EPI Info software and data entry formats specially developed for the study. Frequent analysis on a monthly basis ensured the quality was satisfactory and this was further improved with meetings and training of data collection staff at fortnightly intervals. Quality of data also improved with continuous feedback, fortnightly meetings and feedback to staff and partners. Three separate databases have been created for fatal crash details, nonfatal crashes from police and hospital injured RTI patients. Salient findings from the study are presented in this report and our future communications will focus on specific aspects.

5. KOLAR DISTRICT: A PROFILE

The district of Kolar is the Public Health Observatory of the Centre for Public Health at NIMHANS through an official government notification of the state of Karnataka. Kolar district is situated at a distance of 80 kms from Bangalore and is spread over 3969 sq.kms with a total population of 1536401 as per 2011 census. The district accounts for 2.5% of the total state population with a density of 384 per square km. The male to female ratio in the district is 979 females per 1000 males with an overall literacy rate of 74.4%. The male literacy rate is much higher compared to females at 82 and 67%, respectively. The rural to urban population ratio in the district is 2:1 as per recent census. There are 5 talukas in the district and include national and state highways in their geographical boundaries (Table 3).

Table 3: Kolar district profile (2011 Census)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Area (sq. Kms)</td>
</tr>
<tr>
<td>2</td>
<td>Number of talukas</td>
</tr>
<tr>
<td>3</td>
<td>Percentage of district to state</td>
</tr>
<tr>
<td>4a</td>
<td>Males</td>
</tr>
<tr>
<td>4b</td>
<td>Females</td>
</tr>
<tr>
<td>5</td>
<td>Density of Population</td>
</tr>
<tr>
<td>6</td>
<td>Sex Ratio</td>
</tr>
<tr>
<td>7</td>
<td>Literacy Rate</td>
</tr>
<tr>
<td>8a</td>
<td>Male literacy</td>
</tr>
<tr>
<td>8b</td>
<td>Female literacy</td>
</tr>
<tr>
<td>9</td>
<td>Urban population</td>
</tr>
<tr>
<td>10</td>
<td>Rural population</td>
</tr>
</tbody>
</table>
6. RESULTS

6.1 Motorisation patterns

With a population of 1.5 million, the district is undergoing rapid urbanization, motorization and industrialization in recent years. The number of motor vehicles has increased by nearly 2 times in the last 5 years. The total vehicle population in the district for the year 2014 was nearly 212,590, an increase by nearly 2 times compared to 2010. Among the total vehicles, nearly 73% were 2 wheelers and the rest comprised of other transport and non-transport vehicles (Figures 6 and 7).

The district connects the state capital of Karnataka with many parts of neighbouring state of Andhra Pradesh. Apart from vehicles of the district, nearly 7500 - 8000 vehicles pass through the toll located on the highways from nearby state roads and are found to be predominantly four wheelers, two wheelers, buses and heavy goods vehicles.

In addition to the vehicles from within the district, large number of vehicles passes through the highways from neighbouring states. Data from the recent traffic volume studies conducted by the PWD is awaited.

6.2 Highway’s description in the study area

The district has a total of 1515 kms of roads with 2 national highways and 5 state highways traversing the entire district (Table 4). The total share of highways in the district is 28% of the total road length distributed across both national and state highways. The two national highways account for 88 kms and the state highways account for 322 kms of total highways. However, a distinct demarcation is difficult due to the overlap between state and national highways in some places.

Most interestingly, both national and state highways pass through number of talukas, towns and villages through its route (Table 4 and Figures 8-13). National highway 75 starts at Ramasandra and ends at Gaddur covering a stretch of 60 kms and has about 41 villages along the distance. The other national highway 234 starts at Alambagiri and ends at Thimmaravuthanahalli covering a distance of 28 kms with 43 village’s enroute. The 5 state highways cover approximately 322 kms and have a total of 186 villages spread out on both sides. These numbers include only those that are located adjacent to the highway and numbers will be more if all villages are included within greater a distance.

This distribution of villages and towns alongside highways is considered to have a positive impact as it facilitates greater connectivity and faster movement of goods and people. On the other hand, this scenario also contributes for greater number of crashes, deaths and injuries due to high risk of exposure, indicating the need to improve safety on highways especially in terms of design and operation of highways.
Figure 8: Map of Kolar district with location of highways and villages
Figure 9: Map of Kolar taluka with location of highways and villages
Figure 10: Map of Srinivasapura taluka with location of highways and villages

**LEGEND**

- **National Highway**
- **State Highway**
- **Villages near NH**

**NH75**
- V1 = Kammadam Kamanur
- V2 = Doddagurki
- V3 = Kurbahallihalli
- V4 = Anantapura
- V5 = Janmanahalli
- V6 = Chikkamadennihalli
- V7 = Vittalapura
- V8 = Devarayasaduganahallihalli
- V9 = Koppaladamadaga
du
- V10 = Adugodi
- V11 = Sirisingapura
- V12 = N Yelvanahalli
- V13 = Hallisandra
- V14 = Bheemapura
- V15 = Thondiahalli

**NH75**
- V16 = Halekoppa
- V17 = Dharenahalli
- V18 = Battrahalli
- V19 = Nagli
- V20 = Tattikal
- V21 = Mudigere

**NH234**
- V22 = Venkatapur
- V23 = N Yelvanahalli
- V24 = Kuttandahalli
- V25 = Rachabadanahalli
- V26 = V Gutthihalli
- V27 = Doddagurki
- V28 = Kodippura
- V29 = B Gaddur

**NH234**
- V30 = Kumadseahalli
- V31 = Soannavadi
- V32 = Thoradi
- V33 = Mallakachahnahalli
- V34 = Scringeri
- V35 = Manchiganahalli
- V36 = Melagani
- V37 = Kannatha
- V38 = Emmanatha
- V39 = Kannasaandra
- V40 = Kardgur
- V41 = Tayakur
- V42 = Thirumanaahalli
- V43 = Jhokpalli
- V44 = Gajalabhavi
- V45 = Kodigeppalli
Figure 11: Map of Mulbagal taluka with location of highways and villages
Figure 12: Map of Bangarpet taluka with location of highways and villages
Figure 13: Map of Malur taluka with location of highways and villages
6.3 Road safety resources in police sector

There are 6 police stations situated on the national highways and 15 are located on the state highways. The district police is headed by the Superintendent of Police at the district headquarters and has a taluka office in each taluka with total staff strength of nearly 800 police officials for all activities that includes traffic and road safety, law and order, crime and violence, VIP security and other activities. Among them, nearly 60 are involved in traffic management and road safety activities. However, it is to be realized that at times, the staff posted for traffic management and road safety are also drawn into other activities like crime and violence prevention and investigation, law and order maintenance, and VIP security duties depending on the situation and need.

The district police have only 10 breathalyzers and one interceptor vehicle for speed management. The interceptor vehicle is also equipped with facilities for testing drink driving cases. Surprisingly, the number of cases booked for the entire year with regard to drunk and driving and over speeding was 142 and 31 cases, respectively, indicating low and negligible levels of enforcement.

Discussions also revealed that the district police had not undergone any training in road safety or other areas in the past and specifically, a need was expressed for building their knowledge and skills in this area.

6.4 Health infrastructure

Kolar district has nearly 280 health care institutions with 25% of them being in the public sector (72). The district has a major public sector district hospital, one medical college hospital, 4 taluka hospitals, 3 community health centers, 56 primary health centers, and a large number of sub-centers in the public sector (Table 5). In the private sector, there are 53 nursing homes and many small private hospitals located within the district with the ratio of public to private sector institutions being 1:3.

It is generally acknowledged that primary health centers and sub-centers can only provide first aid care (subject to availability of doctors and nurses) and refer patients to the higher centers at times of need. The community health centers and taluka hospitals are primarily mid-level hospitals and can provide some amount of definitive care in terms of first aid, short interventions, stabilization of the patients, and refer them to the higher centres (again subject to availability of doctors and nurses). Thus, the district and the medical college hospitals are the only apex centers within the district which can address trauma needs of injured people.

The district hospital is the major 250 bedded institution in the public sector providing care for trauma patients. The hospital has specialists, medical officers, staff nurses and other categories of staff. The general hospitals and taluka level

Table 4: Road infrastructure in Kolar District

<table>
<thead>
<tr>
<th>Highways</th>
<th>Length</th>
<th>%</th>
<th>No. of villages on the highway</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH 75</td>
<td>60</td>
<td>3.96</td>
<td>41</td>
</tr>
<tr>
<td>NH 234</td>
<td>28</td>
<td>1.85</td>
<td>43</td>
</tr>
<tr>
<td>SH 5</td>
<td>35</td>
<td>2.30</td>
<td>23</td>
</tr>
<tr>
<td>SH 82</td>
<td>50</td>
<td>3.30</td>
<td>22</td>
</tr>
<tr>
<td>SH 95</td>
<td>63</td>
<td>4.18</td>
<td>38</td>
</tr>
<tr>
<td>SH 96</td>
<td>60</td>
<td>3.98</td>
<td>35</td>
</tr>
<tr>
<td>SH 99</td>
<td>115</td>
<td>7.59</td>
<td>68</td>
</tr>
<tr>
<td>Others (town and municipal roads)</td>
<td>1103</td>
<td>72.84</td>
<td>68</td>
</tr>
<tr>
<td>Total Road length</td>
<td>1515</td>
<td>100.00</td>
<td></td>
</tr>
</tbody>
</table>

Table 5: Health infrastructure in Kolar district

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Kolar District</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total No. of hospitals</td>
<td>280</td>
</tr>
<tr>
<td>2</td>
<td>No. of hospitals in public sector (PHC,CHC,UHC,GH,DH)</td>
<td>72</td>
</tr>
<tr>
<td>3</td>
<td>No. of small nursing homes</td>
<td>53</td>
</tr>
<tr>
<td>4</td>
<td>No. of hospitals in private sector with more than 50 beds</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>No. of hospitals in private sector with more than 50 beds</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>No. of 108 ambulances</td>
<td>8</td>
</tr>
<tr>
<td>7</td>
<td>No. of ambulances in public hospitals</td>
<td>21</td>
</tr>
<tr>
<td>8</td>
<td>No. of ambulances in private hospitals kolar</td>
<td>6</td>
</tr>
</tbody>
</table>
have specialists trained in general surgery, paediatrics, ENT, dentistry and nursing cadres apart from other support staff. The services of Neuro surgeons, radiologists and full time anaesthetists are not available in the public sector district hospital while the medical college hospital has limited number of these facilities. The distribution of manpower across the district varies from hospital to hospital and generally it is observed that 40-50% of the posts are vacant in specialty areas in the district hospital.

The RL Jalappa medical college hospital is a private institution attached to the medical colleges with 875 beds. Being a medical college hospital, it has all required departments and required manpower, even though shortages are a regular feature.

Both institutions have a 24 x 7 emergency service facility to cater for all emergencies, including RTIs and other type of injuries.

Our discussions with staff revealed that the existing staff had not undergone any training in injury and violence prevention or trauma care activities in both institutions and expressed a clear need for this activity.

6.4.1 Emergency care facilities
The district has a total of 35 ambulances
with 8 under GVK-EMRI 108 programme, 21 in public sector and 6 in the private sector. Apart from transportation of injured patients, these ambulances cater to all types of emergencies. Within the district, there are number of health care facilities that can provide emergency care, but all patients requiring advanced or definitive care are referred to the medical college hospital or higher centers in Bangalore.

6.5 Resources in other sectors

Resources in other sectors were not adequate and road safety activities were poorly defined and not a priority area. For example, the transport sector was mainly concerned about vehicle registration and issuing licenses and permits. Similarly, the highway sector was mainly concerned with infrastructure development and expansion and road safety did not receive the required importance as discussed in later sections of this report.

In summary, physical, human and financial resources in transport, health, police and highway sectors that are required to address the growing concerns of road traffic injuries, trauma due to other causes and for safety issues are extremely limited.

6.6. Burden of RTIs in the district

Kolar District has five talukas and over time, road deaths and injuries have been increasing on a continuous basis and at a rapid pace. In the district, RTIs contributed for 39% of total injury deaths and 34% of injured persons in the 2 hospitals.

In 2014, there were 969 crashes reported to the Police from within the district (including property damage crashes) which was a 1.5 fold increase compared to Figures from 2000. The number of fatal accidents increased from 176 to 280, while non-fatal crashes reported a slight decline from 726 to 596 (Table 6).

In 2014, 280 fatal road crashes were registered with the police from the 5 talukas of the district that resulted in 336 deaths and

![Diagram](image-url)

Figure 15: Burden of RTIs in Kolar district
injuries among 202 people. In the same period, there were also 596 nonfatal crashes that resulted in injuries among 1011 persons. Thus, in one year there were 336 deaths and 1213 injured persons in the district at a ratio of 1:4 between deaths and injuries as per official reports. The incidence rate of fatal RTIs in the district of Kolar for 2014 was 22.4/100,000 population. The rate for nonfatal injured has not been calculated as data was collected from only 2 hospitals in the district.

Those who are injured are generally taken to a nearby health care institution for treatment and care. The place of management of those injured depends on nature and severity of injuries and accessibility and availability of trauma care in the contacted hospitals. Thus, most of the injured were brought to the nearby district hospital or medical college or taluka hospitals and data collection was undertaken in these places. Combined data from the 2 hospitals revealed that a total of 8518 injury cases were registered in the 2 hospitals (after excluding duplicates) and RTIs accounted for 34% (n=2845) cases in the district. The ratio between killed and injured RTIs in the district was 1:9 based on data collection in two hospitals. If all RTIs are included, this is likely to be in the range of 1:30 as seen by studies in the neighboring city of Bangalore. Among the injured, nearly 50% (3425) were registered in the district hospital and the medical college registered 27% of cases in the year 2014.

Highest numbers of deaths were reported in Kolar taluka (41%), followed by Mulbagal and Bangarpet talukas within the district (21% and 19% respectively) (Table 7). The contribution of the general hospital in Mulbagal was 21% and this is primarily due to the location of the hospital on national highway 75 which happens to be the first contact point for patients injured in road crashes.

### Table 7: Distribution of road crashes in the district

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kolar</td>
<td>216 (27.45)</td>
<td>265 (34.33)</td>
<td>259 (31.32)</td>
<td>302 (39.37)</td>
<td>395 (40.89)</td>
</tr>
<tr>
<td>Malur</td>
<td>49 (6.23)</td>
<td>50 (6.48)</td>
<td>47 (5.68)</td>
<td>52 (6.78)</td>
<td>100 (10.35)</td>
</tr>
<tr>
<td>Mulbagal</td>
<td>168 (21.35)</td>
<td>141 (18.26)</td>
<td>175 (21.16)</td>
<td>138 (17.99)</td>
<td>196 (20.29)</td>
</tr>
<tr>
<td>Bangarpet</td>
<td>223 (28.34)</td>
<td>191 (24.74)</td>
<td>229 (27.69)</td>
<td>182 (23.73)</td>
<td>181 (18.74)</td>
</tr>
<tr>
<td>Srinivasapura</td>
<td>131 (16.65)</td>
<td>125 (16.19)</td>
<td>117 (14.15)</td>
<td>93 (12.13)</td>
<td>94 (9.73)</td>
</tr>
<tr>
<td>Total</td>
<td>787 (100)</td>
<td>772 (100)</td>
<td>827 (100)</td>
<td>767 (100)</td>
<td>966 (100)</td>
</tr>
</tbody>
</table>

The real burden of road crashes is definitely likely to be higher considering issues of underreporting and non-inclusion of many other health care institutions in the district. Based on data from previous studies in the neighboring districts of Bangalore and Tumkur where RTI studies have been completed, it is likely that the number of road deaths and injured are likely to be in the range of 400 deaths and 12,000 injured, respectively, at a ratio of 1:30 per year in the district. The possible reasons for underreporting include late deaths beyond the 30 day period, cases seeking care outside the district (specially on the highways injured are transported to the neighboring city), proximity to neighbouring Bangalore, non-reporting of crashes to police due to several reasons like self-compromise and other reasons.

### 6.7. Socio-demographic correlates

The age – gender distribution of those killed in road crashes revealed that the male
to female ratio was 1:8 and the age groups of 18 – 49 years yrs accounted for three fourths of total deaths, with the highest number of deaths occurring in 20 – 40 yrs age group. The younger age group of 18 – 29 years was nearly 40 % of total deaths. Children less than 15 years and elderly above 60 years accounted for 8% and 10%, respectively (Figure 16). Among those hospitalised, the pattern was almost similar (Figure 17).

Among deaths on highways, younger people were represented to a higher extent on both national and state highways. The pattern was similar among crashes occurring on national and state highways as well as other roads.

The literacy levels of those who died in road crashes informed that nearly 20% were educated beyond high school levels and 40% were with lower levels of education. Pattern remained somewhat similar among nonfatal injuries.

The occupational status of those who died revealed that nearly 2/3rds were employed in skilled occupational categories. Those employed as students, housewives and professional groups constituted 6%, 5% and 3%, respectively. The hospital data showed similar patterns in different places.

As information on income was not available in police records and was difficult to obtain in hospitals, the socioeconomic status
of injured and killed is not known. However, interactions with local police officials and communities revealed that more than 80% belonged to lower and middle income groups. Similar findings have been reported in earlier Indian studies.

6.8. Timings of road crashes

The 280 fatal road crashes were distributed across the 12 months with slight variations across different months. Generally about 8 to 10% of overall fatal crashes occurred every month, with an upper peak of 12% in May and a low of 4% in June. The distribution of nonfatal crashes was somewhat similar in the entire period. This data needs to be seen for the previous years to examine whether any specific patterns could be observed.

As shown in Figure 20, majority of the crashes occurred during daylight hours with nearly one fourth after 6 pm. Nearly 24% of crashes took place during 9 am – 12 noon and night time crashes were 29% in the total series. However, among those reaching a hospital, majority of crashes occurred between 6 am – 6 pm.

6.9. Vulnerable road users

Table 8: Road user category of those killed in road crashes

<table>
<thead>
<tr>
<th>Road user category</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two wheeler rider</td>
<td>146 (43.4)</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>64 (19.0)</td>
</tr>
<tr>
<td>Three wheeler occupant</td>
<td>32 (9.5)</td>
</tr>
<tr>
<td>Bus occupant</td>
<td>18 (5.3)</td>
</tr>
<tr>
<td>Car occupant</td>
<td>14 (4.1)</td>
</tr>
<tr>
<td>Two wheeler pillion</td>
<td>11 (3.2)</td>
</tr>
<tr>
<td>4-wheeler driver (Maxi cab, tempo etc)</td>
<td>10 (3.0)</td>
</tr>
<tr>
<td>Occupant of 4-wheeler</td>
<td>8 (2.3)</td>
</tr>
<tr>
<td>Car driver</td>
<td>9 (2.7)</td>
</tr>
<tr>
<td>Three wheeler rider</td>
<td>6 (1.8)</td>
</tr>
<tr>
<td>Pedal Cyclist</td>
<td>4 (1.1)</td>
</tr>
<tr>
<td>Truck driver</td>
<td>4 (1.1)</td>
</tr>
<tr>
<td>Truck occupant</td>
<td>2 (0.6)</td>
</tr>
<tr>
<td>Bus driver</td>
<td>1 (0.3)</td>
</tr>
<tr>
<td>Others</td>
<td>7 (2.1)</td>
</tr>
<tr>
<td>Total</td>
<td>336 (100.0)</td>
</tr>
</tbody>
</table>

Figure 19: Road deaths month wise in Kolar district

Figure 20: Time of occurrence of fatal crashes (Police, n=280)
Two wheeler riders (44%), pedestrians (19%) and 3 wheeler occupants (10%) were the major categories of road users (Table 8) who died among the 336 road deaths from 280 fatal crashes during the one year period. The vulnerable road users predominantly comprised of these three categories along with two wheeler pillion riders. Motor car drivers and occupants accounted for nearly 7% of deaths. Three wheeler drivers and occupants accounted for nearly 10% of deaths.

Data from the 2 hospitals on those injured revealed that the same 3 categories of two wheeler drivers, pillions and pedestrians accounted for 50%, 14% and 14%, respectively (Table 9). The pattern was similar among non-fatal injuries reported to the police with 44% and 16% represented by two wheeler riders and pedestrians respectively. Car occupant and car driver comprised of 4.6% and 5.3% respectively.

Further analysis of this data as per different road categories of national highways, state highways and other roads did not reveal any significant change and the pattern remained similar. On all categories of roads, pedestrians, two wheeler rider and pillion, three wheeled occupants and cyclists were the major categories...
among both deaths and injuries. Our discussions with police indicated that the collision of these slow moving vehicles with heavy vehicles occurring at higher speeds resulted in more number of deaths and serious injuries.

Table 9: Road user category of the injured

<table>
<thead>
<tr>
<th>Road user category</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two wheeler rider</td>
<td>1422 (50.0)</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>395 (13.9)</td>
</tr>
<tr>
<td>Two wheeler pillion</td>
<td>395 (13.9)</td>
</tr>
<tr>
<td>Occupant of 4-wheeler</td>
<td>132 (4.6)</td>
</tr>
<tr>
<td>Three wheeler occupant</td>
<td>122 (4.3)</td>
</tr>
<tr>
<td>Bus occupant</td>
<td>108 (3.8)</td>
</tr>
<tr>
<td>4-wheeler driver (Maxi cab, tempo etc)</td>
<td>55 (1.9)</td>
</tr>
<tr>
<td>Car occupant</td>
<td>51 (1.7)</td>
</tr>
<tr>
<td>Pedal Cyclist</td>
<td>42 (1.4)</td>
</tr>
<tr>
<td>Unknown</td>
<td>37 (1.3)</td>
</tr>
<tr>
<td>Three wheeler rider</td>
<td>30 (1.0)</td>
</tr>
<tr>
<td>Car driver</td>
<td>26 (0.9)</td>
</tr>
<tr>
<td>Truck driver</td>
<td>6 (0.2)</td>
</tr>
<tr>
<td>Truck occupant</td>
<td>6 (0.2)</td>
</tr>
<tr>
<td>Bus driver</td>
<td>4 (0.1)</td>
</tr>
<tr>
<td>Others</td>
<td>14 (0.5)</td>
</tr>
<tr>
<td>Total</td>
<td>2845 (100.0)</td>
</tr>
</tbody>
</table>

6.10. Distribution of crashes as per highways

The distribution of crashes as per various road categories within the district indicated that road crashes on the highways increased by nearly 1.5 times from 360 in 2010 to 590 by 2014. Correspondingly, non-highway crashes decreased from 427 to 376 in the same period (Table 10). This decline needs to be interpreted with caution as this may not be a real decline, but rather underreporting as injured might have been registered in other hospitals.

Table 10: Distribution of road crashes as per highways

<table>
<thead>
<tr>
<th>Highway</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Highway</td>
<td>360 (45.74)</td>
<td>407 (52.72)</td>
<td>434 (52.48)</td>
<td>406 (52.93)</td>
<td>590 (61.08)</td>
</tr>
<tr>
<td>State Highway</td>
<td>427 (54.26)</td>
<td>365 (47.28)</td>
<td>393 (47.52)</td>
<td>361 (47.07)</td>
<td>376 (38.92)</td>
</tr>
<tr>
<td>Other Roads</td>
<td>787 (100.00)</td>
<td>772 (100.00)</td>
<td>827 (100.00)</td>
<td>767 (100.00)</td>
<td>966 (100.00)</td>
</tr>
<tr>
<td>Total</td>
<td>833 (100.00)</td>
<td>944 (100.00)</td>
<td>1000 (100.00)</td>
<td>980 (100.00)</td>
<td>1150 (100.00)</td>
</tr>
</tbody>
</table>

6.11. Road deaths and injuries as per highways

Among the total road crashes, 1/3 (37%) occurred on national highways and 25% on the state highways. Rural roads contributed for 28% of fatal crashes. Among the non-fatal cases reported to the police the distribution was almost similar with 37% on national highways and 29% on the state highways. Data from those registered in the hospitals indicated that both national and state highways accounted for 32% each of total non-fatal injuries along with rural roads contributing for 43% of injured persons.

Information on place of death among the 233 road deaths (for which place of death was clearly known) in 2014 revealed that 43 % died at the crash site within minutes of the crash, 18% on the way to the hospital and 37% in the hospital. The proportion of deaths occurring at crash site remained similar between 40 – 45% on all 3 categories of roads. Nearly 28% of deaths occurred on the way to hospital among crashes on highways, higher than the other 2 categories of roads, possible due to long distance of travel to one of the 2 hospitals. About 2% of deaths occurred following discharge due to complications (Table 11). Most significantly, number of deaths occurring at crash site was more on all 3 types of roads, while those on the way to hospital were higher among national highway crashes.

Table 11: Place of death in road crashes occurring on different roads

<table>
<thead>
<tr>
<th>Place of Death</th>
<th>National Highway</th>
<th>State Highway</th>
<th>Other Roads</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>At crash site</td>
<td>33 (40.00)</td>
<td>24 (44.78)</td>
<td>42 (43.75)</td>
<td>99 (42.48)</td>
</tr>
<tr>
<td>On the way to hospital</td>
<td>23 (28.00)</td>
<td>6 (11.11)</td>
<td>14 (14.58)</td>
<td>43 (18.45)</td>
</tr>
<tr>
<td>In the hospital</td>
<td>27 (32.00)</td>
<td>23 (42.58)</td>
<td>37 (34.37)</td>
<td>87 (37.33)</td>
</tr>
<tr>
<td>After discharge</td>
<td>-</td>
<td>1 (1.43)</td>
<td>3 (0.03)</td>
<td>4 (1.71)</td>
</tr>
<tr>
<td>Total</td>
<td>83 (100.00)</td>
<td>54 (100.00)</td>
<td>96 (100.00)</td>
<td>233 (100.00)</td>
</tr>
</tbody>
</table>
Figure 23: Crash location details of road crashes on National and State Highways in the district
(Numbers in parenthesis indicate number of road deaths and injuries in specific locations; only those locations with high numbers are shown in the map)
Figure 24: Kolar District- major accident zones (fatal/non fatal)
(Numbers in brackets indicate killed and injured at respective crash sites, respectively. Those with higher numbers of > 5 are shown in red)
Figure 25: Kolar taluka with locations of hospital, village, highway, police station and crashes
Figure 26: Map of Malur taluka with locations of highways, villages, crashes, hospitals & police stations
Figure 27: Map of Mulbagal taluka with locations of highways, villages, crashes, hospitals & police stations
Figure 28: Map of Srinivaspura taluka with locations of highways, villages, crashes, hospitals & police stations
Figure 29: Map of Bangarpet taluka with locations of highways, villages, crashes, hospitals & police stations
Information about the crash to the police was provided primarily by family members of those who were killed or injured in more than half of the cases. Information from the witness or the involved person was only 18% in the entire series. Intimation to the local police by ambulances or by the hospital was significantly less.

6.12. Crash locations and details

Data on crash locations was collected by review of crash records, discussions with local police staff and also with local people who knew about the crashes. The location of nonfatal crashes was also done in a similar way. This was possible mainly because the data was collected at the taluka and district level and helped in identifying crash locations.

Most interestingly, road crashes were seen on the entire stretch of both national and state highways; however, there were specific locations that registered a clustering of cases and frequency of crashes was higher in these places. This pattern was similar among both national and state highways and it was also possible to identify some of the contributing factors for high number of these crashes. Information on high risk crash locations are shown in maps 23 – 29.

Further analysis of 30 crash sites with high number of deaths and injuries has been done separately. This examination identified several environmental and road related factors along with human factors that contributed for higher number of crashes and deaths in these locations. Some of the major contributing factors were – presence of traffic generators at these locations, heterogeneous traffic mix, increasing movement of pedestrians and two wheelers, design of highways without provision for safe road use for vulnerable road users (especially to walk and cross the road), over speeding by moving vehicles, consumption of alcohol, non-use of helmets and seatbelts by drivers and pillions, unsafe and risky behaviours among pedestrians and two wheelers in crossing roads, deficient trauma care and other issues.

6.13. Crash characteristics

Among road deaths, single death was the commonest pattern in 76% of crashes. Two people had died in 14% of crashes and in nearly 10% of crashes more than 2 people had died. Data from the hospital indicated that in 22% of crashes more than 2 persons were injured.

In half of the fatal road crashes, involvement of a single vehicle was the commonest pattern (collision with a pedestrian being the reason) and among the rest 2 or more vehicles were involved in crashes. Involvement of 2 or more vehicle was more frequently seen in crashes occurring on national highways, state highways or town roads. Among the nonfatal injuries reported to the police, involvement of 2 or more vehicles was commonly seen in national highways (71%) or state highways (65%) (Table 12).

Table 12: No. of vehicles Involved in accidents at Different Roads

<table>
<thead>
<tr>
<th></th>
<th>National Highway</th>
<th>State Highway</th>
<th>Town roads</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>47 (47.00)</td>
<td>32 (46.38)</td>
<td>64 (57.68)</td>
<td>143 (51.07)</td>
</tr>
<tr>
<td>Two</td>
<td>52 (52.00)</td>
<td>36 (46.37)</td>
<td>47 (42.32)</td>
<td>135 (48.21)</td>
</tr>
<tr>
<td>Three</td>
<td>1 (1.00)</td>
<td>1 (1.45)</td>
<td>0</td>
<td>1 (0.36)</td>
</tr>
<tr>
<td>Total</td>
<td>100 (100.00)</td>
<td>69 (100.00)</td>
<td>111 (100.00)</td>
<td>280 (100.00)</td>
</tr>
</tbody>
</table>

6.13.1 Characteristics of Pedestrian Deaths and Injuries

Among fatal crashes, pedestrians were predominantly hit by a four wheeler motor car on the national highways (55%) followed by a bus or truck (17%). Two wheelers had collided with pedestrians to the extent of 10% on national highways (Tables 13). However, on the state highways, the pattern was different with heavy vehicles like buses and trucks colliding with a pedestrian to the extent of 69%. Among all crashes, four wheelers (35%) and buses/trucks had collided with pedestrians to a greater extent (Figure 30).
Among the hospital series, it was documented very clearly that collision between pedestrians and two wheelers was the common pattern in majority of the road crashes on all types of roads. Collision with four wheeler vehicles was the second most common pattern.

Table 13: Pedestrian collision patterns in fatal crashes on different roads

<table>
<thead>
<tr>
<th></th>
<th>National Highway</th>
<th>State Highway</th>
<th>Other Roads</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four Wheeler</td>
<td>16 (55.17)</td>
<td>2 (12.5)</td>
<td>4 (22.22)</td>
<td>22 (34.92)</td>
</tr>
<tr>
<td>Two Wheeler</td>
<td>3 (10.34)</td>
<td>3 (18.75)</td>
<td>5 (27.78)</td>
<td>11 (17.46)</td>
</tr>
<tr>
<td>Bus/Truck</td>
<td>5 (17.24)</td>
<td>12 (68.75)</td>
<td>6 (33.33)</td>
<td>22 (34.92)</td>
</tr>
<tr>
<td>Unknown Vehicle</td>
<td>4 (13.79)</td>
<td>-</td>
<td>2 (11.11)</td>
<td>6 (9.52)</td>
</tr>
<tr>
<td>Tractor</td>
<td>-</td>
<td>-</td>
<td>1 (5.56)</td>
<td>1 (1.59)</td>
</tr>
<tr>
<td>Three wheeler and other vehicles</td>
<td>1 (3.45)</td>
<td>-</td>
<td>1 (5.56)</td>
<td>1 (1.59)</td>
</tr>
<tr>
<td>Total</td>
<td>29 (100)</td>
<td>17 (100)</td>
<td>18 (100)</td>
<td>64 (100)</td>
</tr>
</tbody>
</table>

The activities of the pedestrians at the time of death or injury indicated that they were either walking or crossing the road and a small percent of 5-8% were standing on the road. Further analysis of data with respect to the different type of activities indicated that on national highways and state highways crossing the road was the predominant pattern, followed closely by walking when pedestrians were injured and killed.

Table 14: Pedestrian collision patterns in nonfatal crashes on different roads

<table>
<thead>
<tr>
<th></th>
<th>NH</th>
<th>SH</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four Wheeler</td>
<td>7 (14.89)</td>
<td>11 (20.37)</td>
<td>41 (13.95)</td>
<td>59 (14.94)</td>
</tr>
<tr>
<td>Three Wheeler</td>
<td>1 (2.13)</td>
<td>4 (7.41)</td>
<td>22 (7.48)</td>
<td>27 (6.84)</td>
</tr>
<tr>
<td>Tractor</td>
<td>1 (2.13)</td>
<td>-</td>
<td>3 (1.02)</td>
<td>4 (1.01)</td>
</tr>
<tr>
<td>Two Wheeler</td>
<td>33 (70.21)</td>
<td>35 (64.81)</td>
<td>196 (66.67)</td>
<td>264 (66.84)</td>
</tr>
<tr>
<td>Bus/Truck</td>
<td>2 (4.26)</td>
<td>3 (5.56)</td>
<td>22 (7.48)</td>
<td>27 (6.84)</td>
</tr>
<tr>
<td>Unknown vehicle</td>
<td>3 (6.38)</td>
<td>1 (1.85)</td>
<td>10 (3.40)</td>
<td>14 (3.54)</td>
</tr>
<tr>
<td>Total</td>
<td>47 (100.00)</td>
<td>54 (100.00)</td>
<td>294 (100.00)</td>
<td>395 (100.00)</td>
</tr>
</tbody>
</table>

6.13.2 Characteristics of Two wheeler Rider and Pillion Deaths and Injuries

Among the two wheelers deaths, collision between 2 two wheelers (39 %), with trucks and buses (31%) four wheelers (21%) were the commonest patterns (Figure 31). On the national highway, collision with a four wheeler was seen among 35 % of crashes. The pattern remained somewhat similar on state highways and other categories of roads as well. As per hospital data, collisions between two wheelers and four wheelers were the commonest pattern.

Figure 14: Pedestrian collision patterns in nonfatal crashes on different roads

Figure 31: Collision patterns among two wheeler deaths
Table 15: Two wheeler collision patterns with different vehicles on different roads

<table>
<thead>
<tr>
<th></th>
<th>NH</th>
<th>SH</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four Wheeler</td>
<td>40 (34.48)</td>
<td>31 (24.41)</td>
<td>75 (18.89)</td>
<td>146 (22.81)</td>
</tr>
<tr>
<td>Three Wheeler</td>
<td>10 (8.62)</td>
<td>6 (4.72)</td>
<td>33 (8.31)</td>
<td>49 (7.66)</td>
</tr>
<tr>
<td>Tractor</td>
<td>4 (3.45)</td>
<td>9 (7.09)</td>
<td>10 (2.52)</td>
<td>23 (3.59)</td>
</tr>
<tr>
<td>Two Wheeler</td>
<td>47 (40.52)</td>
<td>63 (49.61)</td>
<td>231 (58.19)</td>
<td>341 (53.28)</td>
</tr>
<tr>
<td>Unknown vehicle</td>
<td>3 (2.59)</td>
<td>2 (1.57)</td>
<td>3 (0.76)</td>
<td>8 (1.25)</td>
</tr>
<tr>
<td>Bus/Lorry</td>
<td>11 (9.48)</td>
<td>16 (12.60)</td>
<td>35 (8.82)</td>
<td>62 (9.69)</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>0</td>
<td>0</td>
<td>5 (1.26)</td>
<td>5 (0.78)</td>
</tr>
<tr>
<td>Others</td>
<td>1 (0.86)</td>
<td>0</td>
<td>5 (1.26)</td>
<td>6 (0.94)</td>
</tr>
<tr>
<td>Grand Total</td>
<td>116 (100.00)</td>
<td>127 (100.00)</td>
<td>397 (100.00)</td>
<td>640 (100.00)</td>
</tr>
</tbody>
</table>

Data from nonfatal crashes registered with police indicated the pattern to be similar with collision with a four wheeler being common on national highways (35 %), followed by 2 wheelers colliding with each other (41%) as shown in Table 15. On state highway and other roads, two wheelers colliding with each other were commonly seen (50 % and 58 %, each).

With regard to crash mechanisms, rear end and side collisions were common, followed by head-on collisions in 18 % of deaths. Hitting objects on or off road (generally road dividers) or even parked vehicles was seen among 15 % and 4 % of deaths (Figure 32).

![Figure 32: Crash mechanisms among two wheeler deaths in fatal crashes](image)

7. BEHAVIOURAL RISK FACTORS

Information on behavioural risk factors like alcohol consumption by the driver of the impacting vehicle, use of helmets and seat belts, use of cell phones while driving and speeding were not clearly documented in the police records. In this scenario, a combination of information from different sources has been utilized to arrive at a clear understanding of the influence of these factors on road deaths and injuries.

- With regard to the alcohol, about 6% of drivers were under influence of alcohol at the time of crash as per police reports. However, data from hospital source indicated this number to be 18.5%. It is common to see the presence of alcohol selling outlets on the highways or in the nearby towns and villages. Many community respondents opined that drinking and driving is extremely common on the highways, including observing drunken pedestrians on the road. The highway enforcement of drink driving laws was found to be weak due to administrative issues and resource constraints. Further, public education of people on harm from drinking and driving on highways or other roads was found to be totally lacking. There was no information available on drugs and driving even though it is generally believed that drugs are available on highways.

- Helmet usage was poorly documented in police records and available data showed that less than 5% of two wheeler riders had worn a helmet at the time of crash. The hospital data showed that more than 90% of riders or pillions had not worn helmet at the time of crash. Many respondents of our community discussions informed that generally very few wear helmets as there is no enforcement of helmet rules. On the contrary, the helmet law in the state does not apply to the district of Kolar as the
district is not currently covered by the law. Public education programmes on informing communities about benefits of helmet use was totally missing. Even on the highways, signages on helmet wearing were not seen regularly.

- Similarly, information on seat belt use was not known from police records; however, hospital interviews indicated that only 17% had worn seat belts at the time of crash. As in the case of helmets, seat belt laws are not applicable in the district. As drivers enter highways from different corners and in the absence of seatbelt legislation and enforcement, many do not wear seat belts. As in the case of helmets, public information programmes and public display of sign boards were found totally lacking.

- Data on speeding was not available in both police and hospital records. However, all police records of fatal crashes mentioned speeding indirectly. In many records, “careless driving, negligent driving, rash driving, mad driving” implied that generally drivers were over speeding and / or overtaking on the roads. Our interactions with many police officials indicated that almost all fatal crashes involved an element of over speeding beyond the prescribed speed limits. Many community respondents also felt that vehicles just race on the highways and drivers have little control over their vehicles at times of sudden stoppage. Further, our FGDs, local eye witness accounts and interviews with injured patients mentioned speeding as a major contributing factor in all types of fatal and nonfatal crashes. We also observed very limited number of signage boards that would indicate the prescribed speed limits on highways and other roads.

- Pedestrian safety has been highly compromised on highways with no provisions for safe walking and road crossing along hundreds of villages located in and around the highways. With the accelerated construction of highways to promote rapid mobility, pedestrian crossing facilities are extremely limited or absent. Left with no choice, people on their own had cut open medians in their desired places and also crossed wherever and whenever they need to, thereby risking their lives. Combined with poor visibility and high speeding, it is only a matter of seconds for a fatal crash to take place. We also did not see any prominent display of warning signages for pedestrian movements along the highways.

- With increasing permeation of cell phones into people’s lives and coupled with lack of awareness on distracted driving and poor enforcement of procedures, cell phone use while driving is clearly a major risk factor. It is extremely common to see people talking and walking – driving on roads and highways. On the highways, this behaviour was seen among all categories of road users and public information was extremely limited on this issue.

- Most interestingly, only half of the drivers injured and killed had a license in their name indicating the poor status of licensing regulations within the state. Further, only a third of the vehicles involved in crashes also had a valid insurance at the time of crash.

- Apart from some of the major ones listed above, many strange and risk road use behaviours were commonly seen on the study highways, a detailed description of which is beyond the scope of this report. In some ways, these undoubtedly contribute for road crashes.
8. ENVIRONMENTAL FACTORS

Even though traffic separation between incoming and outgoing vehicles was commonly seen on the national highway, more than 80% of crashes took place on two way roads where traffic generators were commonly present. Crashes were seen most commonly on paved roads (78%), during day light hours (51%) and when the visibility of roads and vehicles was quiet good (60 %). Some of the important environmental factors that contributed to more crashes on highways were – absence of traffic separation between fast moving and slow moving vehicles, mix of high and low speeding vehicles, presence of construction sites that are unsafe, poor visibility at night times and even during day time at certain locations, presence of traffic generators like schools / colleges - markets – temples – village shops and others, absence of pedestrian crossing facilities (consequently, people had cut open roads for 2 wheeler and other smaller vehicles to cross over), and poor safety signage’s on roads.

- On the high ways, nearly 1/4th of crashes occurred early morning and during evening and night times indicating that poor visibility might be a contributing factor. Discussions with community respondents informed that after sunset, highways turn into death traps as incoming and outgoing vehicles (even with separated traffic on some of the stretches) are unable to see dangers on the road with no marked shoulders in number of places. Most importantly, it is common to see many slow moving vehicles, high speeding vehicles and pedestrians crossing or walking on highways during evening or night times; due to poor visibility many crashes are likely to occur at these times.

Our environmental scanning of high risk crash locations highlighted some of these observations. Examination of the presence of specific sign boards on the highways indicated that on the national highway 75 covering a distance of 61 km there were 21 signages on speed signals, 26 pedestrian crossing boards and 8 danger signage boards. On NH 234, there were very few safety signage boards. On the state highways, the signage boards were very few and even these were not in appropriate places.

9. VEHICLE FACTORS

With regard to the vehicle characteristics, nearly 22% of vehicles involved in crashes were manufactured before the year 2000, while the rest were manufactured in recent years. Nearly 2/3rd of the vehicles were insured at the time of crash and 1/3 did not have vehicle insurance as per official records. Among the various types of vehicles defects seen, the most common ones were break failures, (12%), headlight problem (8%), steering wheel defects and bald tires (5%). The pattern remained similar among non fatal injuries registered with the police. Detailed information on vehicle related factors were not available in police records and requires in-depth research.
10. TRAUMA CARE

10.1 Prehospital care

Trauma care for the injured is a continuum of activities from the time of crash till the person is restored to an optimum state of functioning. With regard to trauma care practices, nearly 45% of the injured people had received first aid at or near to crash site on all the roads (Table 16). However, in majority of the instances, the place of first aid was commonly the nearby doctor in a government hospital or the medical college hospital or a clinic.

On the highways, less number of people (34 %) received first aid as compared to other two roads. Only ¼\textsuperscript{th} of them received first aid near a crash site and that too when an ambulance was able to reach them at a short notice. Amongst those receiving first aid, doctor in a nearby hospital was the predominant source for first aid in 62% of deaths, 63% of non fatal injuries, and 68% of hospitalized patients.

<table>
<thead>
<tr>
<th>National Highway</th>
<th>State Highway</th>
<th>Other Roads</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>179 (34.1)</td>
<td>205 (53.39)</td>
<td>801 (45)</td>
</tr>
<tr>
<td>No</td>
<td>346 (65.9)</td>
<td>179 (46.61)</td>
<td>979 (55)</td>
</tr>
<tr>
<td>Total</td>
<td>525 (100)</td>
<td>384 (100)</td>
<td>1780 (100)</td>
</tr>
</tbody>
</table>

Chi square=35.34 ; dof=2 ; p value= <0.0001

The mode of transportation varied widely between crashes and in different locations. Among those who survived the initial impact of crash, EMRI 108 and other ambulances was the commonest mode of transportation (50 %), followed closely by use of private vehicles including three wheeler vehicles. This was primarily because nearby drivers or community members preferred to wait for an ambulance or local police to arrive for shifting injured persons. Also, they were not sure of what needs to be done in an emergency.

Discussion with local residents and officials informed that 108 ambulances was the commonest choice in severe and serious road crashes as people were not willing to come forward on their own and information was sent to 108 by local or other people. In less severe cases, nearby residents or others gathered the injured and transported him to the nearest hospital through any available mode of transport. It was also clear that medico legal problems and involvement with police in serious crashes was a major barrier, thus delaying transportation in serious road crashes.

Table 17: Mode of transportation among RTI injured registered with police

<table>
<thead>
<tr>
<th>Mode of Transportation</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambulance (108)</td>
<td>137 (44.19)</td>
</tr>
<tr>
<td>Private vehicle or taxi</td>
<td>101 (32.58)</td>
</tr>
<tr>
<td>Auto rickshaw (3-wheeler)</td>
<td>22 (7.1)</td>
</tr>
<tr>
<td>Ambulance (G)</td>
<td>18 (5.81)</td>
</tr>
<tr>
<td>Not Known</td>
<td>14 (4.52)</td>
</tr>
<tr>
<td>Govt. vehicle</td>
<td>10 (3.23)</td>
</tr>
<tr>
<td>Police van</td>
<td>7 (2.26)</td>
</tr>
<tr>
<td>Other</td>
<td>1 (0.32)</td>
</tr>
<tr>
<td>Total</td>
<td>310 (100)</td>
</tr>
</tbody>
</table>

Since the introduction of EMRI 108 services in the state of Karnataka, 108 ambulances have been involved in transport of injury victims to the nearby hospitals. In 2014, the services provided transport facilities for nearly 17, 761
persons for all types of medical emergencies within the district (Table 19). Among them, 2766 (15.5%) were for injured persons and 2261 (82%) for persons injured in vehicular trauma as shown in Table 20.

Table 18: Mode of transportation among RTIs registered in hospitals

<table>
<thead>
<tr>
<th>Mode of transportation</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private vehicle (personal or taxi)</td>
<td>1446 (50.83)</td>
</tr>
<tr>
<td>108 (EMRI)</td>
<td>864 (30.37)</td>
</tr>
<tr>
<td>Auto rickshaw (3 wheeler)</td>
<td>287 (10.09)</td>
</tr>
<tr>
<td>Any Ambulance</td>
<td>172 (6.05)</td>
</tr>
<tr>
<td>Police vehicle</td>
<td>17 (0.59)</td>
</tr>
<tr>
<td>Walking</td>
<td>15 (0.53)</td>
</tr>
<tr>
<td>Others</td>
<td>44 (1.55)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2845 (100.00)</strong></td>
</tr>
</tbody>
</table>

10.2. Injury severity and patterns

The severity of injuries among nonfatal road crashes registered with police indicated that 35% were grievous injuries, 37% were mild injuries and 28% were simple injuries.

Among cases reaching the 2 hospitals for trauma care, 57% were minor injuries, 33% were moderate requiring hospital stay of 6 hours and more for investigations and treatment and 10% were serious requiring hospital admission and intensive management. Examination as per crashes on different roads indicated that severe injuries were higher on national and state highways as compared to other roads (Table 21).

Table 21: Severity of the Injury

<table>
<thead>
<tr>
<th>Severity</th>
<th>NH</th>
<th>SH</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild (Requiring ER care)</td>
<td>285 (51.16)</td>
<td>231 (57.89)</td>
<td>1109 (58.9)</td>
<td>1625 (57.23)</td>
</tr>
<tr>
<td>Moderate (Requiring 6 hrs of hospital stay)</td>
<td>180 (32.32)</td>
<td>114 (28.57)</td>
<td>633 (33.62)</td>
<td>927 (32.65)</td>
</tr>
<tr>
<td>Severe (Direct medical /surgical / other admission requiring intensive management)</td>
<td>92 (16.51)</td>
<td>54 (13.53)</td>
<td>141 (7.49)</td>
<td>287 (10.11)</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>557 (100)</strong></td>
<td><strong>399 (100)</strong></td>
<td><strong>1883 (100)</strong></td>
<td><strong>2839 (100)</strong></td>
</tr>
</tbody>
</table>

Chi square= 47.16; dof= 4; p value= <0.0001

Table 22: Time taken to reach hospital

<table>
<thead>
<tr>
<th>Hospitalization Time</th>
<th>National Highway</th>
<th>State Highway</th>
<th>Other Roads</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30 minute</td>
<td>73 (75.26)</td>
<td>38 (70.37)</td>
<td>47 (56.63)</td>
<td>158 (67.52)</td>
</tr>
<tr>
<td>30 minute-1 hour</td>
<td>20 (20.62)</td>
<td>13 (24.07)</td>
<td>34 (40.96)</td>
<td>67 (28.63)</td>
</tr>
<tr>
<td>1-2 Hours</td>
<td>4 (4.12)</td>
<td>3 (5.56)</td>
<td>2 (4.09)</td>
<td>9 (3.85)</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>97 (100)</strong></td>
<td><strong>54 (100)</strong></td>
<td><strong>83 (100)</strong></td>
<td><strong>234 (100)</strong></td>
</tr>
</tbody>
</table>

Chi square value= 10.23; dof=4, p value= 0.03

Most of the injured reached a nearby hospital within 1 hour and only 8% reached beyond two hours. However, those with moderate to severe injuries were referred to the higher hospital for definitive care (Table 22). More than 60% of injured reached the hospital on their own, while the rest were referred from the first contact public or private hospitals.
Injury to the head and face was the commonest injury seen among fatal road crashes. The hospital data showed that more than two thirds of the injured had an injury to face and head region, 32% had an injury to lower limbs and 31% to upper limbs. Abdominal, chest and neck injuries were commonly seen in 8%, 13% and 14% of patients in the hospital. Fractures of various bones were seen among 60% of those injured and primarily in upper and lower limb regions. Majority of the brain injured were referred to the city of Bangalore for management (Table 23).

With regard to mode of management, nearly 2/3rd were provided care and sent home or admitted for further care in both hospitals. Nearly 1/3rd were referred to the nearby hospitals in the city.

<table>
<thead>
<tr>
<th>Injured area</th>
<th>National Highway</th>
<th>State Highway</th>
<th>Other Roads</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>260 (46.68)</td>
<td>199 (49.87)</td>
<td>991 (52.63)</td>
<td>1450  (51.07)</td>
</tr>
<tr>
<td>Face</td>
<td>259 (46.5)</td>
<td>188 (47.12)</td>
<td>861 (45.72)</td>
<td>1308  (46.07)</td>
</tr>
<tr>
<td>Lower Limb</td>
<td>195 (35.01)</td>
<td>141 (35.34)</td>
<td>600 (31.86)</td>
<td>936   (32.97)</td>
</tr>
<tr>
<td>Upper Limb</td>
<td>192 (34.47)</td>
<td>141 (35.34)</td>
<td>564 (29.95)</td>
<td>897   (31.6)</td>
</tr>
<tr>
<td>Neck</td>
<td>70 (12.57)</td>
<td>55 (13.78)</td>
<td>270 (14.34)</td>
<td>395   (13.91)</td>
</tr>
<tr>
<td>Chest</td>
<td>73 (13.11)</td>
<td>60 (15.04)</td>
<td>231 (12.27)</td>
<td>364   (12.82)</td>
</tr>
<tr>
<td>Abdomen</td>
<td>39 (7)</td>
<td>42 (10.53)</td>
<td>167 (8.87)</td>
<td>248   (8.74)</td>
</tr>
<tr>
<td>Spine</td>
<td>22 (3.95)</td>
<td>16 (4.01)</td>
<td>70 (3.72)</td>
<td>108   (3.8)</td>
</tr>
<tr>
<td>Groin</td>
<td>14 (2.51)</td>
<td>7 (1.75)</td>
<td>42 (2.23)</td>
<td>63    (2.22)</td>
</tr>
</tbody>
</table>

11. SAFETY ON HIGHWAYS: ISSUES AND CONCERNS

- Amidst the growing number of road crashes and deaths in India, a comprehensive understanding of issues and causes to formulate road safety policies and programmes has been limited. There is an immediate need to invest in safety as this should not be compromised for promoting rapid mobility or infrastructure development as happening in current scenario. Highway safety should be a larger part of the national comprehensive road safety management process; nevertheless, highway safety deserves special attention due to its different characteristics.

- Road crashes are due to a complex interaction of people, vehicles and roads in mixed traffic environments operating in the absence of well-defined road safety policies and programmes. In India, there is no single responsible lead agency as an umbrella body to guide – develop- coordinate- formulate- finance- implement- monitor – and evaluate all road safety activities.

Shortage of resources and lack of data to guide our actions and programmes are the other limitations. Consequently, road safety is the shared responsibility of different ministries-departments-and agencies at national, state and local levels.

- In our several rounds of discussions, it was not clear as to who and which agency is primarily responsible for implementation of different measures for road safety on highways. Several departments like NHAI, SHAI, local public works department, local police, and health departments are all involved in their respective domains without integrated and coordinated efforts. Further, all these agencies have severe shortage of human, physical and financial resources that are essential to implement programmes. Even though specific guidelines are available from various agencies like (CRRI, NHAI, TRIPP-New Delhi and several other agencies), the lack of implementation was found to be a key factor.
Responsibility and accountability for safety on highways?

- The present study has examined road crashes on highways traversing through one district of the state of Karnataka. The pattern is likely to be similar across the 642 districts of India that includes both national and state highways. It is possible that these patterns are further influenced by geography and topography of the district and the region. The details of road crashes, deaths and injuries in these districts are not known apart from the numbers available with the district or state police. Many other details are not known; even if known, are not available in the public domain.

- Highways are used by all categories of motorised and nonmotorised vehicles and people for transport and travel purposes. These roads are characterised by movement of heavy vehicles and buses and in larger numbers. As these roads traverse through villages, people use these roads for variety of activities as public transportation facilities in general and in rural areas in particular are extremely limited and absent in many places. Hence, people use two wheelers, bicycles and other local vehicles on these roads. This movement of slow moving and fast moving vehicles on roads that are not separated in any way brings in different exposures, added risk, increasing conflicts and greater number of crashes.

- Highway crashes are different from those in urban and other rural areas. The greater movement of heavy vehicles like buses and trucks along with cars travelling at higher speeds (at times even slow moving heavy vehicles), mix of vulnerable road users amidst this speeding traffic, presence of large number of traffic generators and lack of facilities for vulnerable road users are some differentiating features of travel patterns on highways apart from many others that are discussed below.

- Vulnerable road users like pedestrians, two wheeler riders and pillions, bicyclists, and drivers/passengers of other slow moving vehicles are at a greater risk of sustaining road crashes on Indian highways as shown in the present study. This scenario of slow moving vehicles intermixing with fast moving vehicles is very specific to countries that are fast motorising, like India; how to make them safer should be a matter of serious concern for all. Making these categories of road users safer should be given prime importance in the coming years.

- As Indian highways pass through myriad number of villages and small settlements on both sides, the roads will have umpteen number of traffic generators and will see continuous movement of pedestrians, two wheelers, bicycles, bullock carts, and other local transport vehicles, all of which are slow moving in nature and small in size compared to buses, trucks and cars. Highway engineering and auditing should be given importance in the design, maintenance and operation and should consider number of issues like traffic separation between slow and fast moving traffic, lane separation between fast and slow vehicles, provisions for safer walking and crossing for pedestrians, travel of other vulnerable road users like two wheelers and cyclists, provision of service lanes, bypasses around major towns and other measures. In summary, traffic separation, traffic calming and speed control should be given highest importance from the design stages of highway development.
The crash patterns on highways are also different as compared to other categories of roads. Apart from a greater exposure and consequent risk to vulnerable road users, collision of large size buses-trucks-motor cars- other heavy transport vehicles with smaller ones like pedestrians- two wheelers-three wheelers- and cyclists will result in greater energy transfer to the latter category and high level impact, definitely influenced by speed of vehicles. Subsequently, the impact on the individual is high. Consequently, the outcomes are more serious and result in higher numbers of deaths and serious injuries. This issue needs to be considered seriously and all efforts to reduce crashes and its impact should be considered from design stages to highway operations. This needs greater discussions between road engineers, highway road builders, enforcement officials, district authorities, local communities and others to design safer highways based on a scientific understanding of road crashes in India.

Data clearly indicates that road crashes are dotted throughout the length of national and state highways (Figure 33). However, there were specific locations that had a greater frequency of occurrence (see box 1). These high risk crash locations also had certain specific environmental and road characteristics like presence of traffic generators, poorly designed road stretches, unseen or unrecognised blind spots, badly maintained or managed roads, invisible / poor road markings, unrecognisable or absent road shoulders, poor visibility of people and vehicles on the roads, presence of alcohol outlets and easy availability, roads cut open by local people and several other reasons. Thus, it is important to implement area wide interventions of lesser cost and specific safety management of these locations. Further, many local people and police had designed their own interventions that are neither scientific nor sustainable in the long run and more risky (like unseen barricades at night times).
Figure 33: Map of Kolar district with location of highways, crashes, hospitals and police stations
Box 1: Patterns and characteristics of high risk crash locations on a stretch of 3 kms

Location 1
The Bellur Bridge junction on NH- 75 is a death trap over a distance of 100 meters. In this location, over 21 accidents – 5 fatal and 16 nonfatal have been reported in one year with 5 deaths and 27 being injured. There is a single one-way flyover located here with number of traffic generators in and around the area. The open area below the flyover connects villages and traffic on both sides of the road. Fast moving vehicles from both directions enter the link connecting road and as the visibility is poor and drivers cannot make out entering vehicles, crashes often occurs here. Some contributing factors are mix of traffic, speeding vehicles, poor visibility, absence of signages, and at night times, it is reported as a virtual death trap. While providing this link between both sides of highway is essential, improving safety is the need of the hour.

Location 2
The stretch of 150 meters on the Narsapura Industrial area on NH 75 is a high risk crash location that witnessed 21 crashes in the last 1 year. Five fatal crashes and 16 nonfatal crashes resulted in death of 7 people and injuries among 21 individuals. Being an industrial area there is constant movement of goods carrying heavy vehicles, employees and workers walking or travelling in two wheelers, presence of nearby shops and eateries, other traffic generators add continuously for movement of goods and traffic. Over speeding vehicles, connectivity to an industrial area, absence of signage’s, presence of a service road, poor visibility in late hours, road cut open by public for easy crossing and a U turn pass are issues.
Location 3
The 100 meter stretch on Narsapura bypass area witnessed 10 crashes in the study period (1 fatal and 9 nonfatal) that resulted in 2 deaths and 11 injured. Increasing movement of vehicles, connectivity with villages and industrial area, a single flyover with poor visibility below, unmanned intersection, sudden turn of vehicles were some contributing factors.

- Road users on highways were obviously poorly informed of safety issues on highways. On the selected stretches of highways there was limited display of signage’s or information boards. Further, any community level engagements or public awareness activities were found to be missing. A larger discussion on safety of people on highways was not seen on a regular basis. This only forced people to initiate actions at their own level without discussion with concerned agencies.

- The fact that nearly half the drivers were driving without a driver license is a matter of serious concern. It is well acknowledged that driver licensing systems are very weak in India (reasons are several) and graduated driver licensing systems as seen in High Income Countries are absent. As drivers from different states and neighbouring cities travel on highways, this issue has to be addressed at state and national levels. A related issue requiring attention is the insurance status of vehicles as road crashes impose huge burden on individuals, families and society.

- Many of the legislations with regard to use of helmets, seat belts, child restraints were not found to be present as they are not currently applicable to the district, and hence there was no enforcement. In the state of Karnataka, helmet laws are present and enforced in select municipal corporation areas and few cities and many districts and highways are not covered with the current laws. As it is not possible to have
separate laws for each district across the country, the highway safety codes should include mandatory laws in these areas on both national and state highways and should be notified by the state for uniform implementation. Further, there is also severe shortage of police resources and technological limitations.

- Drinking and driving is extremely common on all parts of country and state and highways are no exception to this. More number of alcohol selling outlets on or near to highways and easy availability of alcohol compounds the problem further. It was reported that both speeding and drink driving laws are applicable in the district, but enforcement is limited due to paucity of human and technological resources and administrative issues. These obviously necessitate the need for uniform road safety laws that are applicable to all regions rather than select places.

- Driver fatigue and sleep deprivation are two major issues that has been least understood in India due to lack of data and research in this area. As drivers of heavy vehicles are involved in long and strenuous travel on highways. Even though there are strict guidelines and standards available in HICs, the indian situation is different and such norms are generally not followed. Further, some of the recent technological developments have not been tested and implemented on Indian highways. This area requires good quality research to delineate the patterns to decide on interventions.

- Many dangerous road user practices also exist on our highways. For example, the sudden appearance of speed humps or the practice...
of cutting open the central median to cross road in the middle of highways or sudden appearance of barricades was very dangerous (well, what to expect when such provisions are not made). Combined with poor visibility of these locations especially during evening and late night hours, these can result in serious crashes and high number of injuries.

• The single most contributing factor for greater number of deaths and serious injuries on highways are linked to speeding. While debates and discussions continue on the most appropriate speed limits on highways, at present, no driver was seen adhering to even existing speed limits. Excessive speeding can result in sudden collisions, loss of control over vehicle, higher impact in collisions and poor outcomes. It was clear that roads promoted higher speeds, vehicles could travel at greater speeds, and people were unaware of dangers of over speeding along with overtaking. ‘The local people mentioned that people drive like zombies without any control’. It is important to have a balanced mix of highway road engineering, enforcement of speed legislations, greater use of technology, and public awareness to address speed related issues.

• As road crashes will continue to occur, developing an efficient trauma care system is obviously the need of the hour. Data of the last 5 years indicate that nearly 12000 emergencies reached the district hospital and about 500 RTI admissions occur every year. Even in a taluka hospital the burden of RTIs and injuries is significantly high (Figure 34). However, the preparedness of these health care institutions to manage trauma is extremely limited. Consequently, majority are referred outside resulting in poor and negative outcomes.

• Several issues of first aid care, safe transportation, triage at first medical contact, timely communication, preparedness of hospitals are some critical elements of an efficient prehospital care system. Even though 108 ambulances (with
25 in the district) were available, the time interval between injury and reaching a definitive hospital was considerable longer. Public awareness on early transportation, availability of care in health centers, mandatory triage, trained personnel in and out of ambulance and first aid community responders were not present. These should be available in the district whether on highways or on any other roads.

- Our observations reveal that the load of RTIs and all other injury causes included, places a significant burden on the district and taluka hospitals. Despite the presence of a local medical college hospital, large numbers of patients were referred to the neighbouring city resulting in poor outcomes. In the public hospitals, especially district hospital, availability of trained manpower, presence of investigative (X-ray, CT, and others) and managerial facilities (like blood bank, telemedicine, etc.), use of trauma care guidelines along with management protocols are crucial elements of a trauma care system and were found to be limited in the study areas. The scenario is likely to be similar across other districts and highways. The district hospital can function as an integrated trauma care centre if trained manpower (specialists are unlikely to be available in all areas in the nearby future), equipment's and support facilities are available, thereby minimising referrals. It is essential to note that strengthening trauma care services in a district hospital will benefit all trauma/injury patients and the entire district.

Figure 34: Burden of RTIs in SNR District Hospital, Kolar
• Increasing number of referrals, especially those with moderate and severe injuries and those with injury to vital body organs (brain, chest, abdomen, others) was found to be a common practice. This resulted in delayed care to the injured and was commonly due to nonavailability of specialists and facilities, medico legal nature of road crashes, choice of patients and their family members and inability of people to pay for trauma care in the private sector. These factors contributed to delays in accessing care and required travel to the neighbouring city, thus resulting in poor outcomes.

• Many survivors of road crashes are left with various types and varying levels of disabilities ranging from short to long periods of time. Disabilities in a district due to many other causes like falls, mechanical injuries, burns, and other injuries are also huge and significant. Rehabilitation needs of RTI and injury survivors will significantly increase in the coming years due to the growing burden of injuries. However, there is a total lack of facilities in the district for rehabilitation of injured and those affected had to travel to the neighboring city for care and support. This scenario highlights the need to strengthen cost effective and culture specific measures of rehabilitation in the district.

• In addition, cost of trauma care for the injured is a matter of serious concern. The sudden occurrence of RTI had suddenly wreaked havoc on individuals and families, especially when they did not own a BPL (Below Poverty Line) card (for free care) and when they had to seek care in the neighboring city. Even though, few of the recent schemes of Government of Karnataka (Vajpayee Arogya shree for BPL card holders, Rajiv Gandhi Arogya Bhagya for APL card holders, Jyothi Sanjeevini for government employees and Chief Minister’s Santhvana Scheme) were helpful, many of the injured had to face problems in accessing these services as they were unaware of such schemes, and at times procedural delays. People had to arrange finances as the situation had to be managed. This issue will be of prime importance in all crashes on highways throughout the country.

• Most significantly, road safety in general and highway safety in particular, needs to be guided by good road safety information systems and local research. Local data for local action is extremely critical in this area. At present, this area is significantly weak due to absence of research, information systems, poor documentation and absence of any data analysis. The data available at present with both police and hospitals was not helpful for any prevention, management or policy activities and needs considerable strengthening in the days to come. In addition, there is limited capacity available at the district and state level to undertake research, further complicated by lack of funding. There is need to undertake good quality and in-depth research on highway safety in multiple sites across the country to determine future interventions.

• Most importantly, road safety is caught with number of medico legal issues. As road crashes and many other type of injuries are considered medico legal in nature, they have to be registered with police and are subject to investigation by both police and courts over time. Even though, the Supreme Court order and directives from ministries have tried to address this issue over time, the ground situation has not changed for the better. This is also confirmed by a recent study by Save Life Foundation and a pending Public interest Litigation in the Supreme Court of India. Medico legal issues comes in the way of information gathering, underreporting, care for the injured in institutions, failure of people to be good samaritans, compensation of the injured and other issues, requiring urgent intervention by policy makers.
12. SUMMARY

The present study has examined in depth, the burden, pattern and characteristics of highway crashes in one of the districts of India where infrastructure expansion and motorization are notable features. Highway crashes on both national and state highways are increasing over time and in the current scenario is likely to increase further. Highway crashes accounted for a significant number of total crashes in the district. Young people, and predominantly males were affected most. Pedestrians, two wheeler riders and pillions killed and injured in greater numbers were the vulnerable road users. Highway crashes involved motor vehicles and heavy vehicles in a large number of instances as compared to crashes on town roads and rural roads. Several high risk crash locations were identified based on number of crashes and requires further research to identify potential and sustainable interventions. Information on risk factors like helmet use, seat belt use, drinking and driving and speeding was not available requiring more in depth studies. Trauma care was deficient and referral to the neighbouring city was the common practice. Resources in police, health and transport sectors were limited requiring urgent interventions.

In summary, road safety interventions on highways needs systematic recognition of the problem, prioritization of issues, focus on vulnerable road users and developing an implementable intervention matrix. It requires a judicious combination of engineering, enforcement, education and trauma care. It needs a mix of political support, professional’s contribution, policy maker’s right decisions and public support. Road safety has to be guided by data and use of technology along with monitoring and evaluation inputs.
13. RECOMMENDATIONS

• Road safety in all states and especially on state and national highways should be considered an important issue and given priority in the larger scheme of societal growth and infrastructure development - expansion activities in India. Road safety has to be considered a public health problem in the larger growth and development of Indian society.

• Infrastructure development and highway operations need to consider holistic requirements of people and safety should not be comprised at the cost of promoting rapid mobility. This should be a part of all infrastructure development programmes in the country.

• Safe systems approach that takes into account the vulnerability of people and develops road safety management, safe roads, safe vehicles, safe people and efficient post crash should be strongly promoted in all road and highway safety programmes.

• Road safety management has to be systematically and scientifically strengthened at both national and state levels through dedicated road safety lead agency in all states of India that brings all stakeholders’ together to guide-develop –implement-finance-coordinate-monitor and evaluate highway safety policies and programmes.

• Human, physical and financial resources in all sectors need to be increased significantly along with increased use of technology to address road safety issues at both state and district levels.

• Capacity strengthening of policy makers in National and State Highway Authority, national and state agencies in transport, police, health, law, welfare, finances, infrastructure areas and others including local municipal agencies should be promoted and strengthened to give importance for highway safety activities.

• Safety features should be incorporated in design – construction and operation of highways based on local transport patterns, and needs and requirements of people. Road safety audits should be mandatory in all road development programmes on both new and existing highways.

• To make highways safer, area wide safety programmes should be implemented along with specific interventions in accident black spot locations and high risk crash locations. Addressing safety on highways has to be a continuous activity that is based on research and data developed at the local level.

• Driver licensing systems that promote driving by trained drivers should be implemented through scientific approaches and developing driver data bases that are interlinked across states. In addition, ensuring proper insurance status of vehicles will be an essential requirement.

• Known and proven legislations in the areas of helmets (covering riders and pillions), seat belts (covering front and rear seat passengers), child restraints, drinking and driving, cell phone use while driving should be notified in all states, covering national and state highways as well. Necessary changes should be promulgated at the state level to bring uniformity in legislation. All these legislations should be enforced by the enforcement officials in a visible - uniform - random method along with education of road users. Greater use of technology like speed cameras, breath analysers along with increased manpower will be required to scale
up enforcement. The fines collected from road users can be used for these activities.

• Speeding beyond prescribed limits is one of the major causes of road crashes on Indian highways. This should be addressed through engineering, technological, enforcement and educational strategies in a scientific manner keeping the needs and requirements of people. Traffic separation, traffic calming and speed control need to be the cardinal features of highway safety programmes.

• Increasing visibility of people, vehicles, and roads will have a positive effect in reducing road crashes. Day time running if lights, better road markings, improved signages, reducing the glare from vehicle head lights, use of brighter clothing, reflective tapes and borders on vehicles and helmets can also help in increasing visibility and should be implemented through a combination of legislative, engineering and educational approaches.

• Early prehospital care like developing community first aid responders (specially police, drivers, teachers, etc.,), rapid availability of care, safe transportation, triage at the first contact hospital or in the ambulance should be strengthened on highways.

• The District Hospital and medical college hospitals should be strengthened with physical (at least with an availability of ER), human (trained and skilled manpower), financial (for all essential supplies) resources to improve local trauma care. Triage and referral guidelines should be made mandatory in all health care institutions. Trauma care centers located at or near to highways should be fully functional.

• District rehabilitation centers and programmes should be strengthened to provide services for injured residents in a district to improve their quality of life and to minimize their travel to cities.

• Increasing awareness about road safety issues in local communities, engaging communities along with stake holders to improve safety and informing local communities on safe and proper use of highways and other roads has to be a continuous activity and should use local communication methods.

• Road safety information systems, surveillance and crash analysis should be strengthened with the involvement of academic institutions and research centers to better understand crashes on a continuous basis and to develop data driven - evidence based interventions. National agencies like Indian Council of Medical Research should work to develop Trauma Registries in select district hospital or medical college hospital to develop information and data using uniform and standardised methods. Changes should be brought in the existing systems of documenting information in road crash documentation /registration in both police and in hospitals.

Road safety is a complex issue and needs scientific and systematic approaches. It definitely requires proactive approaches and change in mindset along with implementing a mix of countermeasures that are scientific, evidence based and data driven. All implemented activities needs to be monitored and evaluated for cost effectiveness, sustainability and technological appropriateness. People, especially young productive people, should not be killed, injured and disabled due to an eminently preventable condition like Road Traffic Injuries. We need to act now.
14. REFERENCES


Mohan D. The Road ahead, Indian Institute of Technology, New Delhi, 2006


Road accident statistics. Ministry of Road transport and highways, Government of India, New Delhi, 2014

Gururaj G. Bangalore Road safety and injury Prevention Programme, National Institute of Mental Health and Neuro Sciences, Bangalore, 2011.
As India prepares to invest and expand highway road infrastructure across the country through different programmes of central and state governments, safety on our national and state highways is a matter of serious concern. This aspect has taken back seat in our quest to promote rapid mobility to provide faster connectivity across the country.

In the past 5 years, between 2010 – 14, nearly 8,00,000 persons have died on Indian roads. Among them, a minimum 4,00,000 persons have died on our national and state highways. The number of people hospitalized and disabled is not clearly known and it is estimated that for every death, 30 – 40 persons are seriously injured and a large number of these persons live with serious disabilities for the remaining part of their life. Majority of these deaths, hospitalizations and disabilities are among young productive men. Pedestrians, two wheeler riders and pillions, bicyclists, and passengers in medium and large vehicles are killed and injured in greater numbers. Most significantly, nearly 70 – 80 % of them are from middle and lower income sections of our Indian society. Road crashes have disastrous effects on poor and middle income households.

Highway road crashes are different from crashes in urban areas. As highways pass through millions of villages and towns, the exposure of people to crashes are higher, thereby increasing their risk of involvement. Heavy vehicles like trucks, buses and others are involved to a greater extent on highways. Greater speeding by all vehicles on highways is a major contributor for deaths and injuries and raises serious questions on the design of highways that pays poor attention to the needs of vulnerable road users. Absence of - helmet – seat belts – drink driving – cell phone use- speeding laws on highways and, lack of enforcement even when such laws exist, increase the severity of injuries resulting in poor outcomes. The poor status of trauma care on highways is well acknowledged that only adds to more deaths and disabilities. There are several other issues that need to be unfurled to develop a better understanding of safety on Indian highways.

Road safety in general and highway safety in particular needs the serious attention of our society. It needs a serious and scientific approach. Road safety needs to be promoted with well established institutional mechanisms along with implementing countermeasures that are proven and cost effective; there are several of these time tested measures. Road crashes are predictable and preventable. This tragedy on our roads and highways can only be averted, if we all recognize that people's lives are vital and precious and take actions to prevent road crashes.