ABSTRACT
“Speed Thrills but Kills” but still people wants to speed in daily life. The deadly game of hunted and hunter is daily played on the Indian Roads, with the big vehicles playing the role of hunter and the vulnerable section and smaller vehicles being hunted. Road traffic accidents are the most inflammable topic in today’s scenario on the Indian road network. A number of people are losing their lives in road accidents. These crashes not only cause considerable suffering and hardship but they also have a major impact on the country’s economy, costing an estimated Rs 300 billion or more than 3% of India’s GDP every year. India has the second largest road network in the world with over 3 million km of roads of which 46% are paved. These roads carry an estimated 60% of freight and 80% of passengers and they make a vital contribution to India’s economy. This paper will try to focus on some very important and inflammable issue like road accidents, their trends, factors responsible for road accidents, adverse effects of road accidents, prevention and control and some recent approaches to improve the safety on roads. In 2009 only, 1.27 lakh people died in road accident in India resulting a financial cost of approximately 1,36,000 crore Indian rupees. Road traffic injuries are one of the top three causes of death for people aged between 5 and 44 years. Therefore, Road crashes deserve to be a strategic issue for any country’s public health and can lead to overall growth crisis, if not addressed properly. The projected 40% increase in global deaths resulting from injury between 2002 and 2030 is predominantly due to the increasing number of deaths from road traffic accidents. Thus we can say that road accidents are a very serious and critical issue on Indian Roads. This paper presents the current situation of road accidents, which are happening on Indian roads and also discuss the countermeasures that have promise to address these specific road accident problems.

KEY WORDS: Road Traffic Accident, GDP, WHO

1. INTRODUCTION
During the past two decades, dramatic changes have taken place in the lifestyle of the middle class population of India. The expansion of the highway infrastructure, especially in major metropolitan areas, has not kept pace with the increasing traffic demand. Such imbalance in supply and demand is causing an unprecedented level of safety challenges vs. Recent years have witnessed an increase in motorization, infrastructure expansion and increasing mobility of people in India and in cities; this change is likely to continue in the coming years. Everybody if given a choice would like to be in the biggest vehicles as they generally own the road literally. People may be surprised to know that nearly 95000 people get killed on Indian Roads on yearly basis, or nearly 260 people getting killed on daily basis. Road accidents now leads the list of accidental deaths in India much more than any other such as by drowning, fire, rail or air mishaps etc. Driving or riding a vehicle in India is by large becoming a dangerous experience and Indian roads like those of other Asian countries are becoming virtual death traps. There is always a human tendency to underreport undesirable facts. In our country it’s the number of accidents which often fails to get registered. Human Death due to its complexity cannot be neglected and thus often gets registered. Experts have researched and indicated that a ratio of 1:15:70 for road accident deaths, injuries requiring hospital treatment, and minor injuries is taking place. Thus it indicates that nearly 8 million people “Directly-influenced” by accidents. The persons who are only injured are “blessed” and they know that things could have been either way. In 1970’s the percentage of Total killed by total accidents was around 12% which has increased to nearly 21.5% in 2004. In spite of improvement in infrastructure, vehicle designs, driver knowledge and hospitals still accidents are becoming more fatal in nature. The reason can be increase in speed. The researchers have traditionally identified the problems as lack of driver ethics and knowledge, road design issues and high traffic violations. When all these three ingredients combine, we have a recipe for disaster. Consequently, there has been an increase in road crashes, deaths, injuries (RTIs) and disabilities.
Photograph 1: Severity of accidents
(Source: Internet)

Table 2: Showing the number of accidents in Indian in comparison to other major counties of world

<table>
<thead>
<tr>
<th>Country</th>
<th>Road length (km)</th>
<th>Population in thousands</th>
<th>Land area (sq.km)</th>
<th>Motorized vehicles</th>
<th>Fatality due to road accidents</th>
<th>Fatality/1000 registered vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>3315231</td>
<td>1045547</td>
<td>2973190</td>
<td>58863000</td>
<td>84700</td>
<td>1.44</td>
</tr>
<tr>
<td>Pakistan</td>
<td>255856</td>
<td>148720</td>
<td>9161923</td>
<td>54082200</td>
<td>5842</td>
<td>0.11</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>239226</td>
<td>141340</td>
<td>786598</td>
<td>5132037</td>
<td>42884</td>
<td>0.27</td>
</tr>
<tr>
<td>USA</td>
<td>6358571</td>
<td>282909</td>
<td>161490000</td>
<td>5842</td>
<td>3503</td>
<td>3.88</td>
</tr>
<tr>
<td>Germany</td>
<td>231400</td>
<td>82501</td>
<td>357045</td>
<td>325900</td>
<td>3321</td>
<td>1.00</td>
</tr>
<tr>
<td>U.K</td>
<td>387674</td>
<td>59834</td>
<td>37269752</td>
<td>5530</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>863100</td>
<td>62324</td>
<td>545630</td>
<td>5530</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>1183000</td>
<td>127619</td>
<td>78279000</td>
<td>10913</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>1624952</td>
<td>1299880</td>
<td>41753700</td>
<td>107077</td>
<td>2.56</td>
<td></td>
</tr>
</tbody>
</table>

Road deaths and injuries are increasing at a rapid pace in metros and other parts of India and are likely to increase in comparison to other major countries of world, if systematic and scientific road safety policies and programmes do not accompany this change.

Available data indicate that the economically progressive states of India are already reporting higher number of crashes, deaths and injuries, only highlighting that mobility; transport and safety need to grow together for a healthy and safe society.

Figure 1: Percentage Share of various Causes of Accidental Deaths during 2008 (Ref; 01)

In addition, greater reliance on motor vehicles also results in many direct and indirect health effects leading to some non communicable diseases (obesity, cardiac diseases, diabetes etc..) and environmental and climate changes.

The World Health Organization also declared the year 2004 as the Year of Road Safety and launched World Health Day in April 2004 with the slogan – “Road safety is no accident”. The World Report on Road Traffic Injury Prevention of the World Bank and World Health Organization (WHO) in the year 2004 stated that road traffic injuries are a major but neglected global public health problem requiring concerted efforts for effective and sustainable prevention. Of all the systems that people have to deal with on a day-to-day basis, road transport is the most complex and the most unsafe mode of transportation. The report forecasts that without any increased effort and new initiatives, the total number of road traffic injuries and deaths worldwide would rise by 65 per cent between 2000-2020 whereas in low-income and middle-income countries, deaths are expected to increase by as much as 80 per cent. The majority of such deaths are at present of “vulnerable road users, pedestrians, pedal cyclists and motorcyclists”. In high income countries, deaths among car occupants continue to be predominant but risk per capita that vulnerable road user’s face is high. Obviously, the level of road deaths and injuries is unacceptable and to a large extent avoidable. Thus, there is an urgent need to recognize the worsening
road safety situation in order to take appropriate action. Road traffic injury prevention and mitigation should be given the same attention and scale of resources that are currently being channeled towards other predominant health issues, if increasing human loss and injury on the roads, with their devastating human impact and large economic cost to society are to be avoided.

Fig: 2 Road accidents and fatality distribution in India (1970 to 2010) (Reference: 07)

1.1 Road Accident
Road accidents may be defined as a human tragedy, associated with major health problems, negative socio-economic growth, and poverty. Road accidents involve high human suffering and monetary costs. Losses from Road accidents
- Material damage to property and vehicles
- Lost productivity of those killed or injured
- Cost of medical treatment
- Administrative costs (insurance, police, courts, etc.)
- Subjective costs (pain, grief, and suffering)
- Unquantifiable social and community cost
- Poverty

1.2 Road users killed in Road Accidents
Data for road user types killed are not available at the national or state levels in India. Some cities maintain such details locally, but data are not available for all cities in the country. Proportions of road users killed in the late 1990s in the cities of Mumbai and Delhi and selected highway locations are given in Table 3). These data show that car occupants were a small proportion of the total fatalities. Pedestrians, bicyclists, and motorized two-wheeler riders accounted for 60-90% of all traffic fatalities. This pattern is very different from that obtained in all high-income countries.

1.3 Why accidents do occur
There are various reasons for the occurrence of accidents but some of the important reasons are as follows:

1. Defects in vehicle e.g. breakage of tie rod of a running vehicle tyre bursting, wheel coming loose or failure of brakes. Due to such occurrence the driver loses control on the vehicle and an accident results.

2. Error of driver e.g. overtaking at a wrong place, turning abruptly or stopping without prior signaling, which can cause collision with the vehicle following, driving fast through villages exceeding the speed limit, falling asleep at the wheel, overturning due to round a curve at excessive speed, driving while intoxicated etc.

3. Environment around the road e.g. error of drivers of other vehicles like bullock carts, cycles, rickshaw, pedestrians, school children being run over, cattle, or dogs etc.

4. Defects in roads: A study of accidents registered with the police shows that the number of accidents due to this reason is around 10% of total accidents. Even allowing for some errors in analysis of reasons for accidents, the figure will not exceed 20%.

Table: 3, showing the traffic fatality by Road user and Type.

<table>
<thead>
<tr>
<th>Type of road user</th>
<th>Location (percent)</th>
<th>Mumbai</th>
<th>Delhi</th>
<th>Highways*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck</td>
<td></td>
<td>2</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Bus</td>
<td></td>
<td>1</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Car</td>
<td></td>
<td>2</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Three-wheeled scooter taxi</td>
<td></td>
<td>4</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Motorized two-wheeler</td>
<td></td>
<td>7</td>
<td>21</td>
<td>24</td>
</tr>
<tr>
<td>Human and animal powered vehicle</td>
<td></td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Bicycle</td>
<td></td>
<td>6</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Pedestrian</td>
<td></td>
<td>78</td>
<td>53</td>
<td>32</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

(Source: Mohan and Tiwari, 2000)
*The data are for 14 selected locations, and thus might not be representative for the entire country. (Tractor fatalities are not included.)
Table: 4, showing number of persons killed in road accidents in Indian (cause wise)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Causes</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fault of Driver</td>
<td>65830(74)</td>
<td>58961(69)</td>
<td>69631(75)</td>
</tr>
<tr>
<td>2.</td>
<td>Fault of Cyclist</td>
<td>1361(2)</td>
<td>1193(1)</td>
<td>979(1)</td>
</tr>
<tr>
<td>3.</td>
<td>Fault of Pedestrian</td>
<td>1875(2)</td>
<td>1451(2)</td>
<td>1363(1)</td>
</tr>
<tr>
<td>4.</td>
<td>Mechanical Defect</td>
<td>1909(2)</td>
<td>1967(2)</td>
<td>2015(2)</td>
</tr>
<tr>
<td>5.</td>
<td>Bad Roads</td>
<td>936(1)</td>
<td>1224(1)</td>
<td>1506(2)</td>
</tr>
<tr>
<td>6.</td>
<td>Other Causes</td>
<td>15763(19)</td>
<td>21202(25)</td>
<td>17124(19)</td>
</tr>
<tr>
<td>7.</td>
<td>Total</td>
<td>84755(100)</td>
<td>85998(100)</td>
<td>92618(100)</td>
</tr>
</tbody>
</table>

(Source: Reference 07)

1.4 Factors contributing to accidents
Understanding why accidents occur has been explored in depth in studies worldwide. Many factors may contribute to accident occurrence, and most accidents involve more than one factor. Human factors contribute to 95%, road factors to 25%, and vehicle factors to less than 5%. The main human errors are: going too fast for the situation, failing to give way at junctions, following too close, overtaking improperly, misperceiving or misjudging the road situation ahead, and impairment as a consequence of drinking alcohol. Road deficiencies that are main contributory factors are: poor design of layout or control at junctions, inadequate signing, road markings and lighting, slippery roads, and obstructions on the road such as parked vehicles. Main vehicle factors are: defects in tyres, brakes and lights, arising from poor maintenance of the vehicle.

Fig:3, The main factors responsible for road accidents (Source: Sabey 1980, Treat 1980)

1.5 Trends in Accidents, Injuries, Fatalities, Motor Vehicles & Road Network
The Compound annual growth rate (CAGR) in number of accidents, injuries, fatalities and motor vehicles (registered) has moderated during 1990s (1990-2000) after a spurt during the 1980s (1980 to 1990). Moderation in the growth of accidents, fatalities and injuries during 1990s has taken place in the backdrop of lower growth in the number of registered vehicles and step up in the growth of road network. However, post-2000 (up to 2009) growth rate of fatalities has accelerated vis-à-vis the preceding decade (1990-2000).

1.6 Adverse effect of Road Accidents
- Injury to head and face was the most common injury in 77% of fatal and 45% of non-fatal injuries.
- Injury to upper and lower limbs was present in 62% of fatal and 80% of non-fatal injuries.
- Injury to chest was found in one fourth of deaths.
- Half (51%) of road traffic injury patients had a moderate injury requiring observation and intensive management.
- One sixth (16%) of patients had a serious injury requiring varying periods of admission and surgical / medical management.
- Even though disabilities were not documented in the present programme, it is known that all severely injured patients, 50% of moderately injured and 20% of mild injuries are discharged from the hospitals with varying levels of disabilities, requiring short-term and long-term rehabilitation services.

Table 5: Compound annual growth rate for various parameters

<table>
<thead>
<tr>
<th>Period</th>
<th>Number of Accidents</th>
<th>Number of Injuries</th>
<th>Number of Fatalities</th>
<th>Number of Registered vehicles</th>
<th>Road Length (in kilometers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980/1970</td>
<td>3.0</td>
<td>4.5</td>
<td>5.2</td>
<td>12.4</td>
<td>2.3</td>
</tr>
<tr>
<td>1990/1980</td>
<td>6.3</td>
<td>8.4</td>
<td>8.5</td>
<td>15.5</td>
<td>2.9</td>
</tr>
<tr>
<td>2000/1990</td>
<td>3.3</td>
<td>5.0</td>
<td>3.8</td>
<td>9.8</td>
<td>5.3</td>
</tr>
<tr>
<td>2009/2000</td>
<td>2.4</td>
<td>2.9</td>
<td>5.3</td>
<td>10.0</td>
<td>2.7</td>
</tr>
</tbody>
</table>
1.7 Why is Road Safety Important

- Road accidents will be with us for a long time.
- Accidents trends are on the rise and issues need to be addressed.
- Comprehensive road safety programs can reverse accidents trends.
- Road accidents block economic and social development.

2.0 PREVENTION AND CONTROL

The main thrust of accident prevention and control across the world has been on 4 E’s, viz. (i) Education, (ii) Enforcement, (iii) Engineering and (iv) Environment and Emergency care of road accident victims.

- **Educational approach:** It relies on dissemination of road safety awareness and regulation through media, classrooms and non-governmental organizations (NGOs). This approach takes a longer time to achieve the desired change in individual perceptions and attitudes. The WHO/World Bank Report on Road Traffic Injury prevention in the light of global experience about education has observed, “When used as a single, isolated intervention, do not deliver tangible and sustained reductions in deaths and injuries”.

- **Enforcement Approach:** Its prime emphasis is on restraining road users from undertaking behaviors which expose road users and others to risk of accidents and injuries. The Indian Motor Vehicle Act of 1988 has Chapter 8 and portion of Chapter 13 devoted to many rules and regulations, viz. laws with regard to use of safety devices (helmets), speed limits, etc.

- **Environmental & Engineering Approach:** This covers broad range of interventions to make road user safe through better road environment and safer vehicles. Safer vehicles by improving crash worthiness and safety of occupants – safety belts, airbags, laminated windshields, improving braking conditions, installing suitable lights to reduce glare; better roads through better road design, geometry and markings, traffic calming techniques, identification of accident black spots and their treatment, good visibility of roads with lighting, segregation of traffic into slow and fast moving categories.

- Among the important environmental measures is better land use pattern which promotes shorter travel time and distance thus restricting demand for travel leading to reduced traffic congestion on roads. These measures are passive and one time efforts and are not dependent on actions of road users. These do not require constant monitoring and have been found to be quite effective worldwide. Their impact is easy to measure. However, these measures do require substantial resources, which developing countries may find it difficult to harness.

- **Emergency accident care:** This covers organization, delivery of emergency accident care and logistic support for effective and coordinated delivery of health care to accident victims. WHO guidelines for “essential trauma care” recommend establishing achievable and affordable standards for injury care.

3.0 SOME RECENT APPROACHES TO IMPROVE THE SAFETY OF THE ROAD ENVIRONMENT

**Accident Prevention:** Improved planning and design of new roads and developments particularly in urban areas. Basic principles include:

- Land-use should be distributed to minimize vehicle trips and pedestrian vehicle conflicts.
- Networks should be classified into a hierarchy with the emphasis on speed management.
- Layouts of roads in residential areas should be designed to keep out through traffic and keep speeds down to appropriate levels.
- New scheme should be checked for safety i.e. road safety audits.

**Accident Reduction**

- Low-cost engineering improvements at hazardous locations
- Area (urban) wide schemes
- Traffic calming

3.1 Road Safety Engineering: Road Environmental Improvements

A few of pragmatic road safety measures which could immediately be implemented at relatively low cost and within short periods of time for achieving safer road operations in India are identified. Investigational studies in accident problem characteristics dictate that priorities be placed on such principles as traffic segregation to provide separate movement facilities and road spaces for pedestrians and Non-Motorized Vehicles (NMVs), pragmatic measures to improve and correct road user behavior (self-enforcing measures) through public motivational programs, proper channelization of road junctions, effective speed control/reducing measures and properly enforcement of traffic safety laws etc. Immediate measures to achieve enhanced road safety and which would also offer cost-effective results include:
• Safety conscious planning of new road networks and safety audits of existing roads.
• Small changes/improvements in road layout and use of roundabouts.
• Incorporation of safety features in the design and construction of new road schemes.
• Treatments of roadway shoulders (provide wider and stronger shoulders).
• Provision for and augmentation of adequate pedestrian facilities (crossings, urban and rural footways, safety zones).
• Provision of special facilities for non-motorized vehicles and designated truck/bus lanes.
• Intersection designs/improvements (flaring, channelization, traffic islands etc.).
• Installation and up gradation of median barriers, edge barriers at turning roads and refuse islands.
• Treatments of roadside hazards (trees, ditches, other fixed objects).
• Improvements of narrow and deteriorated bridges, culverts and lanes.
• Control over speeding and dangerous undesirable overtaking including traffic calming measures.
• Installation of delineation devices (lane markings, guide posts, chevrons) to facilitate and guide traffic movements.
• Improved access controls, cross-sections, sight distances and alignments.
• Setting safety standards for fronts of vehicles, which would be less hazardous to pedestrians and cyclists.
• Improved conspicuity of vehicles in general, bicyclists and pedestrians in particular.
• Compulsory helmet use for motorcyclists and effective enforcement of laws and sanctions against alcohol impaired drivers.
• Compulsory use of seatbelts by motor vehicle operators and car occupants including child restraints.
• In passing it should be noted that the benefits of road safety engineering measures could be best achieved by the understanding of and constant reference to the fundamental safety principles and operational elements of safer road designs. The main principles of a safe road environment are:
  • To provide guidance: guide the driver through unusual sections;
  • To provide information: inform the driver of conditions to be encountered;
  • To warn: warn the driver of any substandard or unusual features;
  • To control: control the driver’s passage through conflict points or sections; and
  • To forgive: forgive the driver’s errant or in appropriate behavior.

3.2 Road Safety Audit: A New Approach to Road Safety

The road safety audit technique has been able to contribute significantly to make the roads safer by identifying many highway designs and operational aspects which would have contributed to the occurrence of road accidents and which would otherwise have been overlooked. Again, road safety audit is of particular importance in the developing countries like India because they are still developing their basic national road networks, and unless safety checks are undertaken this will result in unsafe networks in future. A formal road safety audit process would focus on such explicit safety implications and recommend desirable changes or modifications appropriate to the local safety needs/standards. In India, the focus should be on the most important national strategic roads or traffic projects (urban and /or rural) which are of considerable safety concern so as to make positive impacts on all concerned viz. the management, the policy makers, road users and the community at large. There is considerable potential application of road safety audits.

4.0 CONCLUSION

Road Safety is a multi-sectoral and multidimensional issue. It incorporates the development and management of road infrastructure, provision of safer vehicles, legislation and law enforcement, mobility planning, provision of health and hospital services, child safety, urban land use planning etc. In other words, its ambit spans engineering aspects of both, roads and vehicles on one hand. And the provision of health and hospital services for trauma cases (in post-crash scenario) on the other. Road safety is a shared, multi-sectoral, responsibility of the government and a range of civil society stakeholders. On the basis of above data it can be said that road safety is a critical and challenging issue on Indian roads in today’s scenario and government would have to start think very seriously on this inflammable issue. Countries are facing various crises and loss due to road safety degradation. However, the only long term solution to road accident problems is to provide a higher quality road system with increased length of divided highways, which have a better safety record than undivided highways. The safety of the vulnerable road users must also be sufficiently catered for in the
Vulnerable road users are much more susceptible to accidents when vehicle speeds are high and can even suffer fatal injuries in accidents with motor vehicles at moderate speeds. Thus the most critical and effective measure which perhaps should be immediately adopted is to reduce speeds particularly in urban areas. This measure alone will greatly reduce the overall number of road deaths as shown by experience all over the world (the number of fatalities was reduced by 32 percent in urban areas after speed limits of 50 km/h were enacted and strictly enforced in Hungary). A necessary prerequisite to the development of such cost effective solutions to the accident problems is of course an improved understanding of the accident problem.

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