



ROAD SAFETY AND ACCIDENT PREVENTION IN INDIA:

A REVIEW
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Review Article

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ABSTRACT

Road accidents are a human tragedy. They involve high human suffering and monetary costs in terms of untimely deaths, injuries and loss of potential income. Although we have undertaken many initiatives and are implementing various road safety improvement program the overall situation as revealed by data is far from satisfactory. During the calendar year 2010, there were close to 5 lakh road accidents in India, which resulted in more than 1.3 lakh persons. These numbers translate into one road accident every minute, and one road accident death every 4 minutes. Unfortunately, more than half the victims are in the economically active age group of 25-65 years. The loss of the main bread winner can be catastrophic.

Road traffic accidents are amenable to remedial action. Many a countries have curbed the menace of road accidents by adopting a multipronged approach to road safety that encompasses broad range of measures, such as, traffic management, design and quality of road infrastructure, application of intelligent transport system, safer vehicles, law enforcement, effective and quick accident response and care etc. The Government alone cannot tackle road safety problems. There is a need for active involvement of all stake-holders to promote policy reform and implementation of road safety measures. Addressing road safety in comprehensive manner underscores the need to involve multiple agencies and sectors like health, transport and police. The present study provides the magnitude and various dimensions of road accident in India. The analysis on road accidents in this study will help to create awareness, guidelines and assist in informed decision making on road safety.

KEYWORDS: Road Safety, Accident Prevention, Pedestrian Safety, Accident Classification.

INTRODUCTION

Road traffic fatalities are forecast to increase over the next ten years from a current level of more than 1.3 million to more than 1.9 million by 2020. The Commission for Global Road Safety believes that the urgent priority is to halt this appalling and avoidable rise in road injury and then begin to achieve year on year reductions. The world could prevent 5 million deaths and 50 million serious injuries by 2020 by dramatically scaling up investment in road safety, at global, regional and national levels.

Each year nearly 1.3 million people die as a result of a road traffic collision, more than 3000 deaths each day and more than half of these people are not travelling in a car. Twenty to fifty million more people sustain non-fatal injuries from a collision, and these injuries are an important cause of disability worldwide. Ninety percent of road traffic deaths occur in low and middle-income countries, which claim less than half the world's registered vehicle fleet. Road traffic injuries are among the three leading causes of death for people between 5 and 44 years of age. Unless immediate and effective action is taken, road traffic injuries are predicted to become the fifth leading cause of death in the world, resulting in an estimated 2.4 million deaths each year. This is, in part, a result of rapid increases in motorization without sufficient improvement in road safety strategies and land use planning.

Road Accident Scenario in India

In India mobile phones and personalized vehicles are increasing with the same growth rate. As an estimate India have that number of cars only if put them together in a single lane, it will reach from New Delhi to New York. Projection of the present trend of vehicles usage reveals a rather ugly and unsustainable situation both in terms of traffic congestion and safety. For instance while the population of India increased by 17.64 percent over the past ten years, the number of licensed vehicles increased by 132 percent over the same period.

According to official statistics, 430,654 people were killed in road traffic crashes in India in 2010 (NCRB 2010). The situation in India has worsened in recent

years. Traffic fatalities increased by about 5.5% per year from 2009 to 2010. This is attributable partly to an increase in the number of vehicles on the road, and partly to the absence of a coordinated official policy to control the problem.

- 443 Deaths and 1301 injuries per day due to Traffic Accidents.
- 367 Deaths per day and 1290 injuries per day due to Road Accidents.
- 73 Deaths per day by Truck/Lorry and 77 deaths by Two-wheeler.

Motor vehicle population has grown at a compound annual growth rate (CAGR) of 10 percent 2000-2009, during fueled by a rising tide of motorization. Concomitantly, traffic risk and exposure have grown. During the year 2010, there were around 5 lakh road accidents, which resulted in deaths of 134,513 people and injured more than 5 lakh persons in India. These numbers translate into 1 road accident every minute and 1 road accident death every four minutes.

The loss to the Indian economy due to fatalities and accident injuries estimated at 3% of GDP in 1999-2000 is particularly severe as 53.1% of road accident victims were in the age group of 25 to 65 years in 2010, with pedestrians, bicyclists and two-wheelers, who comprise the most unprotected road users, accounting for around 40% of all fatalities.

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Trends in Road Accidents, Injuries, Fatalities, Motor Vehicles & Road Network

Road accidents are an outcome of the interplay of various factors, some of which are the length of road network, vehicle population, human population and adherence/enforcement of road safety regulations, etc. Higher exposure to road accident risk may be mitigated by behavioral standards by adhering to road safety regulations and policy interventions.

CAGR of the number of accidents, injuries, fatalities and motor vehicles (registered) has moderated during 1990s, after a spurt during the 1980. 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, in the decade 2000-2010, the growth in fatalities edged upwards vis-à-vis the preceding decade (1990-2000).

Table 1: Growth in Select Accident Related Parameters: CAGR in per cent

Period	Number of Accidents	Number of Injuries	Number of Fatalities	Number of Registered Vehicles	Road Length (in kilometre)
1980/1970	3.0	4.5	5.2	12.4	2.3
1990/1980	6.3	8.4	8.5	15.5	2.9
2000/1990	3.3	5.0	3.8	9.8	5.3
2010/2000	2.5	2.8	5.5	10.0*	2.7**

* refers to 2009/2000. The latest year for which the data on the number of registered vehicles is available is 2009.
** refers to 2008/2000. The latest year for which data on road length is available is 2008.

(Source: Report on Road Accidents in India 2010)

Between 1970 and 2010, the number of accidents increased by 4.4 times with 9.3 times increase in fatalities and 7.5 times increase in the number of persons injured, while there was an increase of 82 times in the number of registered motor vehicles and more than three times increase in the road network.

Classification of Accidents

The Road Accidents can be classified in the following manners:

Classification of Persons by Injury Severity

Introduction: The purpose of this classification is to describe the most severe injury to any person involved in a road vehicle accident.

Categories: There are four mutually exclusive categories for classification of injured persons. In order of precedence, these are:

- person with fatal injury
- person with Grievous Injury
- person with minor injury
- person with no injury

Time of classification: Injuries should be classified on the basis of conditions at the scene of the accident. The single exception to this rule applies to fatal injuries. If any injury results in death within a specified period after the road vehicle accident in which the injury occurred, the injury classification should be changed to fatal injury. For general use in the administration of highway safety programs, the specified period is 30 days. This 30-day fatality counting rule is suitable for most applications, but other fatality counting rules are sometimes needed to meet specialized requirements. A 12-month rule for counting fatalities is used under World Health Organization procedures adopted for vital statistics reporting in the United States. Experience indicates that, of the deaths from motor vehicle accidents which occur within 12 months of those accidents, about 99.5 percent occur within 90 days and about 98.0 percent occur within 30 days.

Guide to classification. The injury classification applies to any person involved in road vehicle accidents while either in or out of a road vehicle. The categories are so defined that, for the most part, neither medical attention nor special tests are required for classification. Classification usually can be done by ordinary observation at the time of the accident or from information submitted on the accident report.

Classification of Road Vehicles by Damage Severity

Introduction: The purpose of this classification is to describe the most severe damage to any road vehicle involved in a road vehicle accident.

Motor Vehicles: In order of precedence, motor vehicle categories by severity of damage are:

- Disabling damage to motor vehicle
- Functional damage to motor vehicle
- Other motor vehicle damage
- No damage to motor vehicle

Other Road Vehicles: In order of precedence, other road vehicle categories by severity of damage are:

- Disabling damage to other road vehicle
- Functional damage to other road vehicle
- Other other-road-vehicle damage
- No damage to other road vehicle

Accident Classification by Vehicle Type

Introduction: The purpose of this classification is to describe the type of transport accident.

Categories: The exclusive categories for classification of transport accidents. In order of precedence, these are:

- Motorized two Wheeler accident
- Motorized three wheeler accident
- Car/Jeep/Van/Taxi accident
- Bus Accident
- Light Transport Vehicle accident
- Heavy Articulated Transport Vehicle accident
- Tractor with Trolley accident
- Bicycle/Pedestrian accident
- Animal/Hand Drawn Cart accident

Accident Classification by Injury Severity

Introduction: The purpose of this classification is to describe the severity of a road vehicle accident in terms of injuries received. The accident is classified according to the most serious injury to any person involved.

There are some mutually exclusive categories of injury severity for classification of road vehicle accidents are:

- Fatal accident
- Grievously injured
- Minor Injury
- No injury accident

Accident Classification by Damage Severity

Introduction: The purpose of this classification is to describe the severity of a road vehicle accident in terms of damage to property.

Categories: There are some categories of damage severity for classification of motor vehicle accidents or other-road-vehicle accidents

Motor vehicle accidents: Motor vehicle accident categories, in order of precedence, are:

- Disabling damage accident
- Functional damage accident
- Other motor vehicle damage accident
- Other property damage accident
- No damage accident

Interpretation: This classification does not actually describe or measure the severity of the whole road vehicle accident, but only the most serious damage to one road vehicle. A motor vehicle accident in which one motorcycle was disabled would have the same "damage severity" as one in which four trucks with trailers was demolished.

General: The "no damage" classification applies only when there is injury but no damage in a road vehicle accident; if there were neither damage nor injury there would be no accident.

Accident Classification by Number of Vehicles

Introduction: The purpose of this classification is to describe a motor vehicle accident in terms of the number of motor vehicles in-transport which are involved, or other road- vehicle accident in terms of the number of other road vehicles in-transport which are involved.

Categories: The categories for classification of road vehicle accidents by number of vehicles are:

- Single-vehicle accident
- Two-vehicle accident
- Three-vehicle accident
- And so on

Noncontact road vehicles: A noncontact (or "phantom") road vehicle is not counted as one of the road vehicles involved in an accident. Noncontact vehicles may or may not be recorded on accident reports but should not be counted when classifying accidents by number of vehicles involved. Information about a noncontact vehicle may be recorded for legal purposes, but such vehicles are not counted for statistical purposes.

Single-vehicle accidents: Common types of single-vehicle accidents are non collision accidents or collisions involving pedestrians, fixed objects, wild animals or unrestrained domestic animals.

School bus: If a school bus is directly involved (as a contact vehicle) in a motor vehicle accident, the school bus is counted as any other motor vehicle would be. If a school bus is indirectly involved (e.g., as a noncontact vehicle) in a motor vehicle accident or another-road-vehicle accident, it is not counted.

Accident Classification by First Harmful Event

Introduction: The purpose of this classification is to describe a road vehicle accident in terms of the first harmful event that occurred.

Motor vehicle accidents: Motor vehicle accident categories are:

Collision accident

1. Collision involving pedestrian
2. Collision involving motor vehicle in-transport
3. Collision involving parked motor vehicle
4. Collision involving bicycle
5. Collision involving animal
6. Collision involving fixed object
7. Collision involving other object

Non-collision accident

1. Overturning accident

2. Other non-collision accident

Other-road-vehicle accidents: Other-road vehicle accident categories are:

Collision accident

1. Collision involving pedestrian.
2. Collision involving other road vehicle in transport
3. Collision involving parked motor vehicle
4. Collision involving animal
5. Collision involving fixed object
6. Collision involving other object

Non-collision accident

1. Overturning accident
2. Other non-collision accident

Guide to classification. The use of the first harmful event rather than the most severe or significant harmful event is specified for uniformity in reported road vehicle accident statistics. For analytic purposes it may be desirable to collect and use information about subsequent harmful events

Classification of Persons by Work Status

Introduction: The purpose of this classification is to indicate, for each person involved in the motor vehicle accident, whether or not the person was at work or not at work.

Categories: There are two mutually exclusive categories for classification of work status of a person involved in a motor vehicle accident. The categories are:

- At work
- Not at work

Guidelines for Road Safety and Prevention of Road Accidents

This section provides guidelines for road safety, examining what is known about their practicability, effectiveness, cost and acceptability to the public. In this in chapter some guidelines are developed, of course, may not easily be implemented, but will instead require careful adaptation and evaluation. Where effective guidelines are altogether lacking, scientific research is needed to develop and test new measures. Some guidelines of Road safety are as follows:

Guidelines for Safe Traffic System Design

Road traffic deaths and serious injuries are to a great extent preventable, since the risk of incurring injury in a crash is largely predictable and many countermeasures, proven to be effective

- Make the provision of safe, sustainable and affordable means of travel is a main objective in the planning and design of road traffic systems.
- Preventing pedestrians and cyclists from accessing motorways and preventing motor vehicles from entering pedestrian zones are two well-established measures for minimizing contact between high-speed traffic and unprotected road users.
- Giving priority in the road network to higher occupancy vehicles.
- Road safety is the integral part of road design at planning stage.
- Giving vehicles with many occupants priority in traffic over those with few occupants is a means of reducing the overall distance travelled by private motorized transport and hence of cutting down on exposure to risk.

Guidelines for Managing exposure to risk through transport policies

Perhaps the least used of all road safety strategies are those that aim to reduce exposure to risk. Yet the underlying factors determining exposure to risk can have important effects. While further research is required to fully explore strategies, it is known that exposure to road injury risk can be decreased by strategies that include:

- Reducing the volume of motor vehicle traffic by means of better land use;
- Providing efficient networks where the shortest or quickest routes coincide with the safest routes
- Encouraging people to switch from higher-risk to lower-risk modes of transport
- Placing restrictions on motor vehicle users, on vehicles, or on the road infrastructure

Guidelines for Safe Planning of Road Networks

In an efficient road network, exposure to crash risk can be minimized by ensuring that trips are short and routes direct, and that the quickest routes are also the safest routes. Route management techniques can achieve these objectives by decreasing travel times on desired routes, increasing travel times on undesired routes, and re-directing traffic. Some guidelines are given for safe planning:

- Classifying the road network according to their primary road functions;
- Setting appropriate speed limits according to those road functions
- Improving road layout and design to encourage better use.

Guidelines for Incorporating Safety Features into Road Design

- Higher-speed roads include motorways, expressways and multi-lane, divided highways with limited access. They are designed to allow for higher speeds by providing large-radius horizontal and vertical curves, “forgiving” roadsides, entry and exit “grade-separated” junctions where there is no contact between motorized and non-motorized traffic and median barriers to separate opposing directions of traffic.
- Single-lane carriageways in rural areas include many different types of road like:-
 - Provision for slow-moving traffic and for vulnerable road users.
 - Lanes for overtaking, as well as lanes for vehicles waiting to turn across the path of oncoming traffic.
 - Median barriers to prevent overtaking and to eliminate head-on crashes.
 - Better highlighting of hazards through road lighting at junctions and roundabouts.
 - Improved vertical alignment.
 - Advisory speed limits at sharp bends.
 - Regular speed-limit signs.
 - The systematic removal of roadside hazards – such as trees, utility poles and other solid objects.
- Residential access roads are often designed to achieve very low speeds. Speed limits, usually supported by physical self-enforcing measures to encourage compliance, are normally around 30 km/h, though lower limits are often prescribed.

- Safer routes for pedestrians and cyclists. The creation of networks of connected and convenient pedestrian and cyclist routes, together with the provision of public transport, can lead to greater safety for vulnerable road users

Guidelines for Design Crash-Protective Roadsides

Collisions between vehicles leaving the road and roadside objects including trees, poles and road signs, often of very high mass, are a major road safety problem worldwide. So there is need to design protective roadside having following provisions:-

- Designing roads without dangerous roadside objects
- Introducing a clear zone at the side of the road
- Designing roadside objects so that they are more “forgiving”
- Protecting roadside objects with barriers to absorb part of the impact energy.
- Protecting vehicle occupants from the consequences of collisions with roadside objects, through better vehicle design.

Guidelines for Safety Audits of New Transport Project at Various Stages

When new transport projects are proposed, area-wide safety impact assessments are needed to ensure the proposals do not have an adverse safety impact on the surrounding network. Road safety audits are then required to check that the proposed design and implementation are consistent with safety principles, and to examine whether further design changes are needed to prevent crashes. Safety audit are carried out in the following stages of a project:

- The feasibility study of the project
- The draft design
- The detailed design
- Before the project becomes operational
- A few months after the project is operational

Guidelines for Remedial Action at High-Risk Crash Sites

Low-cost road and traffic engineering measures consist of physical measures taken specifically to enhance the safety of the road system. Ideally, they are cheap, can be implemented quickly, and are highly cost-effective Examples include:

- Physical changes to roads to make them safer (e.g. the introduction of skid-resistant surfacing)
- The installation of central refuges and islands
- Improved lighting, signs and markings
- Changes in the operation of junctions, for example, by installing small roundabouts, changing the signal control or improving signs and markings.

Such measures can be applied at

- High-risk sites, for instance, a particular bend or junction.
- Along a section of route where the risk is greater than average, though the measures are not necessarily concentrated at specific sites

Guidelines for Pedestrian and Bicyclist Safety

Although all types of road user are at risk of being injured or killed in a road traffic crash, there are notable differences in fatality rates between different road user groups. In particular, the “vulnerable” road users such as pedestrians and two-wheeler users are at greater risk than vehicle occupants and usually bear the greatest burden of injury. This is especially true in countries like India, because of the greater

variety and intensity of traffic mix and the lack of separation from other road users. Some guidelines are given for pedestrian and two-wheeler safety:

- Free left turns must be banned at all signalized junctions. This will give a safe time for pedestrians and bicyclists to cross the road.
- Speed control in urban areas. Maximum speed limits of 50 km/h on arterial roads need to be enforced by police monitoring, and 30 km/h in residential areas and by judicious use of speed breakers, dead end streets and mini roundabouts. In the short term of three years, a target of covering 10% of the roads can be attempted.
- Increasing the conspicuity of bicycles by fixing of reflectors on all sides and wheels and painting them in yellow, white or orange colors.

Guidelines for Crash-Protective Vehicle Design

- Ensure that all motor vehicles meet safety standards set for high income countries – regardless of where the vehicles are made, sold or used – including the provision of seat belts and other basic safety equipment.
- Begin manufacturing vehicles with safer vehicle fronts, so as to reduce injury to vulnerable road users.
- Continue to improve vehicle safety by ongoing research and development.
- Advertise and market vehicles responsibly by emphasizing safety.
- Design of Intelligent vehicles, new technologies are creating new opportunities for road safety as more intelligent systems are being developed for road vehicles. Start the vehicle to be equipped with technology that could improve road safety in terms of exposure, crash avoidance, injury reduction and automatic post-crash notification of collision.

Guidelines for Setting up Model Inspection and Certification Centers for Vehicles

The Fitness tests of motor vehicles, being carried out presently are visual in nature, resulting in subjective evaluation by the inspecting officer. The prescribed tests are more of routine nature rather than fulfilling any meaningful exercise. 'In use' vehicles, therefore, require focused attention in the wake of worsening road accident scenario and environmental pollution. The Ministry intends to put in place a suitably designed Inspection and Certification system throughout the country to ensure proper inspection of motor vehicles and to remove the defects before they are allowed to ply on road.

Guidelines for Enforcement of Rules and Regulation

Good enforcement is integral part of road safety. Here some guidelines are given for enforcement are:

- It is critical that the deterrent be meaningful for the traffic law enforcement to be successful.
- Setting road speed limits is closely associated with road function and road design, as already mentioned.
- Automatic speed enforcement, such as by means of speed cameras, is now employed in many countries.
- Speed limiters in heavy goods and public transport vehicles.
- Enforcement levels need to be high and maintained over a period of time, so as to ensure

that the perceived risk of being caught remains high.

- Once offenders are caught, their penalties should be dealt with swiftly and efficiently.
- Using selective enforcement strategies to target particular risk behaviors and choosing specific locations both improve the effectiveness of enforcement.
- Of all the methods of enforcement, automated means – such as cameras – are the most cost-effective.
- Publicity supporting enforcement measures increases their effectiveness; used on its own, publicity has a negligible effect on road user behavior.

Guidelines for Setting and Enforcing Alcohol Impairment Laws

In our country drink-driving, alcohol is significant and widespread factor in road crashes. The scientific literature and national road safety programs agree that a package of effective measures is necessary to reduce alcohol-related crashes and injuries.

- Blood alcohol concentration limits
- Blood alcohol concentration limits for the general driving population
- Minimum drinking-age laws, minimum drinking-age laws specify an age below which the purchase or public consumption of alcoholic beverages is illegal.
- Random breath testing and sobriety checkpoints.
- Lower blood alcohol concentration limits for young or inexperienced drivers.
- Penalties for excess alcohol offenders

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