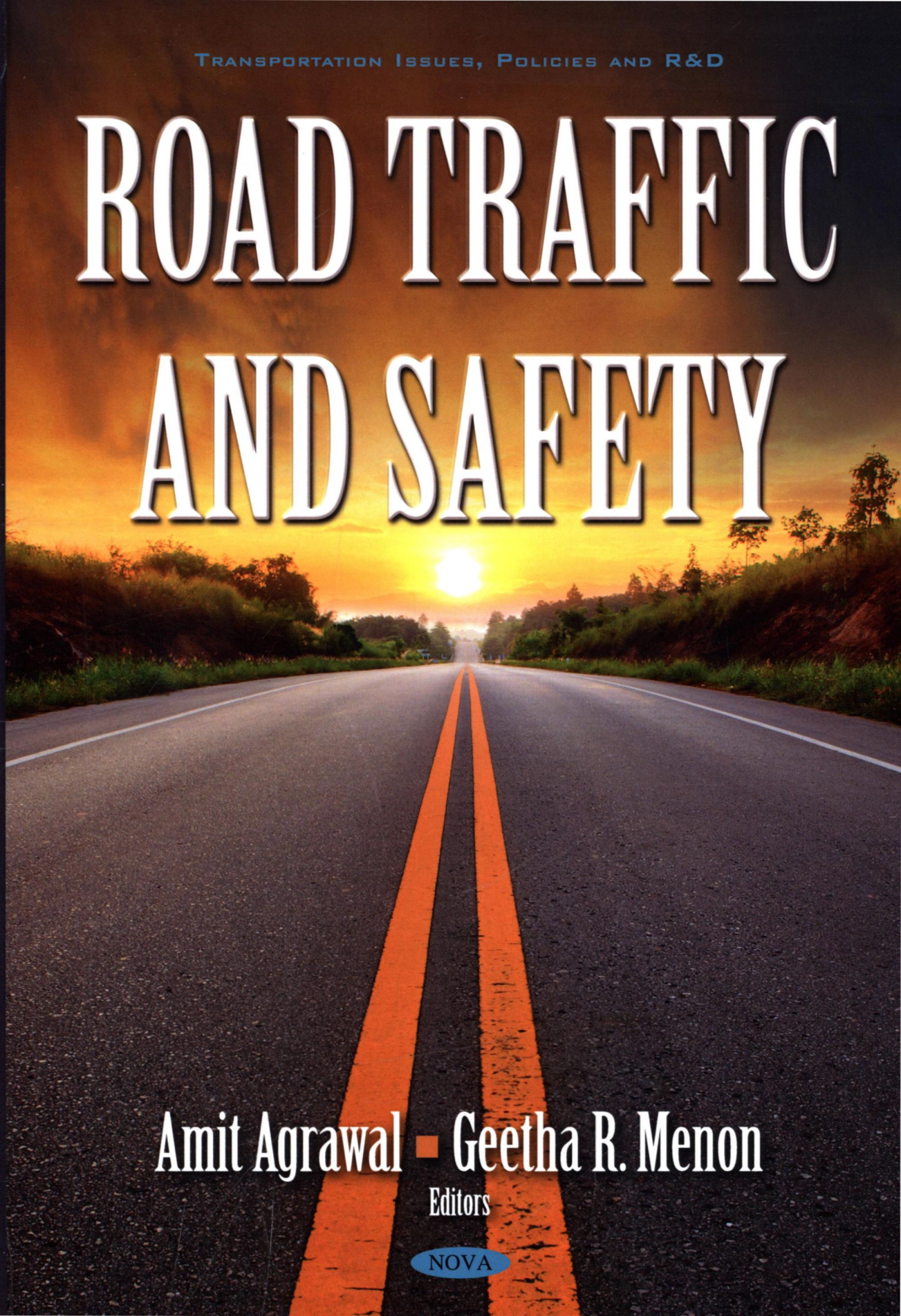
TRANSPORTATION ISSUES, POLICIES AND R&D

ROAD TRAFFIC AND SAFETY



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Editors

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Road space is shared by multiple vehicles (i.e. cars, taxis, buses, trucks, motorcycles, and mopeds), pedestrians, animals and many other categories of travelers. Easy availability of motor vehicles and advancements in their technology has made road travel easy; on the other hand, this has also resulted in a significant increase in the number of motor vehicle related injuries. Road traffic related injuries remain an important public health problem globally. It has been estimated that approximately 1.25 million people succumb to road traffic injuries annually worldwide, and between 20 and 50 million people sustain non-fatal injuries. It is a cause of great concern that 59% of the severely injured population is young adults aged between the age of 15 and 44 years. At present, globally road traffic injuries are ranked as the eighth leading cause of mortality, and if the current trends continues, it is expected to be the seventh leading cause of mortality at the global level by 2030.

Road traffic safety is one of the most significant concerns of the United Nations and a 5-tiered approach has been proposed to combat traffic accidents and fatalities. This includes improvements in health care services focusing on injury care, road safety management, road network safety, vehicular safety, and implementation of road safety legislation. Changes in practices like speed control, use of seatbelts and helmets, respecting traffic signals and signs, avoiding drunken driving (or use of drugs), following traffic rules (lane driving) and avoiding mobile phones while driving are some of the behavioral changes that can bring about a significant reduction in the number of road traffic related injuries.

The present book consists of fifteen chapters related to various aspects concerning road traffic and safety, including epidemiology of road traffic injuries, occupant protection and safety devices, risk factors, a manual of safety measures, road safety in hilly terrain and conflict zones, prevention of head injuries, the role of alcohol and bicycle related injuries. The authors hope that the book shall help the readers to get an overview of various aspects related to global road traffic and safety.

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science publishers
www.novapublishers.com

ISBN 978-1-53612-489-7
9 781536 124897

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Library of Congress Cataloging-in-Publication Data

ISBN: 978-1-53612-489-7

Published by Nova Science Publishers, Inc. † New York

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PREFACE

Road space is shared by multiple vehicles (i.e., cars, taxis, buses, trucks, motorcycles, and mopeds), pedestrians, animals and many other categories of travelers. Easy availability of motor vehicles and advancements in their technology has made road travel easy; on the other hand, this has also resulted in a significant increase in the number of motor vehicle related injuries. Road traffic related injuries remain an important public health problem globally. It has been estimated that approximately 1.25 million people succumb to road traffic injuries annually worldwide, and between 20 and 50 million people sustain non-fatal injuries. It is a cause of great concern that 59% of the severely injured population is young adults aged between the age of 15 and 44 years. At present, globally road traffic injuries are ranked as the eighth leading cause of mortality, and if the current trends continues, it is expected to be the seventh leading cause of mortality at the global level by 2030.

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Chapter 1 - Recent development in human civilization is attributable to industrialization and motorization. Rampant growth in the number of vehicles on our roads has also translated into a new kind of epidemic: 'Road Traffic Accidents (RTA)' and its associated morbidity and mortality. Since 22nd December 1970, when first belt wearing law came into the jurisdiction in Australia, there have been tremendous changes in the design of safety restraints and enforcement laws for the security of on and off road passengers. The authors review and highlight the effectiveness and deficiencies of the various safety restraint devices currently in use.

Chapter 2 - Modern traffic situations are much more complex and dangerous than the situations typical of the world humans evolved in. Driving in busy urban areas presents difficult perceptual challenges for drivers. The chapter discusses the problem of perceptual complexity and some of the challenges it presents to drivers. Growing literatures in psychology document the challenges of complex scenes and in particular the problem of "crowding:" objects competing for perception and identification, and large objects tending to crowd out small objects. In traffic, this reduces the likelihood of perceiving vulnerable road users (pedestrians, bicyclists, and motorcyclists), who tend to be smaller than cars in the visual field. Experiments are reviewed that demonstrate this effect of crowding, with briefly viewed pictures of traffic scenes. The perceptual limitations were manifested as "misses," in which observers thought there was no vulnerable road user in the scene, even though the task was to detect vulnerable road users. The miss rate was quite high, especially when the vulnerable road users were surrounded by (crowded by) automobiles.

Chapter 3 - Seat belts are designed to retain people in their seats during a road traffic crash. The seat belts work as a key part of wider injury prevention measures and safety systems, such as airbags and head restraints. However, a seat belt may not be effective in reducing the risk of injury and death if an occupant is not wearing it at the time of a road crash. The effect of seat belts is to minimize contact between the occupants and vehicle interior and significantly reduce the risk of being ejected from the vehicle. The objective of this study was to examine the spatial pattern of existing seat belt laws, seat belt wearing rates and the effects of seat belt use on road traffic deaths. Data was obtained from the World Health Organization (WHO) website for countries within the 8 continents. Descriptive statistics, Moran's Index and qualitative snippets were used for analysis. Detailed procedure for conducting spatial analysis was presented. For all the countries with available information, 159 countries had existing national seat belt laws and 20 countries had no national seat belt laws. 104 countries had seat belt laws applicable to all occupants. 55 countries either had no seat belt laws or had limited application to some car occupants. The seat belt wearing rates ranged between 16-98%, 10-97%, 13.7-98% and 30-98% for front seat, rear seat, drivers only and all occupants in particular countries with seat belt wearing laws, while some countries had seat belt laws but seat belt wearing rates as low as 1%. In Africa, Asia, Europe, North America,

Oceania, Seven Seas (Open Ocean) and South America, countries with high seat belt wearing rates tend to have low road traffic deaths. Countries with no seat belt laws and low seat belt wearing rates are more likely to have high road traffic deaths. Countries with national seat belt laws particularly applicable to all occupants were observed to have low road traffic deaths. The spatial pattern indicates that when a country has a high seat belt wearing rate, there is a probability that countries that are contiguous to that country will equally have a high seat belt wearing rate. In addition, when road traffic deaths are high in one country, the neighbouring countries are likely to experience high road traffic deaths. The study concludes that seat belt use can reduce road traffic deaths. The study advocates for the existence of seat belt laws in countries currently without seat belt laws. Countries with existing seat belt laws but low compliance are encouraged to scale up the use of seat belts. Also, law enforcing agencies in each country should take up the responsibility of ensuring that seat belt laws are obeyed within their territories. This study further reveals the need for national policies and programmes to promote compliance of seat belt use across the continents. The findings should enable the orientation of policies targeted towards promoting the use of seat belt on the worlds' roads across the continents.

Chapter 4 - Road traffic accidents are one of the most common causes of mortality and morbidity in modern India. Proper application of road traffic safety can help us reduce this burden. This includes the understanding of risk factors and proper utilization at the levels of pre-, post- and during an accident to reduce the morbidity and mortality as well as promote proper rehabilitation of these patients.

Chapter 5 - Road traffic injuries and deaths related to such injuries are a major public health challenge that has been often neglected around the world. Globally, nearly 1.25 million people die in road accidents each year. While the number of deaths due to road accidents has somewhat stabilised in high-income countries, the number of road accident fatalities in low- and middle-income countries has been rapidly increasing due to increased motorisation and population in addition to a lack of prevention tactics. Apart from human loss, road accidents are also a major economic problem costing countries billions of dollars each year. Drunk driving, distractions while driving and speed are the most common risk factors while the use of helmets, seat belts and airbags clearly reduce the probability of mortality in road accidents. Of all the systems that we use on a daily basis, road traffic systems have proven to be the most complex and unfortunately, the most dangerous. It requires effective and sustainable measures to contain and reduce such incidents. The policy makers, automobile manufacturers, public health experts, community groups and individuals need to come together to address this global healthcare issue. The important thing to remember is that deaths due to road accidents are preventable and can be avoided by road safety mechanisms and proper implementation of such mechanisms.

Chapter 6 - Road traffic accidents are common and can be prevented. In spite of the fact that solutions for low-income and middle-income nations may differ from those nations that have a longer history of motorization, some basic principles are the same. These include, for instance, good road design and traffic management, improved vehicle standards, speed control, the use of seat-belts and the enforcement of alcohol limits. Numerous countries have no injury surveillance systems that generate reliable data on road traffic accidents and injuries. Indicators, especially for non-fatal results, may not be standardized, making comparisons difficult. The challenge is to adapt and evaluate existing solutions, or else create new solutions in low-income and middle-income countries. Transferring and adapting some of the more complex measures are more long term and require nation-specific innovative work. In addition, more work is called for in all nations to find new and better road safety measures. Governments can make use of these to develop effective and cost-effective road safety programmes. With properly targeted investment, nations should derive impressive social and economic benefits from reduced road traffic deaths, injuries and disabilities.

Chapter 7 - According to the World Health Organization (WHO), road traffic injuries are the sixth leading cause of death in India with a greater share of hospitalization, deaths, disabilities and socioeconomic losses in the young and middle-aged population. Road traffic injuries also place a huge burden on the health sector in terms of pre-hospital and acute care and rehabilitation. Drivers fault accounts for majority of the accidents. This factor assumes all the more importance in hilly terrain, where the drivers' skills are of paramount importance. Road traffic accidents have become a major public health issue and victims are mainly the poor and vulnerable road users. The Transport Research Wing of the Ministry of Road Transport and highways in its 2015 issue of Road Traffic accidents in India have come up with some scary statistics in which 57 accidents occur daily in our country, with 17 lives lost every hour.

Driving in hilly areas is a testing time even for seasoned drivers, since the topography of hills is extremely different from the plains. The vehicle's fitness is also very important in hilly roads. Adding on to the burden is the nature of hilly roads, which are narrow and very frequently get affected by inclement climatic conditions. This chapter attempts to describe the peculiarities of roads in hilly areas and lays special emphasis on making the driver aware of the factors which, if incorporated, can help them to safely drive in the long run.

Chapter 8 - Road safety encompasses various aspects, which can be broadly divided into, *Mechanical factors* – related to the vehicle, *Human factors*- driver and traffic related, *Environmental factors*- which relates to the terrain, roads, weather etc. Road safety in conflict areas encompasses all the three and is unique because, the factors vary from one conflict zone to another. Knowledge on road safety in conflict zones is extremely essential for citizen of every country, as the warfare has moved out of the conventional war zones to everyday life, due to ever increasing acts of terrorism, which

spares no country or individual. Specific guidelines and advisories cannot be outlined, however a general outline and safety measures can definitely be laid down. Knowledge on conventional warfare and explosive devices, precautionary measures one could follow are extremely valuable. In the current age, knowledge and safety measures to be adopted, for Nuclear, Biological and Chemical (NBC) warfare also need to be incorporated in every safety manual. This article will aim to give a comprehensive overview of various aspects of road safety in conflict zones, with guidelines for various scenarios.

Chapter 9 - Neurotrauma is one of the leading causes of death in young patients, especially in developing countries. The causes are known and are preventable as compared to the other diseases. The common causes of head and spine injury are road traffic accidents, falls and violence. In the developing world, the health resources are already overstretched. Neurotrauma increases the burden on health care in these countries. In the developed world, steps have been taken to reduce the incidence of neurotrauma but it stills remains an endemic problem which needs further awareness and support. By Road traffic safety, the authors mean the methods and measures used to prevent road users from being killed or getting seriously injured. Clinical management of injured patients follow the general neurotrauma management guidelines. The costs to communities in terms of suffering and economics are enormous. There is difficulty in treating and taking care of injured patients because of lack or shortage of facilities and expertise especially in developing countries like India where there are approximately 1800 neurosurgeons for 1200 million people.

The incidence of accidents and the fatalities related to road traffic accidents have been on the rise over the years. The increase in urbanisation and vehicles has significantly contributed to the rise in the incidence of head injury in India. Approximately 70% of the road traffic accident patients sustain head injury. Head injury is the leading cause of death in patients who sustain injury in road traffic accidents. India has the highest accident rate in the world and constitutes 6% of reported incidence while the numbers of vehicles are only 1% of the world's total vehicles.

Adequate prehospital trauma care can prevent or decrease the severity of many fatal injuries. The major advantage of prehospital care is realized when the timely intervention can limit or halt the cascade of events that can quickly lead to death or lifelong disability.Most deaths occurring in first hours after injury are the result of either airway compromise, respiratory failure or uncontrolled haemorrhage. All three of these conditions can be readily treated using basic first aid measures. Prehospital care may also prevent a number of delayed deaths from trauma.Measures like proper wound and burn care, adequate immobilization of fractures, support of oxygenation and blood pressure during the first hours after a traumatic brain injury, as well as other measures reduce the likelihood of complications developing later. Public awareness regarding prevention of accidents is required like the use of helmets, seat belts, knowledge of traffic rules and understanding the long-term complications and implications of severe accidents. India

has lagged behind primarily because of poor understanding and implication of all such factors. The primary factors responsible for such an incidence are poor road design, improper maintenance of roads, poorly maintained vehicles with no safety facilities, apathetic attitude of authorities and poorly trained and reckless drivers. Moreover, poor vision, old age and intoxicated drivers also cause vehicular accidents in India. A multidirectional approach can help in decreasing the number of accidents in India.

Chapter 10 - India has come to the forefront of progress with new leadership and globalization providing a substantial economic stimulus for progress. This also enables people to afford cars and increase their movement on the roads. However, poor infrastructure, congestion and improper maintenance of vehicles lead to more road accidents. According to the World Health Organization (WHO), road traffic injuries are the sixth leading cause of death in India and fourth in the world with a greater share of mortality and morbidity in the young and middle-aged populations. Around 1.9 million deaths annually due to road injuries are predicted by 2020 if no action is taken. Road traffic injuries cost countries 1-3% of the gross domestic product (GDP). Hence, the goal of the United Nations' Decade of Action for Road Safety 2011- 2020 is to save five million lives. The health sector directly and indirectly plays a very important role in this. Most public discussions and government policy documents dealing with transportation and health focus only on air pollution and traffic injuries. But a physician has a greater role in road traffic safety. The major human factors that contribute to the severity of road accidents include drunken drivers, indecisiveness, fatigue, distraction, and confusion. The presence of many diseases like epilepsy, heart diseases with life threatening arrhythmias, covert encephalopathy, visual impairment, depression, etc., increases the possibility of such injuries. The safety of the geriatric population needs to be looked into without restricting their mobility. The professional capability of older drivers should be of concern to the prescribing doctor. Proper instructions and guidance by a physician to his patients can help in reducing these factors. Basic cardio pulmonary resuscitation (CPR) is a lifesaver if administered by a trained person at the proper time and a physician plays a very important role to impart CPR training to the general population to save more lives at the roadside. Strengthening and undertaking research on the public health burden and impact, understanding the risk factors, characteristics of trauma, and measuring the impact of interventions through well-designed public health and clinical research methods is the need of the hour. Health professionals and their professional bodies across wide disciplines need to actively commit for the same.

Chapter 11 - Transportation is at the center of development and human activity. The bicycle as a means of transport was first constructed by the Scottish smith Kirkpatrick in 1839, its structure was completely made of wood, it was called velocipede. Then a new prototype was created in 1864 by two Frenchmen, the blacksmith Pierre Michatix and the stroller maker Pierre Lallement. Both creators gave him a touch of modernity when he covered the wheels with rubber. Despite the benefits of cycling in the last decades, both

the number of cars and trips made by car has increased. Today, the displacement distances in daily life are considerably longer, which favors the use of and discourages walking or cycling. Bicycle use has been associated with high rates of injury and mortality at different ages, especially in the younger population. Legislation is required to use cases at the international level, environmental modifications and monitoring of bicycle user injuries to provide optimal handling of this problem.

Chapter 12 - Traumatic brain injury is the leading cause of death worldwide. The morbidity and mortality due to traumatic brain injury is related to both primary as well as secondary insults. The patients who survive from the primary insults may still have long-term disabilities. Most of these outcomes are related to the high incidence of pre-hospital secondary brain insults. Knowledge of these variables and the timely management of the disease at the pre-hospital level can significantly improve the outcome and decrease the mortality.

Chapter 13 - Road traffic accidents are one of the leading causes of spinal cord injury (SCI) in India. This may be due to increasing number of vehicles on the road, non-adherence to traffic rules, non-adherence to road safety measures etc. The authors conducted focus group interviews of persons with paraplegia regarding their care post injury. Data was collected till data saturation. Qualitative data analysis was done by using ATLAS ti 8 software. The authors retrieved 49 codes under 14 code groups. Four of the codes were related to road traffic and safety. These were knowledge regarding handling the victim at the site of accident, riding a bike under the influence of alcohol, speed of the ambulance, and accident in a hilly area. There is a need to have a general awareness regarding managing the victim at the site of accident in India. Mass awareness through media would be a better option. Traffic rules need to be stringent in case of driving/riding under the influence of alcohol. Speed limit of ambulance remains controversial and there needs to be better road engineering at hilly areas. It is very important to create a mass awareness regarding road traffic rules and safety measures in India.

Chapter 14 - The incidence of road traffic accidents (RTA) in India increased from 5% per year in 2000 to nearly 8% in 2006. Concurrent increase in mortality rate from 36/ million persons in 1980 to 95/ million persons in 2006 is also observed. However, the estimates are not supported by flawless quantification as data sources are often not validated, non-representative, and contain a limited number of relevant variables.Given the potentially catastrophic effects of RTA on immediate families and community, the current chapter will detail more about quantifying the impact of road traffic accidents.

Chapter 15 - India is an important signatory to the Brasilia Declaration on Road Safety held in Brazil in November 2015, a 2nd Global High-Level Conference on Road Safety. That is a commitment to reduce the number of road traffic injuries [RTI] in India by 50% by 2020. This, in itself, is a significant step due to many reasons: 1) the transport research wing of the Ministry of Road Transport and Highways has recently published the latest statistics of RTI in India. The figure comprising about 5,00,000 RTI's in 2014

with about a 30% mortality. India is slowly becoming the World capital of RTIs. 2) The total number of RTIs has been steadily increasing over the years, revealing an increase of 2.5% in 2015 over 2014 with the corresponding increase in mortality of about 4.6%. 3) About 54% of mortality is seen in the age group of 14-34 years, representing the youth of the nation, highlighting the dire urgency for action in prevention of RTIs and implementing global standard of road safety measures. The preliminary step to this effect would be a scientific analysis of the multifactorial nature of an RTI in India which may highlight several local factors responsible for this very dramatic incidence and mortality. These may well be very diverse from those seen in the developed Western World. It is to this end that the authors undertook a systematic review of literature covering over 3 databases, viz., Ovid Medline, Scopus and Global Health. MESH terms were used to search literature published from India. The abstracts were exported to Endnote and duplicates deleted. A total of 116 articles were identified as being relevant to the current discussion. Another aspect of the search was to identify any regional variations in data from different parts of the country, which would represent regional, geographical and topographical differences which may prove to be relevant epidemiological factors. Of the 116 articles, 51 papers were reporting from regional centres. There were two systematic reviews and about 26 articles which considered the overall situation in the country with a need to implement urgent road safety measures. The authors discuss the various ramifications of research in road safety and highlight the pressing need for a unified national policy in RTI prevention.

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