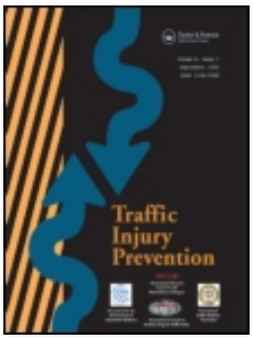

Traffic Injury Prevention

ISSN: 1538-9588 (Print) 1538-957X (Online) Journal homepage: www.tandfonline.com/journals/gcpi20

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To cite this article: Maxwell Barffour, Shivam Gupta, Gopalkrishna Gururaj & Adnan A. Hyder (2012) Evidence-Based Road Safety Practice in India: Assessment of the Adequacy of Publicly Available Data in Meeting Requirements for Comprehensive Road Safety Data Systems, Traffic Injury Prevention, 13:sup1, 17-23, DOI: 10.1080/15389588.2011.636780

To link to this article: https://doi.org/10.1080/15389588.2011.636780

Traffic Injury Prevention, 13(S1):17–23, 2012

ISSN: 1538-9588 print / 1538-957X online
DOI: 10.1080/15389588.2011.636780

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Evidence-Based Road Safety Practice in India: Assessment of the Adequacy of Publicly Available Data in Meeting Requirements for Comprehensive Road Safety Data Systems

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Objective: *To assess the availability and coverage of publicly available road safety data at the national and state levels in India.*

Methods: *We reviewed the 2 publicly accessible data sources in India for the availability of data related to traffic injuries and deaths: (1) the National Crime Records Bureau (NCRB) and (2) the Ministry of Road Transport and Highways (MORTH). Using the World Health Organization (WHO) manual for the comprehensive assessment of road safety data, we developed a checklist of indicators required for comprehensive road safety assessment. These indicators were then used to assess the availability of road safety data in India using the NCRB and MORTH data. We assessed the availability of data on outcomes and exposures indicators (i.e., number of crashes, injuries, deaths, timing of deaths, gender and age distribution of injuries and deaths), safety performance indicators (i.e., with reference to select risk factors of speeding, alcohol, and helmet use), and cost indicators (i.e., medical costs, material costs, intervention costs, productivity costs, time costs, and losses to quality of life).*

Results: *Information on outcome indicators was the most comprehensive in terms of availability. Both NCRB and MORTH databases had data for most of the need areas specified by the WHO under outcomes and exposure indicators. Regarding outcome and exposure indicators, data were available for 81 and 91 percent of specified need areas at the national level from NCRB and MORTH databases, respectively. At the state level, data on outcome and exposure indicators were available for only 54 percent of need areas from either of the 2 sources. There were no data on safety performance indicators in the NCRB database. From the MORTH database, data availability on safety performance indicators was 60 percent at both national and state levels. Data availability on costs and process indicators was found to be below 20 percent at the national and state levels.*

Conclusion: *Overall, there is an urgent need to improve the publicly available road safety data in India. This will enhance monitoring of the burden of traffic injuries and deaths, enable sound interpretation of national road safety data, and allow the formulation effective road safety policies.*

Keywords Road traffic crashes; Injury; Mortality; Data systems; Trauma; India

INTRODUCTION

India is facing an unprecedented increase in the rate of motorization, which is associated with more than 500,000 road traffic injuries (RTIs) and about 120,000 deaths each year, according to official reports (Ministry of Road Transport and Highways [MORTH] 2009; National Crime Records Bureau [NCRB] 2010). The number of RTIs and deaths in India are the highest of any country in the world. Road traffic crashes in India are a major cause of hospitalizations, disabilities, and health-related socioeconomic losses (Gururaj 2006; Patel et al. 2011; World Health Organization [WHO] 2009)_ENREF_1. There is therefore an urgent need to prioritize and implement road safety policies and control programs at the national and state levels to curb this rising trend (Peden et al. 2004). Road safety data of good quality are an important requirement to formulate, implement, and evaluate policies and interventions for the prevention and control of road crashes, RTIs, and deaths. Strong and robust data are required to identify the magnitude of the problem and

Received 12 August 2011; accepted 27 October 2011.

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its determinants, allocation of resources, and prioritization of interventions and to understand what works.

The recently published good practice manual on data collection by the WHO (2010) helps in identifying data requirements and for establishment of comprehensive road safety data systems. The manual recommends that a comprehensive road safety data system should have indicators on (1) outcomes to include crashes, deaths, and injuries in combination with sociodemographic data; (2) safety performance including speed, alcohol, restraints, helmet, road infrastructure, vehicle safety, and trauma management data; (3) costs to include medical costs, material and intervention costs, productivity, and quality of life losses; and (4) process/implementation including road safety policies and plans. The WHO recommends that road safety data systems should capture all crashes and a significant proportion of serious injuries, describe the types of road users and vehicles affected in crashes, situations and circumstances of crashes, and the health and economic impacts. Therefore, the data available become an essential tool for decision-making purposes (WHO 2010). Unfortunately, and far too often, such data systems are unavailable in many low- and middle-income countries (LMICs) such as India (Gururaj 2006; Jagnoor et al. 2011).

In India, data on road deaths and RTIs are primarily collected by police, health, and transport sectors. The most commonly available data in the public domain are from the National Crime Records Bureau (NCRB) maintained by police sources at the national level. Transport sector data are often derived from police sources with additional information on vehicle registrations. A single source for comprehensive health sector data is unavailable in India due to the absence of surveillance systems and limited research (Patel et al. 2011). This article takes a critical look at these publicly available data sources. The overall objective of the current study was to assess the availability and coverage of road safety data at the national and state levels in India. This review focused on current gaps and critical needs to improve road safety data collection methods to promote evidence-based road safety practices. The assessment examined data sources compared to the recommendations of the WHO data manual (WHO 2010).

METHODS

The Johns Hopkins International Injury Research Unit (2011), along with WHO and the Global Road Safety Partnership (GRSP), with support from Bloomberg Philanthropies, are collaborating on the Road Safety in 10 Countries project (RS-10). RS-10 provides support to the Indian government to implement good practices in road safety in 2 sites: Hyderabad and Jalandhar in the states of Andhra Pradesh (AP) and Punjab, respectively (Peden 2010). Monitoring and evaluation (M&E) of the RS-10 project is one of the components, along with capacity building, social marketing, strengthening trauma care, and implementation of good practices with specific reference to promoting helmet use, reducing speeding and drunk driving, as well as enhancing the enforcement of traffic laws. Establishing data collection mechanisms in the 2 sites will guide subsequent M&E of implemented RS-10 projects and strengthen road safety policies.

In India, traffic crashes are officially referred to as "accidents" and are among the 18 unnatural causes of deaths. NCRB defines "traffic deaths" to include road accidents, railroad accidents, and other railway accidents. Because road deaths are unnatural events and are considered medicolegal in nature, police registration is mandatory. All of these deaths as well as nonfatal road crashes are reported to police from village to state levels. These are compiled at the national level and published annually in NCRB's annual report, *Accidental Deaths and Suicides*. All annual reports from NCRB from 1967 until 2009 are available online (National Crime Records Bureau 2011). MORTH compiles crash data collected from state police, along with data on registered vehicles and infrastructure, and infrequently publishes its report titled *Road Accidents in India*. Additional information on overall population characteristics is collected from the Registrar General of India. Comprehensive national and state-level data on road deaths and RTIs are not available from a single source within the health sector, even though information on individual cases is collected in hospitals across the country (Gururaj 2006).

For each data source, we looked for availability of data on outcome and exposure indicators (i.e., number of crashes, injuries, deaths, timing of deaths, gender and age distribution of injuries and deaths), safety performance indicators (i.e., with reference to select risk factors of speeding, alcohol, and helmet use), and economic impact/cost indicators (i.e., medical costs, material costs, intervention costs, productivity costs, time costs, and losses to quality of life; Table I). Quantitative information on processes with relation to policies and programs were not available in the data and therefore were not included in this review. For each of the 3 groups of indicators, we looked for the availability of data at both the national and state (i.e., local) levels.

For each indicator specified in the data systems manual (WHO 2010), we ascertained whether data were directly available in the report database or available data allowed for the indirect estimations. For each indicator, we also estimated "met need" as the ratio of the number of indicator variables in available data to the total number of variables (or need) required for the comprehensive evaluation of the particular indicator, as specified in the WHO manual. Met need therefore could have a minimum and maximum value of 0 and 100 percent, respectively. Likewise, "unmet need" was calculated as the ratio of the number of variables for which no data existed to the total number of variables required for comprehensive evaluation of the particular indicator as specified in the WHO manual. For instance, to estimate the met need for safety indicators, we looked for the availability of data on 10 subindicators under safety indicators in the manual: (1) speeding attributable road traffic crashes (RTCs), (2) speeding-related deaths, (3) speeding-related injuries, (4) alcohol-related deaths, (5) alcohol-related injuries,

Table I Framework used in evaluating adequacy of national road safety database in India

Domain	Definition	Example of indicators
Cost	Direct and indirect medical or socioeconomic cost associated with traffic crashes	Medical costs, material and intervention costs, productivity losses, traffic jams (lost time), loss of life/quality of life
Outcome indicators	Crash data including the burden of road traffic crashes, injuries, and death	Crashes, injuries, and deaths (combined with additional data such as age, gender, residence, etc.)
Safety performance indicators	Operational conditions that influence the likelihood of injuries and deaths from road crashes	Speeding, alcohol, helmet use, road infrastructure, vehicle safety, trauma management
Process/implementation indicators	National or local policies and interventions designed to reduce the road traffic crashes, injuries, and deaths	Road safety policies, plans, programs, implementation of interventions

Source: WHO (2010) and data systems.

(6) alcohol-related crashes, (7) helmet usage, (8) road infrastructure, (9) vehicle safety, and (10) trauma management (Table IIB). Each subindicator was scored "yes" if present and "No" if absent. Percentage met need was estimated as the proportion of yes subindicators.

Except for outcome indicators, the definitions of all other (i.e., safety performance, cost, and process) indicators were retained according to the WHO data system manual. With regard to outcome indicators, information on exposure variables gender, age, urban–rural distribution of RTCs, time of crash, and distribution of road user categories were added to make it comprehensive.

RESULTS

The NCRB and MORTH report databases met most of the data needs for outcome and exposure indicators with national data availability at 81 and 91 percent, respectively (Tables IIA and IIB). At the state level, data on outcome and exposure indicators were available for only 54 percent of prespecified need areas from each of either data sources. NCRB had data on numbers of crashes, fatal and nonfatal injuries, and distribution by age, gender, and time. NCRB data also had details on fatal road crash by types of vehicles and users. MORTH had crash data as detailed above, along with information on road length and crash location in terms of highways and non-highways (Table IIB).

Table II A Availability of outcome indicators and sociodemographic correlates in NCRB database, India

	National level			State level		
Indicator	Available	Coverage years	Most recent estimate	Available	Coverage years	Most recent range
Road traffic crashes	Yes	1967–2009	421,628	Yes	1967–2009	87–60,409
Road traffic injuries	Yes	1967–2009	466,600	NA	—	—
Road traffic deaths	Yes	1967–2009	126,896	Yes	1967–2009	50–14,829
Number of registered vehicles[a]	Yes	1967–2009	89,618	Yes	1967–2009	22,000–10,966
Road length (km)	NA	—	—	NA	—	—
Timing of road crashes	Yes	2009	Most crashes (61%) occur between 9:00 am and 9:00 pm. 12% occur between 9:00 pm and midnight	Yes	2009	Relative distribution differs by state
Gender distribution	Yes	2009	85% of deaths in males, 15% in females	Yes	2009	Relative distribution differs by state
Age distribution	Yes	2009	86% of deaths in 15- to 59-year group, 65% of deaths in 15- to 44-year group	NA	—	—
Urban–rural distribution	NA	—	—	NA	—	—
Fatal crashes by type of vehicle	Yes	2009	21% due to 2-wheelers, 20% due to trucks/lorries; 10% due to buses, 17% due to cars/jeep	Yes	2009	Relative distribution differs by state
Fatal crashes by road users category	Yes	2009	9% of crashes involve pedestrians, 91% vehicle occupants	NA	—	—

[a]Number of vehicles actually operating not reported.
Source: NCRB (2010).

Table II B Availability of outcome indicators and sociodemographic correlates from MORTH, India

	National level			State level		
Indicator	Available	Coverage years	Most recent estimate	Available	Coverage years	Most recent range
Road traffic crashes	Yes	1970–2009	486,384	Yes	2006–2009	63–71,996
Road traffic injuries	Yes	1970–2009	515,458	Yes	2006–2009	151–70,504
Road traffic deaths	Yes	1970–2009	125,660	Yes	2006–2009	55–14,770
Number of registered vehicles[a]	Yes	1970–2009	114,951	NA	—	—
Road length (km)	Yes	1970–2008	4,109,592	NA	—	—
Timing of road crashes	Yes	2009	Most crashes (63%) occur between 9 am and 9 pm	NA	—	—
Gender distribution	NA	—	—	NA	—	—
Age distribution	Yes	2009	53% of crashes involve 25- to 65-year-olds, 30% involve 15- to 24-year-olds	NA	—	—
Urban–rural distribution	Yes	2009	53% of crashes and 62% of crashes/deaths occurred in rural areas	Yes	2009	Relative distribution differs by state
Fatal crashes by type of vehicle	Yes	2009	Two-wheelers (22%) and cars and jeeps (16%) accounted for the majority of crashes	Yes	2009	Relative distribution differs by state
Fatal crashes by road user category	Yes	2009	13% of crashes involved pedestrians, 83% involved occupants	Yes	2009	Relative distribution differs by state

[a]Number of vehicles actually operating not reported.
Source: MORTH (2009).

Available data from both databases also allowed for the estimation of other risk factors, including the number of road crashes and deaths per 100,000 population (MORTH only), as well as per 10,000 vehicles (NCRB and MORTH). NCRB also has data on all types of accidental deaths and suicides from 1970 to 2009, and hence it is possible to ascertain the precise contribution of RTIs among injuries. MORTH data also provide limited information on road infrastructure at both national and state levels.

Safety outcome indicators are those the presence or absence of which can influence outcomes in road crashes and for which interventions may be targeted; they include speeding, alcohol usage, helmet use, seat belt use, safety features in the road infrastructure, vehicle safety, and post-crash care. The NCRB database had no information on these safety performance predictors. We found that MORTH had data in its most recent report and covered 60 percent of need areas for safety performance indicators at both the national and state levels (Table III). There were no available data on the use of helmets at both the national and state levels. In addition, MORTH data did not discriminate between the contribution of alcohol and drugs. There were also no data on vehicle safety and infrastructure, and no information on emergency and acute hospital care was available in any of the databases.

Information on the economic impact/cost of road crashes is not available in either database. However, MORTH's 2009 edition of *Road Accidents in India* reported that, in the years

Table III Availability of safety indicators in MORTH data, India

	National level			State level		
Indicator	Available	Coverage years	Most recent estimate	Available	Coverage years	Most recent range
Speeding attributable road traffic crashes	Yes	2009	219,305	Yes	2009	0–31,534
Speeding attributable road traffic deaths	Yes	2009	53,192	Yes	2009	0–6407
Speeding attributable road traffic injuries	Yes	2009	236,197	Yes	2009	0–31,008
Alcohol attributable road traffic crashes[a]	Yes	2009	27,152	Yes	2009	0–4480
Alcohol attributable road traffic injuries[a]	Yes	2009	30,264	Yes	2009	0–5594
Alcohol attributable road traffic deaths[a]	Yes	2009	9307	Yes	2009	0–1668
Helmet	NA	NA	NA	NA	NA	NA
Road infrastructure	NA	NA	NA	NA	NA	NA
Vehicle safety	NA	NA	NA	NA	NA	NA
Trauma management	NA	NA	NA	NA	NA	NA

[a]Estimates for drugs and alcohol combined.
Source: MORTH (2009).

1999 to 2000, RTIs contributed to a loss of 3 percent of the gross domestic product (GDP) in India (Gururaj 2008; MORTH 2009). This estimate represented only 17 percent of need for cost-related data at the national level and does not discriminate between losses attributable to medical costs, productivity costs, material and intervention costs, time costs, and quality of life losses. In addition, the changing economic impact of road crashes as understood by trend data is lacking, and the economic impact of RTIs at the state level is also not available.

DISCUSSION

In this article, we have reviewed RTC-related data from the MORTH and NCRB databases in India and have attempted to characterize the adequacy of these 2 databases in terms of the availability of data for comprehensive road safety assessment, as recommended by the WHO. Although these sources generally underreport the burden of traffic injuries and deaths, NCRB and MORTH databases have the advantage of easy access, regular collection, and reporting of state-level estimates and hence provide the all-important first step for evidence-based road safety practice. India is facing a major epidemic of road deaths and RTIs, with nearly 126,000 road deaths in 2009, and the situation is likely to worsen if urgent efforts are not made to address the situation. With economic growth and increasing motorization, the burden of RTIs is likely to increase in the absence of road safety policies and programs (Garg and Hyder 2006). For every death, nearly 20 to 30 people are likely to be admitted to the hospital and 50 to 100 receive emergency care (Peden et al. 2004). The economic costs are significant (Gururaj 2006; Mohan 2004). The burden and impact of RTIs in India are likely to be much higher than those reported by the MORTH and NCRB. Independent studies and recent verbal autopsy studies estimated the problem to be much higher, with deaths underreported by 10 to 30 percent and serious injuries by more than 50 percent (Aeron 2000; Dandona et al. 2008; Gururaj et al. 2000; Varghese and Mohan 2003). These databases typically report on the medicolegal cases and hence are more likely to document only the severe cases. Two of the recent estimates from the Global Burden of Disease and Million Death study (Jagnoor et al. 2011) lend further credence to the large numbers of people killed and injured in road crashes (Joshi et al. 2006; Singh et al. 2005).

Information on road crashes and deaths are collected by multiple agencies in India according to their requirements. Because road deaths are considered medicolegal in nature, much of the investigation and data collection on fatal road crashes are done by police officers at local levels. The transport department collects data on vehicle registration and licensing details and obtains crash data from police sources. Because RTIs and deaths are also health problems, some information is collected by the health sector and hospitals in particular, with much of the focus being on care. Data from vital registration sources (i.e., birth and death records) are not available regularly in the public domain and are dependent on completeness and quality of death certification practices. Both the law and welfare sectors collect data and often focus on the criminal nature of investigations. The insurance sector data is also not available in the public domain. Many studies rely on available police and hospital data, though a few have begun improving these mechanisms and are promising in nature (Gururaj 2008). In the absence of any integrated data collection systems at either the national or local level, information systems for RTIs are fragmentary and piecemeal and are not adequate to formulate larger policies or to implement targeted interventions.

In this review of data sources on RTIs in India, both the NCRB and MORTH met most of the needs for outcome indicators. Of the 11 data needs regarding outcome indicators and exposure variables at the national level, MORTH had data on 10 of them and the NCRB data met 9 of them. Both sources obtain basic data from police at the national and state levels at regular intervals. NCRB publishes their data on an annual basis, and MORTH releases data at infrequent intervals. There are a few important differences between the 2 sources on outcome indicators. MORTH data are collected independently from the same source as NCRB, but reported numbers are different on the same outcome indicator; for example, the number of road traffic crashes. A probable reason for this might be the difference in time period used to calculate such indicators. The list of indicators available is also different between the 2 data sources. This lack of uniformity might be due to difference in data needs of the 2 government agencies. MORTH has reported crash data since 1970, effectively permitting the assessment of time trends in the burden of RTIs and the potential impact of interventions and policies. The existence of data on key exposure variables, including gender, age, time of occurrence, and rural–urban distribution, is critical in identifying the most vulnerable people in order to appropriately target national and state-level interventions.

There is still a need to improve data collection and documentation of outcome indicators at national and state levels. Most significant, data on the road user categories injured and killed vary between NCRB, MORTH, and independent studies because police sources document the vehicle involved in a crash and not the victims sustaining crashes. This is amply illustrated by the fact that pedestrians were represented in the NCRB database at only 9 percent (NCRB 2010), though all independent reviews and studies in India indicate that this is between 30 and 40 percent, varying from study to study (Gururaj 2011).

We recognized a greater shortage of data on safety performance indicators at both the national and state levels. This is crucial because transport and road safety is a state subject in India, with development of guidelines and policies by the national central government. India does not have a comprehensive injury prevention policy, program, or plan of action (Patel et al. 2011). A national road safety policy is currently being discussed at the national level, and the implementation and monitoring of interventions at the state level remains weak. Previous studies have highlighted that police sources seriously suffer from a lack of information on modifiable risk factors (i.e., helmets, seat belts, drunk driving, speeding, road factors, etc.). Because

blood and breath alcohol estimation data are not collected and compiled in a systematic manner, either by police or hospitals, data are missing on crucial issues of driving while intoxicated. The NCRB had no safety indicator performance data at either the national or state level, and MORTH had no data on the use of helmets, seat belts, and other related safety indicators and other areas. Multiple studies have documented inappropriate helmet use as a major cause associated with severe RTIs and deaths in India (Dandona et al. 2006; Dixit and Khairnar 1992; Ganapathy 2002; Gururaj 2000; Hazen and Ehiri 2006). Information on these indicators is crucial to reduce road deaths, because effective implementation of these practices is known to reduce road deaths globally (Dinh-Zarr et al. 2001; Hartling et al. 2004; Liu et al. 2004; Nathens et al. 2000; Servadei et al. 2003; Shults et al. 2001; Zaza et al. 2001). Recent studies from different parts of India have shown the positive effect on RTI reduction associated with strengthening these established safety practices (Dandona et al. 2006; Gururaj 2011; Mohan 2004; Mohan et al. 2009).

In the public domain, data on vehicle safety are not available, and a limited amount of data are available on conditions of roads. Information on trauma care is extremely limited, because data are not collected routinely in these areas due to the absence of injury surveillance, trauma registries, and health sector research. Some recent initiatives and programs have demonstrated that with a scientific and systematic approach, it is possible to collect good quality data with adequate training and monitoring, and it is also possible to use data in strengthening capacity building and implementation of road safety programs (Gururaj 2008, 2011). It is important that such information is available in the future to guide national and state programs that aim to promote road safety across the country.

Data on the socioeconomic cost of traffic crashes, RTIs, and deaths complement crash data in informing policymakers about the overall burden of RTCs. We checked for the availability of cost indicators. Unfortunately, only an aggregate estimate of overall socioeconomic data was available at the national level based on a previous study by Mohan (2004). Few independent studies have examined the economic impact of road crashes at the local level. Future data collection efforts must be designed to permit the assessment of each cost indicator to guide comprehensive road safety efforts (Ameratunga et al. 2006; Lin and Kraus 2009; Reddy et al. 2009)_ENREF_4.

Though the focus of this article was restricted to outcomes, safety performance, and cost indicators, it is worth mentioning that the NCRB and MORTH report databases on RTIs in India provide information of a basic nature and are missing critical data requirements for road safety. Comprehensive data are needed to guide policymakers in assessing progress and curbing the rising trend of RTIs in India. With India being a signatory for the Decade of Action for Road Safety 2011–2020, it is imperative that data systems are given high importance for better understanding of road crashes. There is a need to focus on developing and strengthening publicly available minimum data requirements at the national and state levels from police and hospitals. This will facilitate road safety research that allows analysis of collected data through scientific approaches and the effective use of data for planning interventions.

ACKNOWLEDGMENTS

This work was conducted as part of the Road Safety in 10 Countries project funded by the Bloomberg Philanthropies.

REFERENCES

Aeron TA. *Under-reporting of Road Traffic Casualties in Low Income Countries*. Crowthorne, UK: Transport Research Laboratory; 2000.

Ameratunga S, Hijar M, Norton R. Road-traffic injuries: confronting disparities to address a global-health problem. *Lancet.* 2006;367:1533–1540.

Dandona R, Kumar GA, Dandona L. Risky behavior of drivers of motorized two wheeled vehicles in India. *J Safety Res.* 2006;37:149–158.

Dandona R, Kumar GA, Ameer MA, et al. Under-reporting of road traffic injuries to the police: results from two data sources in urban India. *Inj Prev.* 2008;14:360–365.

Dinh-Zarr TB, Sleet DA, Shults RA, et al., and the Task Force on Community Preventive Services. Reviews of evidence regarding interventions to increase the use of safety belts. *Am J Prev Med.* 2001;21(4 suppl):48–65.

Dixit JV, Khairnar BR. Helmets and head injuries. *J Indian Med Assoc.* 1992;90(3):77–78.

Ganapathy K. Prevention and management of head injuries in India: an overview. Paper read at: Icran 2002 International Conference on Recent Advances in Neurotraumatology. 2002.

Garg N, Hyder AA. Exploring the relationship between development and road traffic injuries: a case study from India. *Eur J Public Health.* 2006;16:487–491.

Gururaj G. Behavior and road safety: a multidimensional issue—implications for road safety programmes in developing countries. In: Vonholst H, Nygren A, Anderson AE, eds. *Transportation, Traffic Safety and Health—Human Behavior*. Tokyo: Springer; 2000:327–349.

Gururaj G. *Road Traffic Injury Prevention in India*. Bangalore, India: National Institute of Mental Health and Neuro Sciences; 2006. Publication No. 56.

Gururaj G. Road traffic deaths, injuries and disabilities in India: current scenario. *Natl Med J India.* 2008;21:14–20.

Gururaj G. *Road Safety in India: A Framework for Action*. Bangalore, India, National Institute of Mental Health and Neuro Sciences; 2011. Publication No. 83.

Gururaj G, Aeron TA, et al. Underreporting of road traffic injuries in Bangalore. Implications for road safety policies and programs. *5th World Conference of Injury Prevention and Control*. New Delhi: Macmillan India Ltd; 2000.

Hartling L, Wiebe N, Russell N, et al. Graduated driver licensing for reducing motor vehicle crashes among young drivers. *Cochrane Database Syst Rev.* 2004;2:1–39.

Hazen A, Ehiri JE. Road traffic injuries: Hidden epidemic in less developed countries. *J Natl Med Assoc.* 2006;98:73–82.

Jagnoor J, Bassani DG, Keay L, et al. Unintentional injury deaths among children younger than 5 years of age in India: a nationally representative study. *Inj Prev.* 2011;17(3):151–155.

Johns Hopkins International Research Unit, Johns Hopkins Bloomberg School of Public Health. Available at: http://www.jhsph.edu/iiru. Accessed July 16, 2011.

Joshi R, Cardona M, Iyengar S, et al. Chronic diseases now a leading cause of death in rural India—mortality data from the Andhra Pradesh Rural Health Initiative. *Int J Epidemiol.* 2006; 35:1522–1529.

Lin MR, Kraus JF. A review of risk factors and patterns of motorcycle injuries. *Accid Anal Prev.* 2009;41:710–722.

Liu B, Ivers R, Norton R, et al. Helmets for preventing injury in motorcycle riders. *Cochrane Libr.* 2004;4:1–39.

Ministry of Road Transport and Highways. *Road Accidents in India*. New Delhi: Ministry of Road Transport and Highways, Government of India; 2009.

Mohan D. *The Road Ahead: Traffic Injuries and Fatalities in India*. Delhi: Transportation Research and Injury Prevention Program, Indian Institute of Technology; 2004.

Mohan D, Tsimhoni O, Sivak M, et al. *Road Safety in India: Challenges and Opportunities*. Ann Arbor: The University of Michigan Transporation Research Institute; 2009.

Nathens AB, Jurkovich GJ, Cummings P, et al. The effect of organised systems of trauma care on motor vehicle crash mortality. *JAMA.* 2000;283(15):1990–1994.

National Crime Records Bureau, Ministry of Home Affairs. Available at: http://www.ncrb.nic.in. Accessed July 16, 2011.

National Crime Records Bureau. *Accidental Deaths and Suicides in India*. New Delhi: National Crime Records Bureau, Ministry of Home Affairs, Government of India; 2010.

Patel V, Chatterji S, Chisholm D, et al. Chronic diseases and injuries in India. *Lancet.* 2011;377:413–428.

Peden M. Road Safety in 10 countries. *Inj Prev.* 2010;16(6):433.

Peden M, Scurfield R, Sleet DA, et al. *World Report on Road Traffic Injury Prevention*. Geneva, Switzerland: World Health Organization; 2004.

Reddy GM, Negandhi H, Singh D, et al. Extent and determinants of cost of road traffic injuries in an Indian city. *Indian J Med Sci.* 2009;63:549–556.

Servadei F, Begliomini C, Gardini E, et al. Effect of Italy's motorcycle helmet law on traumatic brain injuries. *Inj Prev.* 2003;9:257–260.

Shults RA, Elder RW, Sleet DA, et al. Task Force on Community Preventive Services. Reviews of evidence regarding interventions to reduce alcohol-impaired driving. *Am J Prev Med.* 2001;21(4 suppl):66–88.

Singh RB, Singh V, Kulshestra SK, et al. Social class and all-cause mortality in an urban population of North India. *Acta Cardiol.* 2005;60:611–617.

Varghese M, Mohan D. Transportation injuries in rural Haryana, North India. Paper read at: International Conference on Traffic Safety; 2003; New Delhi, India.

World Health Organization. *Global Status Report on Road Safety: Time for Action*. Geneva, Switzerland: World Health Organization; 2009.

World Health Organization. *Data Systems: A Road Safety Manual for Decision-Makers and Practitioners*. Geneva, Switzlerland: World Health Organization/Global Road Safety Partnership/FIA/World Bank; 2010.

Zaza S, Sleet D, Thompson RS, et al. Task Force on Community Preventive Services. Reviews of evidence regarding interventions to increase use of child safety seats. *Am J Prev Med.* 2001;21(4):31–47.