



Publications

Books & Monographs

The Future of Traffic Safety and Sustainable Transportation

Mackay, M. (2010). *Transportation Research & Injury Prevention Programme, Indian Institute of Technology Delhi, New Delhi.*

Jubilee Seminar on Road Traffic Safety: Learning From International Experience

Mohan, D. (2010). *Transportation Research & Injury Prevention Programme Indian Institute of Technology Delhi, New Delhi.*

BRT Projects in Indian Cities: Status Report

Tiwari, G. and Jain, D. (2010). *Transportation Research & Injury Prevention Programme, Indian Institute of Technology Delhi, New Delhi.*

Research Papers

Reconstructing fracture progression in impact

Arun, M.W.J. Mukherjee, S., and Chawla, A. (2010). *Proceedings ESAR Conference 2010, Expert Symposium on Accident Research, Hannover.*

Respositioning the human body FE model at the hip (femuropelvic) joint

Dhaval, J., Chawla, A. Mukerjee, S., Goyal, R., Khatri, R., Vusirikala, N., and Jayaraman, S. (2010). *Proceedings 2010 International IRCOBI Conference on The Biomechanics of Injury, International Research Council on the Biomechanics of Injury, Zurich, 207-210.*

Evaluating bicyclists comfort and safety perception

Jain, H., Tiwari, G., and Zuidgeest, M. (2010). *Rep. No. Proceedings 12th World Conference on Transportation Research, WCTR, Lisbon.*

Traffic safety and city public transport system: case study of Bengaluru, India.

Kharola, P.S., Tiwari, G., and Mohan, D. (2010) *Journal of Public Transportation; Vol. 13; No.4; 67-94.*

Analysis of microscopic data under heterogeneous traffic conditions

Mallikarjuna, C., Rao, K.R., Kumar, S.N.V. Satish (2010) *Transport, 25:3, 262-268.*

Prediction of lumbar spine posture for repositioning of spinal FE model

Marathe, R., Chawla, A., Mukherjee, S., and Malhotra, R. (2010).

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Traffic safety: International status and strategies for the future

Mohan, D. (2010). *Proceedings 12th World Conference on Transportation Research, WCTR, Lisbon.*

Childhood injuries in rural north India

Mohan, D., Kumar, A., and Varghese, M. (2010). *International Journal of Injury Control and Safety Promotion, 17 (1), 45-52.*

A road crash reconstruction technique

Mukherjee, S., and Chawla, A. (2010). *Institute of Engineers (India) Journal – MC, 91, 3-8.*

Impact dynamics of metal foam shells for motorcycle helmets:

Experiments and numerical modeling

Pinnoji, P.K., Mahajan, P., Bourdet, N., Deck, C., and Willinger, R. (2010). *International Journal of Impact Engineering, 37(3), 274-284.*

Estimating marginal external costs of transport in Delhi

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Effect of muscle contraction on the lower limb response in low speed

car-pedestrian lateral impact-simulations for a walking pedestrian

Soni, A., Chawla, A., Mukherjee, S., and Malhotra, R. (2010). *International Journal of Crashworthiness, 14(4), 1754-2111.*

Lateral bending moment threshold of the knee joint – effects of active muscles

Soni, A., Chawla, A., Mukherjee, S., and Malhotra, R. (2010). *Proceedings 2010 International IRCOBI Conference on The Biomechanics of injury, Internal Research Council on the Biomechanics of Injury, Zurich, 211-216.*

Elastic response of bones at varying strain rates

Teja, K., Mukherjee, S., and Chawla, A. (2010). *Rep. No. Proceedings 4th International Conference ESAR, Expert Symposium on Accident Research, Hannover.*

Sustainable transport and the modernization of urban transport in Delhi and Stockholm

Thynell, M. Mohan, D., and Tiwari, G. (2010). *Cities, 27(6), 421-429.*

Research & Consultancy Projects

Sustainable Urban Transport in Less Motorised Countries: Research and Training

Sponsor Volvo Research & Educational Foundations

Team D. Mohan, G. Tiwari, A. Chawla, S. Mukherjee, S.R. Kale, P. Mahajan, S. Sanghi, and N. Chatterjee

Estimation of Emissions and Fuel Consumption of in-use Vehicles in Different Driving Conditions.

Sponsor Petroleum Conservation Research Association

Team G Tiwari, S.R. Kale, R.R. Kalaga and D. Mohan

Bicycle Partnership Programme(BPP)

Sponsor Interface for Cycling Expertise (Ice), The Netherlands

Team G Tiwari, and D. Mohan

Review of Contractual Provisions, Establishment of Work-zone Safety Audit Procedure Conducting Work-Zone Safety Audit and Strengthening Work Zone Safety Implementation for Lucknow-Muzaffarpur National Highway Project (LMNHP).

Sponsor National Highway Authority of India

Team K.N. Jha, G. Tiwari, R.R. Kalaga, D. Mohan and S. Mukherjee

Promoting Low Carbon Transport in India

Sponsor UNEP Risoe Centre, Denmark

Team G Tiwari, D. Mohan, S.R. Kale, R.R. Kalaga and A. D. Sagar

Development of Standard Cross Section for Urban Roads

Sponsor Institute of Urban Transport (India)

Team G Tiwari

The Transportation Research and Injury Prevention Programme (TRIPP) at the Indian Institute of Technology Delhi, is an interdisciplinary programme focussing on the reduction of adverse health effects of road transport. TRIPP attempts to integrate all issues concerned with transportation in order to promote safety, cleaner air, and energy conservation. Faculty members are involved in planning safer urban and inter-city transportation systems, and developing designs for vehicles, safety equipment and infrastructure for the future. Activities include applied research projects, special courses and workshops, and supervision of student projects at postgraduate and undergraduate levels. Projects are done in collaboration with associated departments and centres at IIT Delhi, government departments, industry and international agencies.



Global Plan for the Decade of Action for Road Safety 2011-2020*

I call on Member States, international agencies, civil society organizations, businesses and community leaders to ensure that the Decade leads to real improvements. As a step in this direction, governments should release their national plans for the Decade when it is launched globally on 11 May, 2011.

Mr. Ban Ki-moon, UN Secretary-General

General Assembly resolution 64/255 of March 2010 proclaimed 2011-2020 the Decade of Action for Road Safety, with a global goal of stabilizing and then reducing the forecasted level of global road fatalities by increasing activities conducted at national, regional and global levels.

Resolution 64/255, requested the World Health Organization and the United Nations regional commissions, in cooperation with the United Nations Road Safety Collaboration and other stakeholders, to prepare a Plan of Action for the Decade as a guiding document to support the implementation of its objectives. In addition, Resolution 64/255 invited the World Health Organization and the United Nations Regional commissions to coordinate regular monitoring, within the framework of the United Nations Road Safety Collaboration, of global progress towards meeting the targets identified in the plan of action through global status reports on road safety and other appropriate monitoring tools.

In compliance with the above, this plan is intended as a guiding document for countries, and at the same time for facilitating coordinated and concerted action towards the achievement of the goal and objectives of the Decade of Action for Road Safety 2011-2020. It provides a context that explains the background and reasons behind the declaration of a Decade by the United Nations General Assembly. This Global Plan serves as a tool to support the development of national and local plans of action, while simultaneously providing a framework to allow coordinated activities at regional and global levels. It is directed at a broad audience including national and local governments, civil society and private companies willing to harmonize their activities towards reaching the common objective while remaining generic and flexible to country needs.

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. The economic consequences of motor vehicle crashes have been estimated between 1% and 3% of the respective GNP of the world countries, reaching a total over \$500 billion. Reducing road casualties and fatalities will reduce suffering, unlock growth and free resources for more productive use.

Road traffic injuries can be prevented. Experience suggests that an adequately funded lead agency and a national plan or strategies with measurable targets are crucial components of a sustainable response to road safety. Effective interventions include incorporating road safety features into land-use, urban planning and transport planning; designing safer roads and requiring independent road safety audits for new construction projects; improving the safety features of vehicles; promoting public transport; effective speed management by police and through the use of traffic-calming measures; setting and enforcing internationally harmonized laws requiring the use of seat-belts, helmets and child restraints; setting and enforcing blood alcohol concentration limits for drivers; and improving post-crash care for victims of road crashes. Public awareness campaigns also play an important role in supporting the enforcement of legislative measures, by increasing awareness

of risks and of the penalties associated with breaking the law.

United Nations legal instruments developed under the auspices of the regional commissions have assisted many countries in developing and enforcing traffic rules and measures; producing safer road vehicles; reducing the risk of collisions with dangerous goods and hazardous materials; ensuring that only safe and well-maintained vehicles and competent drivers are allowed to participate in traffic. Transport infrastructure agreements developed under the United Nations regional commissions' auspices have given the world coherent and safer road transport networks.

There is growing awareness that the current road safety situation constitutes a crisis with devastating social and economic impacts that threaten the recent health and development gains that have been achieved. Road safety is not a new issue but over the last decade activity at the international level has gained new momentum. A number of documents have been developed that describe the magnitude of the road traffic injury situation, its social, health and economic impacts, specific risk factors, and effective interventions. These have served to provide momentum for the adoption of a number of resolutions that call on Member States and the international community to include road safety as a global policy issue, making specific recommendations for action. The resolutions have called for international collaboration to be strengthened.

The United Nations Road Safety Collaboration (UNRSC) was established as a follow up to General Assembly resolution 58/289 of April 2004, recognizing the need for the United Nations system to support efforts to address the global road safety crisis. Resolution 58/289 invited WHO, working in close cooperation with the United Nations regional commissions, to coordinate road safety issues within the United Nations System. The Collaboration is chaired by the World Health Organization, with the United Nations regional commissions as rotating vice chairs. It has brought together international organizations, governments, nongovernmental organizations, foundations and private sector entities to coordinate effective responses to road safety issues since 2004. It is an informal consultative mechanism whose members are committed to road safety efforts and which provides governments and civil society with good practice guidelines to address the major road safety risk factors.

Even so, current initiatives and levels of investment are inadequate to halt or reverse the predicted rise in road traffic deaths. The United Nations Secretary-General's 2009 report on the global road safety crisis notes that despite evidence of growing awareness of and commitment to road safety issues, political will and funding levels are far from commensurate with the scale of the problem. The United Nations Secretary-General concludes that the crisis requires ambitious vision, increased investment, and better collaboration, and he highlights the First Global Ministerial Conference on Road Safety as a major opportunity for crystallizing action plans and catalyzing the next action steps.

The Commission for Global Road Safety issued a call for a Decade of Action for Road Safety in its 2009 report. Endorsements for the proposal have come from a wide range of public figures as well as the United Nations Road Safety Collaboration. The United Nations Secretary-General, in his 2009 report to the General Assembly, encouraged Member States to support efforts to establish a Decade. A Decade would provide an opportunity for long-term and coordinated activities in support of regional, national and local road safety.

Key partners in global road safety agree that the time is right for accelerated investment in road safety in low-income and middle-income countries, together with the development of sustainable road safety strategies and programs, which rethink the relationship between roads and people, encourage the use of public transport, and also change approaches to measurement of national progress in transport policy. Major risk factors are understood, as are effective counter measures to



address them. Collaborative structures are in place to bring together key international players, funders, civil society, and there is a funding mechanism to support accelerated investment and activity. Sufficient resources and political will are the key elements still lacking.

A Decade would provide a timeframe for action to encourage political and resource commitments both globally and nationally. Donors could use the Decade as a stimulus to integrating road safety into their assistance programs. Low-income and middle-income countries can use it to accelerate the adoption of effective and cost-effective road safety programs while high-income countries can use it to make progress in improving their road safety performance as well as to share their experiences and knowledge with others.

In March 2010 the United Nations General Assembly resolution 64/255 proclaimed a Decade of Action for Road Safety 2011-2020 with a goal of stabilizing and then reducing the forecasted level of road traffic fatalities around the world by increasing activities conducted at national, regional and global levels. The resolution calls upon Member States to implement road safety activities, particularly in the areas of road safety management, road infrastructure, vehicle safety, road user behavior, road safety education and the post-crash response. While supporting the regular monitoring of progress towards the achievement of global targets relating to the Decade, it notes that national targets relating to each area of activity should be set by individual Member States. The resolution requests that the World Health Organization and the United Nations regional commissions, in cooperation with other partners in the United Nations Road Safety Collaboration and other stakeholders, prepare a Global Plan for the Decade as a guiding document to support the implementation of its objectives.

In 2010 the United Nations regional commissions finalized a global project entitled "Improving global road safety: setting regional and national road traffic casualty reduction targets" with the publication of the final report, which recognized the value of targets in improving road safety and assisted governments in low and middle income countries in developing such targets.

The guiding principles underlying the Plan for the Decade of Action are those included in the "safe system" approach. This approach aims to develop a road transport system that is better able to accommodate human error and take into consideration the vulnerability of the human body. It starts from the acceptance of human error and thus the realization that traffic crashes cannot be completely avoided. The goal of a safe system is to ensure that accidents do not result in serious human injury.

The approach considers that human limitations – what the human body can stand in terms of kinetic energy – is an important basis upon which to design the road transport system, and that other aspect of the road system, such as the development of the road environment and the vehicle, must be harmonized on the basis of these limitations. Road users, vehicles and the road network/environment are addressed in an integrated manner, through a wide range of interventions, with greater attention to speed management and vehicle and road design than in traditional approaches to road safety.

This approach means shifting a major share of the responsibility from road users to those who design the road transport system. System designers include primarily road managers, the automotive industry, police, politicians and legislative bodies. However, there are many other players who also have responsibility for road safety, such as health services, the judicial system, schools, and nongovernment organizations. The individual road users have the responsibility to abide by laws and regulations.

The plan for the Decade also recognizes the importance of ownerships at national and local levels, and of involving multiple sectors and agencies. Activities towards achieving the goal of the Decade should be implemented at the most appropriate level and the involvement of a variety of sectors (transport, health, police, justice, urban planning etc) should be encouraged. Nongovernmental organizations, civil society, and the private sector should be included in the development and implementation of national and international activities towards meeting the Decade's

goals. In this respect, having road safety related legislation in place is essential. Such legislation should be harmonized among countries as much as possible.

Goal and specific objectives

The overall goal of the Decade will be stabilize and then reduce the forecast level of road traffic fatalities around the world by 2020. This will be attained through:

- Adhering to and fully implementing the major United Nations road safety related agreements and conventions, and use others as principles for promoting regional ones, as appropriate;
- Developing and implementing sustainable road safety strategies and programmes;
- Setting an ambitious yet feasible target for reduction of road fatalities by 2020 by building on the existing frameworks of regional casualty targets;
- Strengthening the management infrastructure and capacity for technical implementation of road safety activities at the national, regional and global levels;
- Improving the quality of data collection at the national, regional and global levels;
- Monitoring progress and performance on a number of predefined indicators at the national, regional and global levels;
- Encouraging increased funding to road safety and better use of existing resources, including through ensuring a road safety component within road infrastructure projects;
- Building capacities at national, regional and international levels to address road safety.

Initial estimates suggest that up to US\$ 500 billion each year is spent on road infrastructure by the world's road authorities. Dedicating even a small proportion of these funds towards meeting the objectives of the Decade should be a priority for countries.

Nonetheless, to successfully implement the action plan, a significant commitment in additional resources may be required, particularly by countries themselves but also from public and private sector stakeholders. In its 2006 Make Roads Safe report, the Commission for Global Road Safety advocated a US\$ 300 million ten year fund for a global action plan to catalyse a stronger focus on improving the safety outcomes of planned large-scale investments in road infrastructure over the coming Decade and beyond. Although presently falling short of this figure, funds for some aspects of the plan are being made available by the Global Road Safety Facility of the World Bank, as well as from Regional Development Banks, and private sector donors. Initial estimates set the required funding for national activities to around US\$ 200 million per year, amounting to US\$ 2 billion for the whole Decade.

The combined effort of the international community towards funding road safety is roughly estimated to be between US\$ 10-25 million per year. Additional efforts from the traditional donor community are clearly not sufficient to reach the amounts commensurate with the scope of the problem. This funding gap must be bridged through expanded outreach to a broad range of stakeholders. As an example, a few fund that allows the private sector the opportunity to support the implementation of this Plan, primarily in low-income and middle-income countries, has already been established.

Ensuring funding in support of road safety activities, initiatives as projects to be implemented at regional and/or sub-regional levels, is essential for the implementation of this Plan. Global Road Safety Facility of the World Bank, Regional Development Banks, governments and private sector donors should enhance efforts to ensure that this need is timely and adequately met.

A number of global milestones will mark progress through the Decade. The Decade – and implementation of this Plan – will be evaluated at regular intervals by the World Health Organization and the United Nations regional commissions, within the framework of the United Nations Road Safety Collaboration. Baseline data will be obtained through country survey conducted for the 2nd Global road safety status report on road safety due for publication in 2012 and other regional and sub-regional statistics. A third report will be published in 2014 and – should funding be secured – additional status reports will be developed. During the evaluation process, both outcome and process indicators will be developed.



News



Prof. Nagui M. Rouphail visited IIT Delhi from 7th to 10th March, 2011. Dr. Nagui M. Rouphail is Director of the Institute for Transportation Research and Education (ITRE) at North Carolina State University, a post he has held since January 2002. Dr. Rouphail also holds the rank of Professor in the Department of Civil, Construction, and Environmental Engineering (CCEE) at NC State University. Dr. Rouphail is an internationally recognized scholar in the area of highway capacity and operations, traffic simulation and intelligent transport systems, and the interface of traffic flow and vehicle emissions. He gave a talk on "Vehicle Activity and Emissions:" His presentation described the ongoing research program at NC State University in the area of vehicle activity, emissions and fuel use, which focuses on measuring and modeling vehicle emissions under real-world field settings using portable emission measurement systems (PEMS). Several applications were highlighted including the use of direct PEMS measurements for testing the effect of improved signalization, the development of modal emission models at fine and coarse scales based on micro-scale trip data and the relation between macro trip descriptors such as average travel speed and emissions. The transportation sector in general and on-road vehicles in particular are major contributors to the US National Emissions Inventory and responsible for about 27% of all US greenhouse gas emissions.



Prof. Ian Roberts delivered the 4th Annual TRIPP LECTURES on the 11th of March, 2011 in IIT Delhi, entitled, "The Energy Glut: Transport and the Politics of Fatness and Thinness". Professor Ian Roberts, is Professor of Epidemiology & Public Health at the London School of Hygiene & Tropical Medicine. His main research interests are the prevention and treatment of traumatic injury and the links between energy use and health. He trained as a pediatrician in the UK and then in epidemiology at the University of Auckland, New Zealand and at McGill University, Canada. He established and is coordinating editor of the Cochrane Injuries Group, an international network of individuals that prepares and maintains systematic reviews of the effectiveness of interventions in the prevention, treatment and rehabilitation of injury. The Cochrane Injuries Group has published over 100 systematic reviews many of which have changed clinical practice around the world. The last issue of the TRIPP Bulletin (Vol. 7; No. 3; Winter 2010) carried extensive excerpts under the title, "Energy, Mobility and Safety" from his latest book on a related subject.

Future Events

The 2011 IRCOBI Conference will be held in Krakow, Poland, on 14-16 September 2011. For the latest information and guidelines for application, please visit IRCOBI homepage (www.ircobi.org).

The 9th EASTS conference will be held at Jeju, Korea on 19-23 June, 2011. For further detail please visit <http://www.easts2011.org>.

20th Annual Safe Communities Conference will be held in Falun Municipality, Sweden on 5-9 September 2011. For further detail please visit <http://falun.se/www/external/safe2011.nsf>

Canadian Injury Prevention and Safety Promotion Conference will be held in Vancouver, BC, Canada on 16-18 November 2011. Further detail please visit <http://www.safecommunities.ca>

Safety 2012 World Conference, the 11th biennial, International Conference on Injury Prevention and Safety Promotion, co-sponsored by the World Health Organization, 1-4 October 2012. Call for Abstracts & Scholarship application submissions open. The key theme of Safety 2012 is connecting pathways for a vibrant and safer future. <http://www.conference.co.nz/worldsafety2012>

5th Milestones in a Global Campaign for Violence Prevention meeting will take place in Cape Town, South Africa on 6-7 September 2011. The meeting is being generously hosted by the Western Cape Provincial Government's Department of Health with additional support from The California Wellness Foundation.

XXIVth World Road Congress, Mexico City from 26-30 September 2011. The Congress will showcase innovation, progress and new directions in all areas of road transport ranging from road safety, administration, infrastructure, sustainability and maintenance. If you work or have an interest, in any field of roads and roads transport the World Road Congress is a must for you to attend.

11th International Conference on Energy for a Clean Environment from 5-8th July 2011. Instituto Superior Tecnico, Mechanical Engineering Department, Avaneu Rovisco Pais, 1049-001 Lisbon, Portugal. Email: cleanair@ist.utl.pt

Establishment funds have been received from
Asian Institute of Transport Development
Ministry of Industry and Ministry of Urban Development, Government of India
Tata Motors
Volvo Research and Education Foundations

Endowments for perpetual Chairs
CONFER, India: TRIPP Chair for Transportation Planning
Volvo Research and Education Foundations: Volvo Chair for Transportation Planning for Control of Accident and Pollution

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Excerpts from two 2010 publications: A TRIPP BULLETIN INSERT

Traffic Safety and City Public Transport System: Case Study of Bangalore, India. P.S. Kharola, Geetam Tiwari and Dinesh Mohan.

In low and middle income countries, buses are likely to remain the primary mode of mass transit for the foreseeable future (Tiwari 1994). In most transportation scenarios, reliance on buses has a positive impact on air quality because they pollute less per person mile and create less congestion because of their smaller road use footprint. In addition to these benefits, it is usually assumed that buses are among the safest modes of transport available because they are much larger in size and mass than most other road vehicles. Biomechanics and crash investigation studies have confirmed that occupants of buses are at much lower risk of dying in the event of a crash (Bhalla et al. 2006) However, bus users face risks of road traffic injuries on access trips and buses also are associated with road traffic crashes with other road users (Bhalla et al. 2007, Mohan et al. 2009). The total motor vehicle population in India has increased from about 300,000 in 1951 to about 73,000,000 in 2004.

According to official statistics, 105,725 people were killed and 452,922 people were injured in road traffic crashes in India in 2006 (NCRB 2007). Traffic fatalities increased by about 5 percent per year from 1980 to 2000, and since then have increased by about 8 percent per year for the four years for which statistics are available. 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. The fatality rate has increased from 36 fatalities per million persons in 1980 to 95 fatalities per million persons in 2006 (Mohan et al. 2009). However, a study done in Bangalore shows that while the number of traffic crash deaths recorded by the police may be reasonably reliable, the total number of injuries is grossly underestimated (Gururaj 2006).

A major reason why comparisons of fatalities between cities are made difficult is that the geographical jurisdictions of a city are different for different agencies. For example, the city government has well-defined municipal boundaries, but the boundaries of city police are not coterminous with that of the city government. The census that gives the population figures defines a new set of boundaries for itself: the urban agglomeration, the bus transport company plies within limits that are decided by the state government, the urban planning body has a much bigger geographical jurisdiction, the transport department that registers the vehicles and licenses the drivers follows its own territorial jurisdiction which is totally distinct from that of other agencies. Therefore, comparison of data by different agencies is from a different base and hence, comparisons without applying correction factors may give misleading results.

The study clearly brings out that about 25 percent of the victims of fatal crashes involving buses are pedestrians. The analysis has adequately established that pedestrians are the most vulnerable groups on Indian roads, closely followed by cyclists and two-wheelers. The fact that almost all fatal crashes take place on straight stretches of roads and also that most occur when the bus and victim are travelling in the same direction is evidence that road design is forcing conflicts between these road users and is a major cause for concern. Of all traffic fatalities in EU countries, the proportion of pedestrian fatalities is about 17 percent, and the proportion of cyclist fatalities is about 6 percent. Separation of buses from non-motorized road users and provision of safe pedestrian and bicycling facilities on arterial urban roads would be expected to go a long way not only in reducing the number of fatal crashes but also improving access to the public transport system. Studies by Elvik and VAA (2004) revealed that tracks for walking and cycling reduce pedestrian injuries by 35 percent; cycle lanes reduce all types of crashes by 4 percent; and grade-separated crossing

facilities reduce crashes involving pedestrians by 82 percent. The addition of bicycle lanes in Davis, California, reduced crashes by 31 percent. In Denmark, bicycle lanes reduced the number of bicycle crashes by 35 percent. In the long run, improved road infrastructure with adequate illumination during the night can contribute to substantial reductions in fatal crashes. The effectiveness of such designs has been demonstrated on the BRT corridors in Bogota (Echeverry 2004) and Delhi (DIMTS 2009), where road traffic fatalities have been reduced by more than 90 percent.

The results of this study show that 92 per cent of the bus passengers involved in fatal crashes sustained fatal injuries due to a fall while entering or leaving the bus. Similar results have been reported from a study of DTC operations in Delhi (Mohan 1985). The large number of passenger deaths while boarding and alighting indicates the need for having automatic closing doors and much lower floors in buses. The Motor Vehicles Act 1989 and the Motor Vehicle Rules regulate the manufacture and operation of all transport vehicles. State Governments also are empowered to make rules that all vehicles manufacturers must follow. These rules make various stipulations that are from the point of view of safety of road users as well as others. These rules make various stipulations that are from the point of view of safety of road users as well as others.

At present, the traffic situation demands that mechanically-operated doors be mandated in city buses. In all high income countries and others such as China, no city buses can operate unless they are equipped with mechanically-operated doors. Therefore, the time has now come to mandate by law (through the Motor Vehicle Rules) that no city bus shall be permitted to operate unless it has mechanically-operated doors. Thus, with this one intervention, fatalities in bus crashes can be brought down by 20 percent and, it would be expected, injuries by a greater number.

There are a large number of cases where the victim is run over by the bus. Such crashes could be prevented through better design of buses. At present, most of the buses in Indian cities are fabricated on a chassis that is more suited for trucks. As a result, the bus floor is about 1.0m above the ground. Such large ground clearances are helpful in negotiating uneven road conditions. Consequently, the side panel of the bus body also is kept at a clearance of about 70-80 cm from the ground. This leaves a very large opening under the bus, and an inadvertent victim in a crash has a high probability of getting into this opening and getting run over by the wheel. Therefore, there is a strong case for making it compulsory for all buses in cities to have their bodies fabricated in a manner such that the side panels of the bus body are low enough to prevent a person from accidentally or during a crash getting under the bus.

The analysis has brought out that, similar to traffic counts, crashes follow a bimodal pattern in a day. The maximum crashes take place between 0800-0900 hrs and again between 1900-2000 hrs. Traffic peaks and crash peaks in a day do not coincide. This has an important policy implication. At present, all enforcement measures are synchronized with traffic peaks. For example, a maximum number of traffic police are deployed during the traffic peak. As a first step, the traffic regulatory authorities should be sensitized towards the reality that hours during which maximum fatal crashes take place deserve equal, if not more attention than the peak traffic hours.

A long-term solution to high rates of crashes would require several measures, such as proper planning and provisioning of roads, efficient regulation of traffic, better support infrastructure for pedestrians and other complementary modes of transport, managing the demand for public transport, changing laws governing transport safety, etc. For that purpose, it would be necessary that the right structural arrangements are in place.





Continued from overleaf:

Childhood injuries in rural north India

Dinesh Mohan, Adarsh Kumar and Mathew Varghese

A large proportion of the work force in the world is involved in agriculture or related occupations (FAO Statistical Yearbook, 2006). In India, 230 million workers are associated with farm work thereby constituting one-fifth of the world's agricultural work force (Census of India, 2001). In a large number of countries, farming is a part of the unorganized sector and not well covered by insurance or health services. Most of the reports published on rural injuries originate from high-income countries (HICs) (Baker, O'Neill & Karpf, 1984; Cogbill, Busch, Stiers, 1985; Cogbill, Steenlage, Landercasper, & Strutt, 1991; Heeg, Duis ten, & Klasen 1986; Jansson, 1989; Lehtola, Marley, & Melvin, 1994). Very few epidemiological studies of injuries among children are available from low-income countries (LICs) because of inadequate surveillance mechanisms (Field & Gong, 1982; Mohan & Patel, 1992; Mufti, Ahmad, & Majid, 1989).

Injuries among children in rural areas include those due to farm work because unlike other professions, work and play overlap with home and the workplace. It has been reported that children and teenagers sustain 30-40% of agricultural injuries (Muckala, 1967). In the USA, nearly 300 children and adolescents suffer fatal farm injuries each year and another 23,000-27,000 suffer non-fatal farm injuries (Davis, Howell, & Parrish, 1988; Rivara, 1985; Waik, 1993). Factors associated with injuries were tractors, augers, animals, farm machines and falls (Cogbill & Busch, 1985; Salmi et al., 1989; Swanson, Sachs, & Dahlgren, 1987). Tractor-related injury mortality was fewer than 3% for adults and more than 19% for children in Denmark during 1980-1984 (Lund, 1989). A study from India shows that children below 14 years of age were involved in 16% of all agricultural injuries (Mohan & Patel, 19992). The objective of this article is to document the epidemiology of injuries among children in rural households.

The data in this report are taken from a comprehensive health and injury survey done in nine contiguous villages of the Sonapat district of the state of Haryana in India from 1 July 1987 to 30 June 1988. The total population of the nine villages was 22,883 persons comprising 3363 households. Every household was surveyed to establish the basic socio-economic structure of each household. This included the details of family members, occupation and details of permanent disabilities. For the injury survey, 14 field workers were employed to collect injury data. Each One of the 14 field workers visited 16-20 households every day. On each visit, the field workers asked responsible family members if there was any case of ill health/injury since the last visit 2 weeks earlier. If the answer was positive, then the victim and family were interviewed to obtain epidemiological details as per the prescribed form. On the following visit 2 weeks later, the field worker enquired about the previous case and outcome and whether there were any new cases. This procedure was repeated for a period of 1 year. For all injury cases, if any equipment of technology was involved, the details were recorded regarding the same. Independent research assistants visited 10% of the households, selected randomly, every month to cross check details collected by the investigators. Every Monday during the year the principal investigators of the project would meet the field workers and receive the completed forms. The field workers were interviewed regarding every injury case and informed if there were any differences in their record and that reported by the random checks done by the reliability of the documented injuries. A person was considered injured if the injury prevented the victim from continuing a normal daily routine as perceived by the family.

Only 13% of the play injuries were sustained at playgrounds and schools, whereas, 43% at home and 35% while playing on roads and streets. Of all the injuries sustained while at work there were 119 (19% of the total) work injuries of which 65 and 40 were due to agriculture and domestic activities,

respectively. Of the agricultural work injuries, 58% occurred on the farm and 34% while working at home.

The maximum number of injuries was due to falls (35%) during play and 25% were due to impacts with objects, which occurred during play, transportation and work. Machine entanglement (9%) was due to agricultural equipment while playing and working and 9% injuries were due to burns. Eighty per cent of the injuries were minor (AIS1), 18% moderate or serious (AIS 2-3); none severe (AIS 4) and one child had a critical injury (AIS 5). Moderate and severe injuries had a rate of 1251 per 100,000 persons. Among 0-9 year old children, 71% of the moderate and severe injuries were sustained while playing and 14% during transportation. The distribution among older children for moderate and severe injuries was different with 37% during play, 27% in agricultural work and 17% during transportation. There was a death of a child crushed on a narrow lane by a tractor. In older children (10-14 years), most injuries were because of a fall from a bicycle while riding. There were incidences of falls from tonga, (horse drawn carriage) trolley and scooters among children.

Children below 15 years of age were involved in 29 cases of fodder-cutter injuries. In the 0-4 year age group, six injuries were from fodder cutters and four were with hand tools. In this age group, 12 out of total 14 injuries occurred while children were playing with the equipment and two were from falls. Among children in the age group of 5-9 years, 11 injuries were from fodder cutters followed by bullock cart (seven) and hand tools (four). In the age group of 10-14 years 12 injuries were associated with fodder cutters and 35 with hand tools. There were three amputation cases: fodder cutters (two) and tractor hydraulic lift (one) in 5-9 year age group. One fodder cutter amputation case was in the 10-14 year group. Falls from bullock carts were also common (six) cause of injuries among children up to the age group of 9 years. Forty-three injuries were sustained with hand tools, 35 by 10- to 14 year-old children. In younger children up to 9 years the hand tool injuries occurred while playing or they occurred inadvertently.

In the present study, 55% (365) of the injuries were caused while playing. Up to the age of 9 years, of the total injuries, a few injuries were caused while performing agriculture (2%) or domestic work (2%). The age group of 10-14 years, a few injuries were caused while doing domestic or agricultural work. There were 98 injuries out of 611 injuries caused by agricultural equipment. Working or playing with hand tools resulted in most injuries followed by fodder-cutter injuries. In the present survey, there was no injury while driving a tractor. Almost one-third of the injuries were because of falls. The results of fall injuries were similar to other studies with 30-40% injuries among children (Cameron, Bishop & Sibert, 1992; Little et al., 2003; Sosnowska & Kostka, 2007; Vane et al., 1993).

Transport injuries in the present study included falls from bicycles, entanglement of foot in bicycle wheel, entanglement of foot in bicycle wheel, fall from trailers, bullock carts, scooters or entrapment between wall and bullock cart in narrow village lanes. However, in HIC studies all terrain vehicles, farm bikes, tractor driving were reported as cause of injuries among children.

In the present study, burns due to scalds from hot liquids or coming in contact with wood or cow dung stove burners were reported. These are ordinarily placed at the ground level. Because of the low mechanization in these areas, hand tool injuries are very frequent. A very large number, i.e. about 520 million hand tools, are used on Indian farms (Nag & Nagm 2004). Often, these hand tools are not stored securely and because of accessibility, children tend to play with them and get injured. Children also get injured while working with these tools possibly from a combination of design and capability mismatch.

