Vol 22 No 2, 2011

Special issue
Road safety in Asia

Journal of the Australasian College of Road Safety

Formerly RoadWise — Australia's First Road Safety Journal

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ENTRIES OPEN 1st April 2011

3M–ACRS Diamond Road Safety Award 2011

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DIAMOND AWARD

- An individual Team Leader from the winning project will **RECEIVE a trip** to the **USA** to attend the **42nd ATSSA Annual Convention & Traffic Expo in 2012** in **Florida** and to **3M Global Headquarters** in **Minnesota.** This individual will also present on their winning entry and international trip at the following ACRS Road Safety Conference 2012
- The winning entry will be announced at the **ACRS Road Safety Conference Dinner** on **1st September 2011** where **all eligible members** of the winning project will be presented with the 3M-ACRS Diamond Road Safety Award

AUSTRALASIAN COLLEGE OF ROAD SAFETY

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www.acrs.org.au/award

Entries open 1 April 2011 and close 5pm (EST), 1 August 2011.

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Conference Registration Now Open

Full details at http://www.acrs.org.au/activitiesandevents/2011conference/program.html

1 – 2 September, 2011
Melbourne Convention and Exhibition Centre,
Victoria, Australia

As part of the conference program, we are looking to attract short, sharp presentations (one slide only) to showcase productive road safety ideas and innovative projects. To apply to be included in this session please use form available from the conference web site.

Proudly supported by:

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Cover photo

Road traffic in Bangkok, as in many cities in Asia, provides challenges for authorities concerned about improving road safety. Photo by Roman Knertser. Licensed for use by Dreamstime.

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Subscriptions

All issues of this journal are mailed to personal members or corporate delegates of the Australasian College of Road Safety. Organisations and persons who are not members of the College may subscribe to the journal for 2011 on payment of A$80 per annum (Australia) or A$100 per annum (overseas). These prices include airmail postage.

Advertising and sponsorship

Advertising rates, specifications and deadlines are on the College website at www.acrs.org.au/publications/journaladvertisingkit.html or available by email from exa@acrs.com.au. Discounts are available for prepaid advertising booked to run for more than one issue.

The College also welcomes sponsorship of the journal. Our current sponsors are Brifen Australia, the NRMA-ACT Road Safety Trust and the Roads and Traffic Authority of New South Wales. For more information about becoming a journal sponsor, please contact the executive officer at eo@acrs.org.au.

Editorial policy

The aim of the *Journal of the Australasian College of Road Safety* is to provide a medium for expression of views and debate on all facets of the study of road safety. Articles are accepted from a variety of disciplines, such as health and medicine, road and automotive engineering, education, law, behavioural sciences, communication, history, management, and urban and traffic planning. Interdisciplinary approaches are particularly welcome.

The College encourages interested persons and organisations to submit articles, photographs or letters for publication. Published letters would normally show the name of the writer and the state or territory of residence. The journal provides the opportunity for researchers to have their work submitted for peer review, in order to improve the quality of their research papers. However, peer review cannot guarantee the validity of research nor assure scientific quality. The publisher reserves the right to reject submissions or, with approval of the author, to edit articles. No payment is offered for articles published.

Material in this journal may be cited with acknowledgement of the full reference, including the author, article title and the year and volume of the journal. For permission to reprint articles, please contact the Managing Editor.

Guidelines for authors

Instructions for authors can be downloaded from the College website at http://www.acrs.org.au/srcfiles/Instructions-for-authors-revised.pdf. The College has adopted guidelines developed by the Committee on Publication Ethics, which are available at http://publicationethics.org/guidelines. These guidelines include the *Code of conduct; Best practice guidelines for journal editors; Guidelines for retracting articles; Guidelines for the board of directors of learned society journals; Guidance for editors: Research, audit and service evaluations;* and *How to handle authorship disputes: A guide for new researchers.*

Articles may be up to 5000 words in length and should be submitted in Microsoft Word format as email attachments to the Managing Editor at journaleditor@acrs.org.au. The email message should state whether or not peer review is requested. Authors whose primary language is not English should have their papers copyedited before submission. Articles should not be submitted if they have been published previously or are under consideration by other publishers.

By submitting a paper, authors give their permission to the College to make minor editorial changes to conform to the College in-house style manual; to print the paper in the *Journal of the Australasian College of Road Safety;* to send it for indexing to SafetyLit, Informit and other relevant databases; to make the full text of the paper available online through the ACRS website and Informit; and to promote the paper through media releases or by giving permission to reprint it in full or part in other hard copy or online resources that promote road safety. All photographs and diagrams for which the author or the author's employing organisation does not hold copyright must be accompanied by permission from the copyright holder to be used as indicated above.

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Messages may be left on voicemail when the office is unattended.

From the President

Dear ACRS Members,

Recently we joined with ARRB to host a roundtable meeting on the UN Decade of Action for Road Safety at Parliament House in Canberra. The Parliamentary Secretary for Infrastructure and Transport the Hon Catherine King MP, who has responsibility for road safety in the Federal Government, opened the proceedings. The meeting concluded with unanimous support for the following resolution:

The Canberra Road Safety Roundtable supports the UN Decade of Action for Road Safety 2011-2020. The participants of the Roundtable and the organisations they represent express concern at the high level of death and injury on the world's roads and acknowledge that road death and injury is preventable. The participants and their organisations will seek ways in which they can contribute to the Decade of Action and ensure that Australia plays a lead role in the Asia-Pacific region and globally in preventing millions of deaths and serious injuries.

There were five specific actions proposed, which you can see on the article on page 10 of the journal or on the ACRS website (www.acrs.org.au). The last action – for professional groups to establish outreach programs – is one where the College can help directly. I have met recently with AusAID representatives, the Hon Catherine King, the Shadow Parliamentary Secretary for International Development Assistance the Hon Teresa Gambaro, and Deputy Leader of the Greens Senator Christine Milne to encourage their support for the launch of the Decade, as well as for long-term, cost-effective programs, particularly an outreach program over the decade. Any support you can provide through your local state or federal member would be valuable, as well as any contribution you can make through your local Chapter.

We have noticed recently a concerted effort by special interest groups to challenge and disregard the evidence of road safety research to protect what they see as their particular rights without regard for the rights of the broader community. Simplistic 'push polls' are easy to conduct in order to declare alleged public support for an issue. We recently saw the Federal Government withdraw a simple regulatory impact statement review on vehicle pedestrian protection standards on the basis of claims that owners of cars with bull bars might be at risk. We need to explain to the wider community more often and more comprehensively that a Safe System approach to improving road safety results requires us to continually introduce new technologies and features to cars and roads that will reduce, not add to, road deaths and injuries.

We are pleased that this issue of the journal enables us to look beyond Australia and New Zealand, to consider how we can encourage road safety more widely across Asia. The College is looking to work with the Global Road Safety Partnership to extend the College into the Asia region.

Unfortunately, Nancy Lane will be returning full-time to Melbourne and will be unable to continue as our *ACRS Journal* Managing Editor. We have reluctantly accepted her resignation. She has made a valuable contribution to the journal, and we wish her well.

Lauchlan McIntosh AM FACRS
President

RRSP profile – Lauchlan McIntosh AM FACRS

Following the introduction of this feature in the May 2009 journal, we are continuing to profile in each issue an ACRS member who is on the ACRS Register of Road Safety Professionals. To be on the Register, applicants must satisfy stringent criteria. They must have relevant academic qualifications, have worked for at least five years at a senior level in their particular field of road safety, and be acknowledged as an expert by their peers. For details, visit www.acrs.org.au/professionalregister.

Lauchlan trained as a scientist – a geologist – in the mining industry. He studied business and management, and received a Harkness Fellowship to study management science at MIT in Boston. After 20 years directly involved in managing and working in mines in remote sites around Australia, he led the Australian Mining Industry Council for eight years. He then became the full-time Executive Director of one of Australia's largest consumer organisations, the Australian Automobile Association, where he worked for 14 years until the end of 2006.

ACRS Executive Officer Linda Cooke congratulating the ACRS President Lachlan McIntosh and presenting him with his RRSP certificates.

He was honoured as a Member of the Order of Australia for his work in the mining industry and in road safety, and received a Fellowship of the College in 2006. He has maintained accreditation in Management and as a Director, and more recently he has received recognition in a new area relating to agricultural stewardship, as well as a road safety professional in three categories: Engineering, Administration/Policy, and Occupational Health and Safety.

We asked Lauchlan the following questions:

As the first ACRS member to have been awarded RRSP certification in three different categories, how do you define your role in road safety?

I see myself as a manager and a coordinator. I work in areas where I have a keen interest developed from my previous experiences and where I can make a positive contribution. As President of the College, I have enjoyed the opportunity to work with such a wide group of people keen to reduce deaths and injuries in road crashes and to promote the College, both here and potentially overseas.

I have been Chairman of ANCAP in its various guises since 1994, and I am pleased to see the recent improvements in new vehicle crashworthiness and collision-avoidance technologies. The promotion of our independent rating results by manufacturers and dealers to their customers demonstrates the success of the program. The rating programs of ANCAP for vehicles and AusRAP and iRAP (which I am actively supporting in developing countries) for roads are making a real contribution to the Safe System approach to road safety.

I am also chairman of a new company, AgStewardship Australia Ltd, which manages a successful, positive environmental recovery and recycling program for unwanted agricultural chemicals and containers. I am also assisting the Australian Institute of Management to develop a national research and policy program.

How long have you been a member of ACRS?

I became involved through the AAA in around 2002, when I recognised the opportunity to develop a national safer roads coalition with the College and others.

What do you value most about your membership?

I value the interaction with practitioners, professionals and academics who are really contributing to reducing road trauma. I also recognised the value of seeking registration as a professional, and would encourage all members to do so. It is a good personal learning activity, and as more of our members register, the more professional the College becomes.

What is your particular expertise in road safety?

My greatest capability is managing and coordinating the expertise of others, advocating for change based on good evidence, and advocating for the introduction of new technologies into the car and road environment.

What is a typical working day for you?

I live with my wife Lynda on a small rural property where we are breeding a few black Simmental cattle. So my day centres on a quick 'talk' with the cows (and the nearby trees!), and then a drive into Canberra to various offices or travel interstate to support the people who are working in the areas I have mentioned.

Diary

30 June, London, UK. Brake 9th Road Safety Forum International Congress, 'Youth, Gender and Road Risk'.
www.roadsafetyforum.org/events/annualconference.aspx

11-15 July, Queensland University of Technology, Kelvin Grove campus, Brisbane. 'Introduction to Road Safety' intensive short course.
www.carrsqu.qut.edu.au/education

10-12 August, Melbourne. Australian Institute of Traffic Planning and Management National Conference, 'Linking Communities'.
www.aitpm.org.au/conference_2011/AITPM%20Conference%202011.pdf

1-2 September, Melbourne. ACRS National Conference, 'A Safe System: Making It Happen'.
www.acrs.org.au/activitiesevents/2011conference .
See the announcement on page 2 of this journal.

5-7 September, Gothenburg, Sweden. 2nd International Conference, 'Driver Distraction and Inattention'.
www.chalmers.se/ddi2011

27-28 September, Manchester, UK. TISPOL European Traffic Police Network Conference, 'The Challenges Facing Road Safety'.
www.tispol.org/theconference2011

12-16 February 2012, Tampa, Florida. American Traffic Safety Services Association 42nd Annual Convention and Traffic Expo.
www.atssa.com/cs/roadway-traffic-safety-calendar.
For a chance to attend this conference, see the announcement of the 3M-ACRS Diamond Road Safety Award on page 1 of this journal.

College News

Chapter reports

Australian Capital Territory and Region

The ACT and Region Chapter held its AGM on 7 April 2011. The meeting elected the following office holders: Dr Stephen Jiggins, President; Mr Eric Chalmers, Secretary; and Mr Keith Wheatley, Treasurer.

Associate Professor Drew Richardson has agreed to become Patron of the Chapter. Associate Professor Richardson is based at the Canberra Hospital and is also Associate Professor of Road Trauma at the Australian National University. He is a recognised expert in the operation of emergency departments and has published widely on this topic.

Chapter activities have been somewhat constrained due to the retirement of some longstanding members and demands in relation to the consultation process associated with the development of both the national and ACT road safety strategies. It is pleasing to note that the Chapter has been actively involved in both processes.

The AGM endorsed the Chapter's seminar program as the major focus of future Chapter activity. The next major seminar will examine issues arising from Eric Chalmers' Churchill Fellowship study into road-related child injury prevention programs in New Zealand, the USA, the UK, Austria, Germany and Switzerland. His report is at www.churchilltrust.com.au. The aim of the seminar will be to examine ACT child injury data and relevant existing injury reduction programs and strategies, and to identify where any gaps might exist. It is tentatively scheduled for late July in Canberra and envisaged that similar seminars will be held in conjunction with other ACRS Chapters.

Steve Jiggins, ACT and Region Chapter President and Representative on the ACRS Executive Committee

New South Wales

The Sydney Chapter ran a successful half-day workshop on 10 December focussing on 'Pedestrian safety in our cities' as the Chapter's last event for 2010. The workshop was held at the George Institute and the expert speakers included Dr Soufiane Boufous, the George Institute; Dr Peter Cairney, ARRB; Haggai Bocman, RTA; Michael Paine, Vehicle Design & Research; Terry Lee-Williams, City of Sydney; and Peter Croft, ARRB/Austroads. Discussion was lively, particularly relating to access for disabled pedestrians and wheel chairs.

In relation to international road safety activities, a number of Chapter executive members attended the US Academy of Sciences Transportation Research Board January Annual Winter Meeting in Washington, DC. Members chaired and participated in international road safety meetings related to young drivers, motorcycle safety, rollover crashworthiness, roadside barriers, vehicle occupant protection, heavy vehicle safety and international road safety.

Members of the Chapter also met with the NSW Nationals leader the Hon. Andrew Stoner MP. He is now Deputy Premier, Minister for Trade and Investment, and Minister for Regional Infrastructure and Services; previously he served as the Shadow Minister for State Development and the Shadow Minister for Roads and Ports. Members advised Mr Stoner that the College has a wealth of expertise that could be readily tapped into. Members put forward a number of views, in particular emphasising the importance of increasing speed enforcement to help reduce road trauma.

The Chapter Executive is now preparing for their next major event, which will coincide with the launch of the Decade of Action for Road Safety on11 May. The Chapter's AGM will be held on 26 May, preceding the national AGM. Venue and time will be circulated to NSW members.

As a final note, the Chapter committee would like to thank Dr Tom Gibson for his valuable contribution, particularly in the area of vehicle crashworthiness and biomechanics. Tom stepped down in March. This vacancy made way for Ms Doris Lee from Parsons Brinkerhoff to join. Ms Lee is a transport engineer interested in pedestrian safety and road safety audit. Her recent work concerning the Crash Cam, in collaboration with the RTA, has provided useful insight into what occurs in real-world intersection crashes.

Professor Raphael Grzebieta, NSW Chapter Chairman and Representative on the ACRS Executive Committee

Queensland

The Queensland Chapter held its March quarterly seminar and Chapter meeting on 1 March 2011. The seminar, entitled 'Presentation of the Advanced Driving Simulator', was given by Associate Professor Andry Rakotonirainy, CARRS-Q.

Dr Kerry Armstrong, Queensland Chapter Chair and Representative on the ACRS Executive Committee

Victoria

The focus of the Victorian Chapter over the last quarter has been predominantly on preparations for the national conference on 1-2 September this year in Melbourne. The conference is now taking shape, thanks to the great work of our organising committee and the valuable support provided by Linda Cooke and Jacki Percival at the national office.

We have managed to secure a significant number of sponsors, both public and private, and have been overwhelmed by the number of abstracts received – well in excess of the number of slots available in the program! To help us in the very difficult task of selecting papers for presentation at the conference, I must thank College members from all Chapters who willingly reviewed the abstracts within a very short timeframe. The next step involves recruiting a number of professionals to conduct the peer review process to help finalise the conference streams and the program overall.

We are also in the process of organising a seminar on driver training, in which updated evidence of its safety impact or otherwise will be described and the best path to adopt for the future discussed.

David Healy, ACRS Co-Vice President and Victorian Chapter Representative on the ACRS Executive Committee

New Zealand

The Ministry of Transport and New Zealand Transport Agency have developed an online Road Safety Wizard that provides the public with a range of statistics about crashes on New Zealand roads. The tool, smartmoves.org.nz, delivers a crash data report very quickly and easily by selecting from a range of factors, such as location, weather and road conditions.

The major earthquake that struck Christchurch in February closed the city centre and damaged many roads. As traffic resumed, police have noticed an increase in illegal driver behaviours, such as use of alcohol and cell phones, failing to stop and speeding. Some driver testing, licensing and vehicle inspection agencies and services have been temporarily closed or suspended in the greater Christchurch area.

A new older-driver education toolkit, *Staying safe*, became available at the end of March to help improve road safety for people over 70 years of age. The course content and supporting material are designed to help organisations provide road safety refresher workshops for older drivers.

Longer and heavier trucks (High Productivity Motor Vehicles or HPMVs) are permitted on an increasing number of routes as the infrastructure and safety issues for these HPMV routes are resolved. The maximum dimensions of truck loads (weight and length) were increased in 2010, with restrictions on the routes they can use.

A draft *High risk rural roads guide* is out for consultation. This flagship project applies the Safe System approach to identifying and addressing high-risk rural roads, both on the State Highway and local roads. A post-consultation version is planned to go out late in May.

In March Torsten Bergh from Sweden and Bruce Corben from Australia assisted with a proposed Safe System demonstration project on State Highway 2 at Maramarua. The two visitors also led a series of regional seminars for police and local government on progress in implementing the Safe System approach overseas, particularly with respect to roads and roadsides.

New Zealand has introduced a driver development course for truck, bus and coach drivers, SAFED (Safe and Fuel Efficient Driving) NZ, which helps organisations reduce fuel and maintenance costs, reduce emissions and improve safety. Adapted from a successful scheme in the UK, SAFED NZ aims to improve the safe and fuel-efficient driving skills of truck and bus drivers through defensive driving and vehicle maintenance.

Paul Graham, New Zealand Chapter Chair and Chapter Representative on the ACRS Executive Committee

Note from the Managing Editor: We would like to welcome Dr Paul Graham as the new ACRS New Zealand Chapter Representative. Paul started in road safety with the Ministry of Transport in 1989, and is currently Principal Scientist with the New Zealand Transport Agency (NZTA). His research interests have included outcomes measurement, road user behaviour and road safety advertising. On his desk at the moment are NZTA's performance agreement with NZ Police, research projects looking at drugged driving and advertising effectiveness, and audience research into young drivers.

Resignation of the Managing Editor

The College advises that Dr Nancy Lane is resigning as Managing Editor of the journal, and the May issue will be her last. Nancy has been a cheerful, professional and enthusiastic team member who has worked with us to continue to increase the journal's profile. Nancy has other commitments, which has led to her decision, one we respect but naturally regret. The Executive Committee wishes to place on record its gratitude for her dedicated efforts. We wish her well for her life in Melbourne (and travels to Tuscany).

Note from the Managing Editor: I have very much enjoyed my 16 months as Managing Editor. It has been a pleasure to get to know such diverse and dedicated members of the road safety community – some of you personally at events such as the Road Safety Research, Policing and Education Conference in Canberra last September, and others only by an exchange of emails.

I'd like particularly to mention not only the authors who submitted papers for publication, but also the many reviewers who gave freely of their time to read and suggest ways for the authors to improve their papers. These reviewers must necessarily remain anonymous, and thus they get no credit for the many hours they have put in. Thanks so much to all of them for what is indeed a thankless task. May the journal continue to improve in quality.

Nancy Lane

Letter from the Assistant Treasurer and Minister for Financial Services and Superannuation

Throughout 2010 ACRS was in contact with Ministers and Treasury officials setting out the case for the Productivity Commission to investigate independently and demonstrate the impact on the economy of the unnecessary cost of many road crashes. The response received recently from the Assistant Treasurer is a measured one and will be of interest to ACRS members.

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Mr Lauchlan Mcintosh
President
Australian College of Road Safety Inc
PO Box 198
MAWSON ACT 2607

22 FEB 2011

Dear Mr Mcintosh

Thank you for your letter of 9 November 2010 concerning a possible Productivity Commission review of the costs of road trauma. The statistics you present are sobering indeed. I apologise for the delay in responding to you.

As you may be aware, the Commission is currently resourced to undertake six to eight commissioned studies or inquiries at any one time. They are currently operating above capacity, to accommodate the Government's busy agenda.

In 2011 the Commission will only have capacity to commence a few new reviews, as several reviews it commenced in 2010 carry through well into next year, some beyond. Already on their program are challenging and diverse policy priorities such as aged care, disability care and support, emission reduction policies and carbon prices in key economies, the education and training workforce, and a review of the impacts and benefits of COAG reforms.

Though the cost of road trauma is indeed an important issue, it is one of many in competition for a place on the Commission's forward program. The Government must prioritise these issues year-to-year. The Commission will not have capacity to consider this issue until late in 2011. By this time, the National Road Safety Strategy 2011-2020 (NRSS) will have been finalised.

As the draft NRSS was released for public consultation on 1 December 2010, the Australasian College of Road Safety (ACRS) may wish to take advantage of the opportunity to voice its concerns by making a submission during the consultation period. Submissions can be made via the NRSS website at www.infrastructure.gov.au. The consultation period closes on 11 February 2011.

I note that the Bureau of Infrastructure, Transport and Regional Economics (BITRE) published a comprehensive study of the costs to Australia of road crashes in 2006. Given the work prepared by BITRE, I wonder if it is duplicating this work to also get the Commission to undertake significant work in this area of research in the immediate future.

I also note that a feature of the new NRSS is a strong commitment to public accountability for its delivery, supported by the use of a range of key performance indicators to monitor progress. A full review of the strategy is planned to be undertaken by the end of 2014.

The recently formed National Road Safety Council (NRSC) was established by the Council of Australian Governments to facilitate the timely and effective implementation of key road safety measures set out in the NRSS. I understand that the NRSC will also be making a formal submission to the NRSS.

I have copied this letter to the Parliamentary Secretary for Infrastructure and Transport the Hon Catherine King MP who has federal responsibility for road safety matters.

I trust this information will be of assistance to you.

Yours sincerely

Bill Shorten

BILL SHORTEN

Roundtable communiqué on the Decade of Action for Road Safety

The Australasian College of Road Safety and ARRB Group, with the support of the FIA Foundation, sponsored a Roundtable on the Decade of Action for Road Safety. (See Figure 1.) Full details of the Roundtable are available at www.arrb.com.au and www.acrs.org.au. The communiqué resulting from the Roundtable follows:

On 3rd March 2011 more than 40 Australian and international senior road safety professionals from industry, government, academia, police and road user groups met at Parliament House in Canberra to discuss and plan an Australian program for the UN Decade of Action for Road Safety to be launched around the world on 11th May 2011.

The pre-launch Roundtable at Parliament House, designed to consider how Australia should respond to, and support the UN initiative, was officially opened by The Hon Catherine King MP, the Parliamentary Secretary for Infrastructure and Transport and Parliamentary Secretary for Health and Ageing.

The 11th May 2011 will mark the start of a global initiative that was instigated by a United Nations Resolution, and co-sponsored by more than 90 countries, including Australia. It recognised the tremendous global burden of the 1.2 million fatalities resulting from road crashes, as well as the 20 million to 50 million people sustaining non-fatal traffic-related injuries each year. The UN General Assembly proclaimed the period 2011-2020 as the Decade of Action for Road Safety, with the goal of stabilizing and eventually reducing the number of deaths and injuries.

Road crash trauma is a major burden on health systems, as well as inflicting a massive amount of pain and suffering on individuals, families and communities. Around 90% of these deaths and injuries occur in low and middle income countries, many of which are Australia's neighbours.

Australia has made great progress in reducing the road toll from 1970 when the toll peaked at 3798 killed and 33,000 severely injured. That placed us amongst the worst in the world with 30.4 deaths per 100,000 population. Last year, despite increased traffic since the 70's, 1368 were killed at a rate of 6.1 deaths per 100,000 population.

Speakers at the Roundtable centred on the five pillars of the Global Plan for the Decade of Action: road safety management, safer vehicles, safer drivers, safer roads; and post-crash care.

Australia has implemented successful strategies in all these pillars to reduce road trauma and now plays an important and well recognised role in addressing road safety in our region, and the world.

An international perspective to the road safety problem was provided by Datuk Suret Singh, (ASEAN Road Safety representative and Director General Road Safety Department, Ministry of Transport, Malaysia) Rob Klein (GHVI / FIA Foundation) and Tyrrell Duncan (Asian Development Bank).

Other speakers included Eric Howard, previously General Manager Road Safety at VicRoads (management); Rob McInerney, CEO iRAP (safer roads and mobility); Lauchlan McIntosh AM, Chairman ANCAP and President ACRS (safer vehicles); Professor Drew Richardson, ANU Medical School (post-crash care); and Ken Lay, Deputy Commissioner Victoria Police, and Ken Moroney, previously NSW Police Commissioner (road safety policing).

The key recommendations from discussion at the Roundtable were:

1. To accept the offer from the Asian Development Bank to embed a small group of Australian road safety professionals in their transport infrastructure programs and work towards a $20 million regional road safety program on top of existing Bank lending activities throughout the Decade of Action.

Figure 1. Participants in the Canberra Road Safety Roundtable held on 3 March 2011

2. To encourage AusAID to expand their existing financial support for road safety in aid programs, particularly through the UN Decade of Action Fund, and in specifying road safety outcomes in road infrastructure projects, motorcycle helmet usage, NCAP testing for cars produced for sale in developing countries, collection and analysis of crash data, supporting institutional and regulatory reform, establishment of road policing as distinct from traffic enforcement, capacity building for road safety practitioners and development of expertise in assessing and modifying road user behaviour.
3. To encourage the Australian Government to place road safety performance and programs on the agenda for Ministerial Councils for Health, Transport and Justice as well as regional and international Prime Ministerial and other high level meetings such as APEC, WHO and Policing.
4. To encourage the Australian Government to actively participate with industry, agencies (health, transport, disability, justice) and research institutions in skills development, professional accreditation, best practice development and through the extension of various existing regional road safety programs.
5. To encourage professionals through their specialist Colleges and other groups in road safety, medicine, engineering and behavioural science to establish outreach programs with financial support from Governments (Federal and State), their agencies, industry, road user groups through the various international bodies such as the Global Road Safety Facility, WHO, ASEAN, APEC and the development banks.

The meeting concluded with unanimous support for the following Resolution:

The Canberra Road Safety Roundtable supports the UN Decade of Action for Road Safety 2011-2020. The participants of the Roundtable and the organisations they represent express concern at the high level of death and injury on the world's roads and acknowledge that road death and injury is preventable. The participants and their organisations will seek ways in which they can contribute to the Decade of Action and ensure that Australia plays a lead role in the Asia-Pacific region and globally in preventing millions of deaths and serious injuries.

For further information on the Decade of Action, please contact Blair Turner (blair.turner@arrb.com.au, or phone 03 9881 1661) or the ACRS (lauchlan.mcintosh@acrs.org.au, phone 0418 424 886).

Special Issue: Road safety in Asia

ACRS members are invited to contribute articles to future issues of the journal related to the following themes:

- ***Volume 22 No. 3, 2011 – Heavy vehicle safety (a special feature with guest editor Lori Mooren, Senior Research Fellow, Injury Risk Management Research Centre, University of New South Wales, email lori.mooren@unsw.edu.au)***
- ***Volume 22 No. 4, 2011 – Communication, media, and road safety messages (a special feature with guest editor Dr Ioni Lewis, Postdoctoral Research Fellow, Centre for Accident Research and Road Safety - Queensland (CARRS-Q), Queensland University of Technology, email i.lewis@qut.edu.au)***

To submit articles on other road safety topics, contact the Managing Editor, email journaleditor@acrs.org.au.

Asia news

compiled by Road Safety Literature Editor Andrew Scarce,
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Status of road safety in Asia

By 2020 it is estimated that two-thirds of the world's road fatalities will occur in Asia. The current estimate is that half the world's road deaths, or about 700,000 annually, occur in Asia.

China and India accounted for more than half the reported road fatalities in the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) region in 2007. This means the already unacceptable high numbers of road accidents and fatalities will increase if sufficient progress is not made in improving road safety, according to ESCAP.

ESCAP released its *Status of road safety in Asia* report in Bangkok in September 2010 as part of the Regional Expert Group Meeting on Implementation of a Decade of Action for Road Safety, 2011-2020.

'The nature of road safety issues in ESCAP developing countries differs significantly from that in developed countries,' ESCAP said. 'In Asia, most of those killed or injured in road accidents are vulnerable road users, such as pedestrians and motorcyclists.

'In South Asian countries, typically more than 50 per cent of all road fatalities are pedestrians. In East Asia and South-East Asian countries, more than two-thirds of the victims are motorcyclists. In contrast, in North and Central Asia the mix in terms of casualties is similar to that of members of the Organisation for Economic Cooperation and Development.

'All the developing ESCAP countries have higher fatality rates than OECD countries,' ESCAP said. ESCAP detailed progress and achievement by member states against ESCAP road safety goals, targets and indicators, 2007-2015. They included:

- Many member states have introduced national road safety actions and targets over prescribed timeframes. They include Armenia, Bangladesh, Bhutan, Cambodia, India, Indonesia, Japan, Lao, Malaysia, Nepal, Pakistan, Republic of Korea, Singapore, Sri Lanka, Thailand and Vietnam.
- Many member states have plans to designate a lead road safety agency to coordinate and oversee implementation of national road safety activities.
- Road safety audits are carried out in Armenia, Bangladesh, Bhutan, China, Japan, Lao, Malaysia, Republic of Korea, Singapore and Thailand.
- Laws on the use of seatbelts and helmets are in place in Armenia, Bhutan, Cambodia, India, Indonesia, Japan, Kazakhstan, Malaysia, Nepal, Pakistan, Republic of Korea, Singapore, Sri Lanka and Thailand.
- Drink-driving laws are enforced in Armenia, Bhutan, Cambodia, India, Japan, Kazakhstan, Sri Lanka and Thailand.

For more information, see http://www.unescap.org/ttdw/common/Meetings/TIS/EGM-Roadsafety-2010/status_report.pdf.

Thailand plans campaigns to improve road safety

Thailand's Land Transport Department is making an effort to cut down on the number of road accidents. This year it is set to encourage private driving schools to provide high quality training, and to organise more frequent road safety seminars.

Director General Tienchote Chongpeepien said that in 2011, the department planned to hold more free seminars for people coming in to extend their driving licenses. The seminars will refresh drivers on proper road safety skills, as well as traffic rules and regulations.

The move is an effort to achieve the Transport Ministry's policy to reduce the number of accidents to nearly zero. Tienchote said that, as part of the campaign, the department would urge all officials and drivers from state agencies to attend the free seminar so that they could act as role models for responsible drivers.

Moreover, he noted that the department will encourage private driving schools to provide informative driving lessons in accordance with its standards. So far, 21 private driving schools have been standardised, 9 of which are considered by the department as meeting higher standards.

Tienchote said those who passed the exams from high-standard driving schools would immediately obtain a driving license without having to take a test with Land Transport Department officials. Hence, the department is supporting all private driving schools to improve their quality.

(*Source:* http://www.thaivisa.com/forum/topic/427556-campaigns-planned-to-improve-road-safety-in-thailand)

Road deaths in Cambodia

The number of deaths on Cambodia's roads is at a record high, having almost doubled in four years. According to Deutsche Welle (Germany's international broadcaster), more than 1700 people died on Cambodia's roads in 2009. This compares with a road toll of 900 in 2004.

More than 300,000 vehicles were registered in Cambodia in 2009, compared with 38,000 vehicles in 2004. 'Most are motorbikes, and they provide none of the protection of a car,' Deutsche Welle said.

In January 2009, a law was introduced requiring motorbike drivers to wear crash helmets. The law has had a major impact, with the number wearing helmets rising from 20 per cent then to over 80 per cent today. Those who flout the law can be fined by traffic police.

Deutsche Welle said that fatalities from head injuries had dropped from 86 to 76 per cent of road deaths. In 2011 the government will also compel motorbike passengers to wear helmets, and there are moves to increase fines.

(*Source:* Deutsche Welle, 18 November 2010, http://www.dw-world.de/dw/article/0,,6244925,00.html)

Innovation Award for Road Transport in Developing Countries

The International Road Federation has announced the winners of its first Inaroad Innovation Award for Road Transport in Developing Countries. This award recognises exemplary projects that are innovative and sustainable, and that have had positive impact on transport practices. The award showcases how improvements in road infrastructure and transport can also improve the quality of community life and lead to poverty reduction. The winners are as follows:

- First prize - Rajasthan Mega Highways Project, India, in category 'Finance and Economics'. K. Ramchand and Harish Mathur from IL&FS Transportation Networks Ltd. - Road Infrastructure Development Company of Rajasthan Ltd
- Second prize - District Roads Support Porgramme, Nepal, in category 'Rural Transport'. Josef Zimmermann, Dhanda Bahadur Tamang and Sushil Chandra Tiwari from the District Roads Support Programme and Aman Jonchhe from the Swiss Agency for Development and Cooperation
- Third prize - MIROS Road Accident Analysis and Database System, Malaysia, in the category 'Road Safety'. Hizal Hanis Hashim from the Malaysian Institute of Road Safety Research.

(*Source*: International Road Federation, media release 20 April 2011)

Transport opportunities for Australian companies in Asia

Austrade is encouraging Australian companies with transport sector expertise to look to Asia for opportunities in 2011, with various transport projects commencing this year in Indonesia, Vietnam, the Philippines, Thailand, China and India. The scale of these projects is such that their repercussions need to be taken into account by professionals concerned with road safety in the Asian region.

In Indonesia, construction on the US$255 million Ngurah Rai Denpasar Bali International Airport expansion will begin this year. Associated with this development is the Airport Expressway—a 14.5-kilometre road linking Ngurah Rai International Airport and the ports of Benoa and Nusa Dua with Denpasar. These projects are to be built in time for the APEC 2013 Forum, with an estimated value of US$222 million.

In Vietnam, a series of expressway projects have been approved and are due to get underway this year. In Ho Chi Minh City, funding for a US$1.4 billion metro rail line has been approved. It is an 11.3km link from Ben Thanh to Tham Luong near the Tan Son Nhat International Airport; and is one of nine metro projects slated for Vietnam.

In China, Beijing's second airport is likely to start this year with an investment of US$15 billion. In the Philippines, the Department of Public Works and Highways is developing policy and legal frameworks to deliver major projects, including the privatisation of highways, expressways and road safety.

In Thailand, the Suvarnabhumi Airport Development – Phase 2 will include the construction of a new domestic passenger terminal, entrance and exit roads and car park. In the next five years, construction of the third runway is expected. The estimated value of the entire project is US$2.3 billion.

In India, tenders for the Navi Mumbai Airport are expected to be put out to global industry by June this year. The airport is expected to absorb 10 million passengers in 2014, its first year of operation. The project also includes development of non-aeronautical activities in a 270- hectare area south of the airport. There are also opportunities in the areas of roads and expressways, with 70,000km of roads to be delivered. The Indian roads sector arguably represents the largest Public-Private Partnership infrastructure delivery on roads, highways and expressways globally.

For more information on these opportunities contact Austrade on 13 28 78 or email info@austrade.gov.au. *(Source:* http://www.austrade.gov.au/view.aspx?FolderID=3563&ArticleID=14558)

Contributed Articles

The Global Road Safety Partnership in Asia

by Ian Hughes, Asia Region Coordinator, Global Road Safety Partnership

The Global Road Safety Partnership is continuing its essential work in Asia and is actively supporting the United Nations' Decade of Action for Road Safety 2011-2020 both in the region and globally. The global plan for the Decade of Action describes five pillars of activity [1]; our focus will be on safer road users and road safety management, and on the essential partnership and international coordination that is required for the plan's success. In doing so we seek to expand and develop our work and we are keen to find new partners and support.

What is the Global Road Safety Partnership?

We are a non-profit organisation that is dedicated to the sustainable reduction of death and injury from road crashes in low- and middle-income countries, which suffer 90 per cent of the almost 1.3 million annual deaths globally from road crashes [2]. We are currently working in 25 low- and middle-income countries.

The Global Road Safety Partnership is hosted by the International Federation of the Red Cross and Red Crescent Societies (IFRC). It was formed in 1999 and its members are leading multi- and bi-lateral development agencies, governments, businesses and civil society organisations. One of the keys to our success is creating and supporting multi-sector partnerships that are actively engaged with frontline good practice road safety interventions. We also play a critical role in advocacy and coordination at the global level, and we are recognised as a source of expert road safety knowledge and good practice.

Our work in Asia

The Global Road Safety Partnership has been active in many countries in Asia over recent years. The focus for much of our work to date has been on capacity building for professionals working in road safety, delivery of best practice demonstration projects around specific risk issues, and support for road safety planning and management. Funding for the Global Road Safety Partnership's work in Asia currently comes from two key sources: the Global Road Safety Initiative and the Bloomberg Philanthropies RS10 project.

The Global Road Safety Initiative is the world's largest joint commitment of private sector resources toward road safety in low- and middle-income countries. It was created in 2004 by a group of leading global corporations and over five years delivered significant road safety demonstration projects in China and countries of the Association of Southeast Asian Nations (ASEAN), as well as Brazil. The Global Road Safety Initiative Phase 2 has provided a further five years of funding to build on the work undertaken in Phase 1 by continuing support for activities in ASEAN countries, China and Brazil. It also provides for an expansion of activities into India and Africa, which will capitalise on work already undertaken by the Global Road Safety Partnership.

The Bloomberg Philanthropies RS10 project is the world's largest donation to global road safety to date and targets 10 countries worldwide, including China, Cambodia, India and Vietnam in Asia. The Global Road Safety Partnership is a member of a consortium undertaking the project, and other members are the World Health Organization (WHO), Johns Hopkins University, World Resources Institute (EMBARQ), the World Bank Road Safety Facility and the Association for Safe International Road Travel (ASIRT). Our role is to provide capacity building to support key interventions on a range of risk issues, such as drink driving, helmet wearing, speed and seatbelts. In Asia we have already undertaken targeted workshops and other capacity-building exercises, and this work will continue as we move further into the Decade of Action for Road Safety.

Capacity building

Capacity-building activities undertaken by the Global Road Safety Partnership in Asia include police professional development, regional seminars, country-level workshops and study tours within the region.

Workshops conducted by the Global Road Safety Partnership frequently draw on internationally recognised experts in road safety, many of whom are from Australia. A range of topics and issues are addressed; these are designed to complement other projects and initiatives. They have ranged from recent workshops designed to skill police in road safety enforcement techniques to workshops on designing public education campaigns; they have been delivered in many countries across the region. For example, Figure 1 shows Indonesian Ministry of Transportation officers working with the Global Road Safety Partnership.

For several years the Global Road Safety Partnership has successfully held an annual Asian regional seminar. About 150 participants from countries across the region attended our most recent seminar held in Cambodia in November 2010. (See Figure 2.)

The focus was on preparing for the United Nations Decade of Action for Road Safety 2011-2020. It was funded through the

Global Road Safety Initiative and also supported by the International Road Assessment Program (iRAP), FIA Foundation, Asian Development Bank, and the Western Pacific Regional Office of the World Health Organization (WHO).

Study tours, especially to Australia, are occasionally used to demonstrate what can be achieved in road safety. Over the past 18 months we have assisted a group of health professionals from Thailand on a visit to Victoria focused on motorcycle safety; this provided motivation and insights that are resulting in national-level planning with key stakeholders to address issues such as helmet wearing. As part of our role in the RS10 project, we also organised a study tour for Cambodian senior transport and police officials to Queensland and Victoria to learn about drink-driving legislation and enforcement. The skills and knowledge gained from this exercise, together with the welcome donation of 30 breathalysers from the Queensland Police Service, has led to significant improvements in drink-driving enforcement in the Cambodian capital, Phnom Penh.

Best practice demonstration projects

The Global Road Safety Partnership has delivered several road safety best practice demonstration projects in different countries in the region over recent years, including Cambodia, China, Indonesia, Thailand and Vietnam. The following two examples highlight the scope of projects undertaken.

- In China a project was carried out in partnership with the Beijing municipal government, traffic police and local research organisations to improve safety for vulnerable road users at several major intersections. Crash data analysis and techniques to measure traffic conflicts between road users were used to design a program of low-cost engineering treatments that reduced traffic conflicts and improved the behaviour of road users.
- In Thailand with funds from the Japanese Social Development Fund (JSDF) we led a community-based project designed to reduce motorcycle crash-related head injuries by increasing helmet wearing among youth. The project was conducted in two of the poorest provinces in

Figure 1. Indonesian Ministry of Transportation officers carrying out helmet-wearing observation surveys in Palembang in Sumatra

Figure 2. About 150 participants from countries across the Asian region attended the Global Road Safety Partnership's annual regional seminar, held most recently in November 2010 in Cambodia

Figure 3. Key stakeholders in Thailand meet with the Global Road Safety Partnership to plan a national approach to increasing helmet wearing among youth

north-eastern Thailand, and 98 villages and 13 schools were engaged in designing community-based interventions that resulted in a significant increase in helmet wearing. Planning is underway in Thailand to develop the model for further use in all provinces in the country. (See Figure 3).

Support for road safety planning and management

The Global Road Safety Partnership has actively supported regional- and country-level road safety planning and management for many years. We supported the recent establishment of the ASEAN Multi-Sector Road Safety Special Working Group designed to provide a forum for information sharing and planning in the region. At the country level we have provided support for the development of national road safety strategies, including specific activities such as providing experts in road safety management to facilitate planning workshops.

The next steps in Asia for the Global Road Safety Partnership

The Global Road Safety Initiative Phase 2 and the Bloomberg Philanthropies RS10 project are currently central to our activities in Asia for 2011-14. We are, however, actively seeking new opportunities for working in partnership with other organisations and governments in the region, as we are keen to expand our work to ensure the success of the UN Decade of Action for Road Safety.

Issues such as drink driving, helmet wearing, speed, seatbelts, and pedestrian and children's safety will continue to be a key focus for our activities. We intend to work more closely with Red Cross and Red Crescent national societies and encourage them to take a more active role in road safety in the region. Capacity-building activities under the RS10 project in support of the interventions in China, Cambodia, India and Vietnam will continue. We will continue to work closely with our consortium partners to ensure the success of this significant initiative.

The Global Road Safety Initiative Phase 2 will provide funding for a range of activities in the region, with several specific focuses as described below.

City-based road safety management

The Global Road Safety Partnership has developed a city-based road safety management model with proven results through successful trialling in Brazil. The Proactive Partnership Strategy (PPS) involves the development of sustainable partnerships between government, business and civil society in the community to reduce death and injury from road crashes. The model involves working on effective local road crash data collection and analysis, and the development of management structures to plan, implement and monitor interventions. The PPS will be piloted in Asia, starting with selected cities in Cambodia, China and India.

Children's road safety

Children are at severe risk of death or injury on roads in Asia. Road traffic injuries are the second-ranked cause of death globally for 5- to 14-year-olds, and the leading cause for 15- to 29-year-olds [2]. The Global Road Safety Partnership is taking a strong focus on child road safety projects and, in particular, plans to develop the Safe Routes to School model as an approach in selected countries in Asia. This will include pilot projects in Vietnam and China, with the Chinese pilot building on baseline research work already undertaken. The Sesame Street Foundation has also recently joined the Global Road Safety Partnership, and they are already making positive contributions to our work in children and family road safety.

Continuing to support country- or regional-level road safety management

This important work needs to continue to ensure that effective road safety management exists in low- and middle-income countries in the region. This is essential to ensure that the Decade of Action for Road Safety will bring about sustainable reductions to road trauma in Asia.

Continuing to design and deliver capacity-building programs

We will capitalise on our expertise and capability in designing and implementing capacity-building programs, especially in areas such as enforcement and public education, where we have already established a reputation for expertise and quality in training development and delivery.

Developing and supporting sustainable partnerships

In several countries in the region, locally based Global Road Safety Partnerships have been established. These partnerships provide important support and encouragement to governments to tackle road safety issues and also to conduct their own funded projects and campaigns. Existing partnerships will continue to be supported and opportunities for new country-level partnerships will be developed.

Call to action

We and our partners will need serious help to achieve a significant and sustainable reduction to the high level of road trauma in Asia during the Decade of Action for Road Safety. Road safety agencies and professionals in Australia and New Zealand have the necessary expertise to assist the work in this region. The Global Road Safety Partnership extends an invitation to you to explore ways we may be able to work together to make a real difference to road safety in Asia.

For more information about the Global Road Safety Partnership visit www.GRSProadsafety.org. Ian Hughes can be contacted by email at ianh@dynamicoutcomes.com.au

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A toolkit for saving lives

by Greg Smith (iRAP), Blair Turner (ARRB Group) and Joanne Hill (EuroRAP)

Unless dramatic action is taken, it is projected that by 2030 road traffic injuries will become the fifth leading cause of death globally. Each day, around 3500 people are killed on the world's roads, with many of those being children. In Vietnam, for example, children aged 0-9 years are most likely to be killed as pedestrians, while those aged 10-14 are most likely to die while riding a bicycle. Adolescents aged 15-19 are most likely to be killed while riding a motorcycle [1].

Thankfully, global momentum for safety is building. This year marks the beginning of the United Nations Decade of Action for Road Safety, setting an ambitious target of halving the growth in deaths by 2020. To achieve that, though, there will need to be major ramping-up efforts. It won't be easy. One of the major stumbling blocks is simply finding the resources and expertise to make it happen – a particular concern for low- and middle-income countries where 9 out of 10 of the world's road deaths occur.

Tools for safer roads

The *Road safety toolkit* is available at http://toolkit.irap.org (see Figure 1). It is designed to help address the need – as

Figure 1. A screenshot from the Road safety toolkit

identified by the World Health Organization's 2004 *World report on traffic injury prevention* and the World Bank's 2009 study on implementing the world report – for resources and tools that target initiatives on a scale capable of reducing significantly and sustainably the global road death toll.

An initiative of the International Road Assessment Programme (iRAP), the toolkit has been supported by the Global Transport Knowledge Partnership, the World Bank Global Road Safety Facility and Australia's ARRB Group. It builds upon a concept first put into practice by the Australian road authorities (through Austroads). It is a comprehensive and easy-to-use resource that helps engineers, policy-makers and safety practitioners from around the world find the best and most affordable countermeasures to reduce casualties.

A major strength of the toolkit is that it is freely available to all via the internet and is a 'living document' that can be updated as the knowledge base improves. In creating the toolkit, the partners were conscious that the situation can be dramatically different from country to country, and that there is a need for more research and case studies from low- and middle-income countries.

Nevertheless, as the Transport Research Laboratory (TRL) [2] stated in 1991, many of the principles underpinning road safety engineering planning and design are to some extent universal. For example, from time to time we all make mistakes or poor judgements when using the road. Similarly, people around the world are more or less equally vulnerable to high-energy impacts. Road systems, wherever they are, can be made safe by keeping these principles in mind.

By sharing the best information, all countries can learn from successes and avoid mistakes of the past. For each treatment, an estimate of the reduction in casualty crashes is provided, based on research from around the world. For example, after reviewing studies from Sweden, Denmark, the UK, New Zealand and the USA, Elvik et al. [3] estimated that by increasing the radius of a curve from 400-600m to 600-1000m, the number of crashes declines by 23%. It is important to note that crash-reduction estimates are generally not cumulative, and are often comparable between treatments. This is because different treatments get used in different circumstances.

Drawing on the information contained in the toolkit, in no particular order, the following provides 10 ways that death and serious injury can be prevented around the world.

Create space for two-wheelers

Motorcyclists and cyclists are arguably the most vulnerable people using the roads, mixing with heavier, faster-moving traffic, travelling at relatively high speeds and lacking the physical protection of vehicle occupants. In many regions, such as South-East Asia, motorcycles are a popular form of transport as they are relatively cheap, so motorcyclists subsequently make up a large proportion of deaths. But even in areas where motorcycles are not so popular, casualties can form a big part of the crash problem. In Australia, the death rate per 10,000 vehicles is 4.5 times higher for motorcycles than it is for all vehicles.

In Malaysia – where around 60% of vehicles are motorcycles – world-leading efforts have been made to safely cater for motorcyclists. There, 'inclusive' and 'exclusive' lanes (see Figure 2) have been used to cut casualty crashes by 25% to 40% at medium cost.

Figure 2. An exclusive motorcycle lane in Malaysia (Photo courtesy of Raymond Teoh Joo Han, JKJR, Malaysia)

Malaysia built the world's first exclusive lane in the 1970s as part of a World Bank project. The lanes use a carriageway that is completely separate from that used by other vehicles. A review of the lanes found a 39% reduction in motorcycle crashes as a result of fewer conflicts between motorcycles and other vehicles, as well as a lower speed differential between vehicles.

Malaysia has also made wide use of non-exclusive motorcycle lanes. They are built along trunk roads where access to and from the lanes is not controlled. Road signs and central hatching are used to indicate that motorcycle lanes are installed, to help riders understand the intended usage.

For bicyclists, dedicated lanes can be made by allocating part of a road to bicycles or by building off-road paths. On-road bicycle lanes should be located on the outer edge of the road surface and are usually between 1.5m and 3m wide. If traffic speeds or volumes are high, wider lanes are needed, to allow more space between through traffic and bicycles. Off-road paths are safer than on-road lanes, and can be used as part of on-road lanes to bypass road sections where mixing vehicles and bicycles is unsafe.

Get helmets on heads

There are enormous safety benefits associated with helmet use. But the WHO reports that just four in 10 countries have a motorcycle helmet law that covers both rider and passengers, and mandates that helmets meet a national or international standard. [4]

The best strategies legislate compulsory helmet wearing for all riders (including pillion passengers) and promote improvements in the quality of helmets sold through the enforcement of standards. Similar to seatbelt wearing, helmet legislation needs to be supported by education and rigorous enforcement.

In Khon Kaen, Thailand, for instance, helmet-wearing rates were once low and the mortality rate in motorcycle crashes extremely high. When the government introduced helmet-wearing legislation combined with public education and police enforcement, within 12 months it led to a helmet-wearing rate of over 90%, a reduction of 40% in head injury and a reduction of 24% in mortality in motorcycle crashes.

In addition to helmets, protective clothing is also essential if serious injuries are to be minimised. Even in a relatively low-speed motorcycle crash, abrasion is common and can be severe. Hands and feet are particularly vulnerable, and both abrasion and fractures of the lower body and legs are very common, followed by injury to the upper body and arms.

Protective clothing protects against abrasion, reduces the risk of burns from contact with hot metal, and prevents or reduces the severity of some fractures. It also lowers the risk of infection from dirt entering wounds. However, protective clothing is typically not worn by motorcyclists in developing countries, which is more than likely influenced by cost and also perceptions of discomfort due to the local climate. Bright and/or reflective material also assists other road users to notice cyclists and motorcyclists.

As the cost of protective clothing is considerably higher than helmets, clothing campaigns naturally take a lower priority in low-income countries. However, in countries with greater helmet-wearing rates, public education campaigns on protective clothing would be valuable.

Buckle up

One of the most effective ways to prevent injury or death in a crash is to make sure everyone in the vehicles is using seatbelts. A seatbelt can reduce the likelihood of adults dying in a crash by up to 50%, yet the WHO reports that only about half (57%) of all countries require seatbelts to be used by passengers [4].

The 'Por amor' campaign in Costa Rica is a key example of how seatbelt-wearing rates can be vastly improved by combining legislation and penalties, standards and regulations for equipment, enforcement of legal requirements, and publicity campaigns and incentives. From autumn 2003 until summer 2004, the FIA Foundation supported a nationwide campaign to promote seatbelt wearing in conjunction with the Costa Rican Ministry for Transport, the National Road Safety Council, the National Insurance Institute and the Costa Rican Automobile Club.

The campaign was a pilot project based on the principles of best practice developed in the FIA Foundation seatbelt toolkit, which was prepared by TRL and is especially targeted at emerging countries. In the 1990s, compulsory seatbelt legislation was challenged by a group of radical libertarians and the law was overturned. Seatbelt-wearing rates fell to 24%. The main aim of the campaign was to reinstate a seatbelt law, an objective that was achieved in May 2004 when new legislation once again made seatbelt use compulsory for front and back seat car occupants. The target was to achieve a seatbelt wearing rate of 70%. A national survey from August 2003 confirmed that this had been exceeded and seatbelt-wearing rates for drivers went from 24% to 82%.

Build pedestrian crossings and footpaths

Pedestrians are among the most vulnerable of road users. According to the WHO, they account for a significant proportion of deaths in many countries, such as in Kenya, where pedestrians make up 47% of those killed on the roads, while in Chile the figure is 40% and in Bangladesh 54%. [4] They are vulnerable in almost every situation: walking into the path of a vehicle (especially while trying to cross roads), walking along the roadside or on the road, playing or working on the road, boarding or leaving public transport vehicles, and even while standing or walking on footpaths.

A multitude of infrastructure treatments can help pedestrians to cross roads safely. The most recognisable is the unsignalised crossing (or zebra crossing), which consists of signs and painted road markings. The intention is that pedestrians have right of way over vehicles, and where this is the case, zebra crossings have been shown to prevent 25-50% of casualty crashes at a low to medium cost.

However, these benefits are significantly reduced in many regions where drivers simply do not stop for pedestrians, so efforts are needed to improve education and enforcement.

Various other safety devices can be included at crossings, such as refuge islands (see Figure 3), advanced warning signs and pavement markings, street lighting and flashing lights. Grade-separated crossings are the top of the range, and can prevent 60% of casualty crashes, although they are relatively expensive. An issue that planners need to be aware of, though, is that pedestrians will only use crossing facilities located at – or very near to – where they want to cross.

Figure 3. A pedestrian refuge island in Ghana (Photo courtesy of John Fletcher, TRL)

Similar to grade-separated crossings, footpaths reduce crash risk by physically separating pedestrians from fast-moving traffic. In fact, it is estimated that, at low to medium cost, they can prevent casualty crashes by 10-25%.

In urban areas, raised footways are frequently a standard part of the road cross-section, although obstructions (e.g., parked cars) almost as frequently force pedestrians to walk on the road. Unfortunately, in rural areas, footways are often not provided, even where pedestrian volumes are high, such as in East Africa. Here, a footpath may be as simple as a wide flat road shoulder and can be made cheaply by using a grader to flatten and clear one, or ideally both, sides of the road.

Improve intersections

Intersection crashes are one of the most common types of crash problem, particularly in urban areas. In rural areas or where speeds are high, the consequence of collisions at intersections can be particularly severe. There are a number of causes of these crashes – for instance, inadequate sight distance to oncoming vehicles, high approach speeds, or lack of intersection visibility.

One of the more popular intersection treatments is the roundabout. These can be reasonably expensive to build (in the medium to high range), but the costs are invariably outweighed by the savings associated with crash reductions. Roundabouts can cut casualty crashes by up to 70% in rural areas and 55% in urban areas.

The secret to a safe roundabout is its geometric design. Curves on the approaches require all vehicles to slow down before entering. The centre island layout ensures that traffic moves in a one-way direction and that slow speeds are maintained around it and at exits. Drivers approaching need to reduce their speeds, look for potential conflicts with vehicles already in the roundabout and be prepared to stop. Once in the roundabout, drivers should not need to stop and can proceed to their exit, so right-angle, left-turn (or right turn) and head-on collisions are virtually eliminated.

Alternative intersection improvements include better delineation, signalisation, turn lanes and grade separation.

Tackle crashes head-on

Head-on crashes are generally the most severe of all vehicle crash types, and are more likely to occur at bends and where overtaking demand is high. Road shoulders can have a significant influence on the risk of head-on crashes occurring. When a driver has accidentally travelled onto the edge of the road, the risk of crashing will be reduced if the vehicle can either stop on the shoulder or steer the vehicle back onto the road at a shallow angle, reducing the chances that the driver will 'overcorrect' and travel into oncoming traffic. It is estimated that sealed shoulders can cut casualty crashes by 25-40%, at a medium to high cost. However, shoulders should not be too wide, otherwise drivers may use them as an additional lane.

Edge lines can be improved at the time of upgrading the shoulder to further reduce risk. Median barriers generally do not help reduce the risk of a crash occurring, but they can dramatically reduce the severity of a crash. That noted, experience in some countries has shown that the visual narrowing caused by a median barrier can result in slower and more careful driving.

Median barriers (see Figure 4) prevent deaths and injuries by physically separating opposing traffic streams and helping to stop vehicles from travelling into opposing traffic lanes. They are often built on the centre of wide urban multilane roads where they can be used to stop pedestrians crossing at unsafe places. Median barriers can also be used to limit turning options for vehicles and shift these movements to safer locations. It is estimated that median barriers can reduce casualty crashes by 40-60%, often at high cost.

Figure 4. An example of the Coast Road median barrier in New Zealand (Photo courtesy of the New Zealand Transport Agency)

Like roadside safety barriers, median barriers can come in many shapes and forms. The decision about what type of barrier to be used should be based on several factors, including traffic volume, speed, vehicle mix, median width, the number of lanes, road alignment, crash history, and installation and maintenance costs.

Make roadsides forgiving

'Run off road' crashes are common, especially in high-speed areas. They occur at bends and on straight sections of road, and in high-speed environments they can have severe consequences, particularly if a fixed object is hit (for example, a tree or pole), or there is a steep embankment or cliff.

One of the most effective means of reducing risk is making the roadsides 'forgiving'. The concept of 'forgiving' roadsides is by no means new – Robert Baker's 1975 *Handbook of highway engineering* [5] made the point that they are a necessity for safety. Unfortunately, roadsides are still a tremendous problem 35 years later.

Roadside safety barriers are designed to absorb the impact of the crash so that injuries are minimised. There are three main types of barrier. Flexible barriers are often made from wire rope strung between removable posts, and they are the best option for minimising injuries to vehicle occupants. Semi-rigid barriers are usually made from steel beams, which deflect less than flexible barriers and so can be located closer to the hazard when space is limited. Rigid barriers are usually made of concrete and do not deflect, so these should be used only where there is no room for deflection of a semi-rigid or flexible barrier.

Much of the benefit from the use of barriers comes from a reduction in crash severity. Although a crash may still occur, it is likely to have a safer consequence than colliding with the object that the barrier is protecting. Barriers can reduce casualty crashes by around 25-50%, at a medium cost.

Unfortunately, poorly designed barriers can be hazardous. End points of barriers can act like a knife that is able to slice through any car that strikes it. Poorly planned barriers can obstruct pedestrians, forcing them to more risky alternative crossing points. Barriers can also be complemented with treatments that help drivers stay on the road (e.g., advanced information about curves), alert them that they are leaving the road (e.g., rumble strips), and improve the chance of recovering control if a vehicle does leave the road (e.g., shoulder treatments) or reduce the severity of the outcome (e.g., clear zones and crash barriers).

Manage speed

Speed management is fundamental to road safety and is recognised by the international community as a key risk factor. Research shows that the chances of avoiding serious injury or death reduce dramatically above 50km/h (31mph) for side impacts at intersections for the most modern types of cars, and are far less for older vehicles and, particularly, for vulnerable road users. Furthermore, even in the most modern cars, the chances of surviving a head-on crash at speeds above 70km/h (43mph) are greatly reduced. The chances of a pedestrian surviving an impact with a motorised vehicle reduce dramatically above 30km/h (19mph), and even at lower speeds than this, serious harm can be caused [6].

According to the WHO, the global response to managing speed has been poor, with only 29% of countries reportedly meeting basic criteria for reducing speed in urban areas, and less than one in 10 countries having effective enforcement in place [4]. Infrastructure can be effective in reducing speeds when used as part of an area-wide scheme rather than in isolation. Low-profile raised structures on the road (such as speed humps) slow drivers down, especially in urban areas at locations where there are likely to be pedestrians.

Gateways or threshold treatments are used to mark a change in speed environment, including the transition from a high-speed road to a lower-speed environment, such as a village. Gateway treatments usually include road markings to narrow the perceived width of road, large speed limit signs, and pavement markings and other features (such as traffic islands and landscaping) to indicate that a threshold is being crossed. As drivers tend to travel faster on wider roads (possibly because they perceive less risk of running into roadside objects), narrower roads in urban areas tend to slow traffic. Even narrowing the perceived lane width using painted markings can achieve moderately slower speeds.

Overall, it is estimated that these treatments can cut casualty crashes by 40-60%, often at low cost. It is also clear that a program of safety engineering improvements will be more effective if it is complemented with speed enforcement. The experience of high-income countries shows that rules will only be obeyed if people believe that not obeying them will result in unwanted outcomes such as fines or licence cancellation. The perceived likelihood of being caught and penalised for disobeying rules must be high for enforcement to work.

The police responsible for enforcing the rules must be trained and given the tools (e.g., speed detection and alcohol-testing equipment) to do their job properly, and a system should be created to ensure that fines are not taken by officials for themselves.

It is generally accepted that enforcement influences driving behaviour via two processes. General deterrence occurs when road users obey rules because they perceive a high risk of being detected and punished if they do not. Specific deterrence occurs when someone who has broken the rules is punished and stops the unlawful behaviour as a result.

Reduce drunk driving

Drunk driving is acknowledged internationally as a key road safety risk factor. Research shows that at a blood alcohol content (BAC) of 0.15 grams per decilitire, a driver's risk of crashing is over 20 times that of a driver who has a BAC of zero [4].

In most high-income countries, about 20% of drivers killed in crashes have illegally high levels of alcohol in their blood, and in low- and middle-income countries, research has shown that between 30% and 70% of drivers killed consumed alcohol before the crash [4]. Even though nine out of 10 countries have some kind of national drunk-driving law, only about half stipulate a legal limit of less than or equal to 0.05 grams per decilitire.

An effective strategy for reducing alcohol-related crashes will include several components. In general, a law that defines an upper legal BAC limit is required so that police can enforce laws against drunk driving. Most countries have adopted a BAC limit of either 0.05 or 0.08 grams per 100ml of blood. The European Commission recommends a limit of 0.05 for all drivers and 0.02 for novice and professional drivers.

Having sufficient enforcement activities – such as providing police with powers to stop and test motorists at the roadside, random breath testing and compulsory testing of all drivers involved in a crash – is useful to show drivers that they are likely to be caught if they disobey BAC laws. Penalties are also important in discouraging drunk driving.

Having designated drivers is useful for young people who often share a vehicle and can take it in turns to be the non-drinker. Ride service programs also provide transport for people who have consumed alcohol and may otherwise drive. An alcohol ignition interlock can also be fitted to vehicles. This technology is being used successfully in some developed countries to stop repeat drunk-driving offenders.

Require safe vehicles

In high-income countries vehicle safety has improved dramatically, but low- and middle-income countries lag behind. A first step to allow for catch-up is to ensure that all vehicles meet a minimum set of safety standards to be driven legally. Many countries also require that vehicles are tested by inspectors at regular intervals to make sure that they continue to meet these standards. Motor vehicle standards cover requirements such as controls, displays, rear view mirrors, the order of gear-shifting and brake systems. Additionally, they cover headlamps, brake lights, indicators (turning signals), reversing lights, tyre and tyre rim standards, safety glass, seatbelts (and anchoring them correctly), noise and smoke/gas emissions.

Standards also go beyond what is required to make a vehicle safe to drive. For example, many countries have minimum standards of crashworthiness, including aspects such as how resistant the vehicle is to having its roof crushed, whether the side is able to resist side impact and the quality of the safety glass.

Crashworthiness programs – including the consumer-based NCAP – have helped drive the inclusion of more advanced safety features. Such safety features are varied. Airbags and their placement can range from only in the dashboard to the knee well, the door pillar and curtain airbags (an airbag that inflates and covers the side windows). Head protection comes in the form of soft materials in headrests and vehicle side pillars. Adjustable mirrors help the driver monitor what is happening and make it safer to change lanes if they are correctly adjusted. Anti-lock brakes can automatically prevent locking brakes and the resultant skidding in a braking emergency, while traction control is used to stop the wheels spinning or slipping if the driver applies too much power.

Electronic stability control works alongside anti-lock brakes and is designed to help the driver keep control of the vehicle (usually in emergency situations) to stop it spinning out of control. This technology in particular has been found to be very effective in reducing deaths, and will be compulsory in new vehicles in some countries in the near future.

Minimising vehicle defects is also important. Research in developed countries suggests that vehicle defects cause about 3-5% of crashes, and it is likely that the figures are much higher in low- and middle-income countries as the vehicle fleet is likely to be older and less well maintained [7]. This is especially true of heavy vehicles, which are used to move freight and passengers.

Although research in developed countries has not shown that regular vehicle inspections by trained authorities significantly reduces injury crashes, it is a useful tool when starting a nationwide program to improve road and vehicle safety, because it removes dangerous vehicles from the road (or allows time to repair them) and makes sure that the vehicles that are on the road have a suitable level of safe roadworthiness.

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iRAP Malaysia training course: Decade of Action for Road Safety

by Dr Kerry Armstrong (CARRS-Q), Rob McInerney (iRAP) and Dr Mark King (CARRS-Q)

Abstract

The International Road Assessment Program (iRAP) is a not-for-profit organisation that works in partnership with governments and non-government organisations in all parts of the world to make roads safe. The iRAP Malaysia pilot study on 3700km of road identified the potential to prevent 31,800 deaths and serious injuries over the next 20 years from proven engineering improvements. To help ensure the iRAP data and results are available to planners and engineers, iRAP, together with staff from the Centre for Accident Research and Road Safety – Queensland (CARRS-Q) and the Malaysian Institute of Road Safety Research (MIROS), developed a five-day iRAP training course that covers the background, theory and practical application of iRAP protocols, with a special focus on Malaysian case studies. Funding was provided by a competitive grant from the Australia-Malaysia Institute.

Introduction

The International Road Assessment Program (iRAP) is a not-for-profit organisation that works in partnership with governments and non-government organisations in all parts of the world to assess high-risk roads and develop Safer Roads Investment Plans; provide training, technology and support that will build and sustain national, regional and local capability; and track road safety performance so that funding agencies can assess the benefits of their investments. Road Assessment Programs are now active in more than 50 countries throughout Europe, Asia, the Pacific, North and South America, and Africa.

During 2006-2007, iRAP assessed approximately 3700km of national roads throughout peninsular Malaysia in order to develop a star rating of the road network (1 star is least safe and 5 stars the safest) for cars, motorcyclists, pedestrians and cyclists. The program also identified road engineering improvements that are predicted to prevent 32,000 deaths and serious injuries on the roads surveyed over the next 20 years.

Due to the success of the program, the Malaysian Government committed to extending the iRAP survey to the rest of the Malaysian road network. To facilitate this work, it was deemed desirable to build a strong local Malaysian capability to deliver the project. iRAP worked together with staff from the Centre for Accident Research and Road Safety – Queensland (CARRS-Q) and the Malaysian Institute of Road Safety Research (MIROS) to develop a course curriculum that could directly train Malaysian road safety staff, in addition to forming part of a more comprehensive postgraduate qualification in the longer term.

The principal aim of the training program was to develop appropriate capacity-building and educational materials that could be used to train Malaysian road safety staff directly in the development, delivery and ongoing management of iRAP assessments within Malaysia. By addressing this aim, iRAP has contributed to building Malaysia's capacity to prevent road crashes. The iRAP Malaysia Pilot Study identified ways to save approximately one in every three fatalities on the roads through the systematic application of proven road safety engineering improvements across the country. The extension of the iRAP surveys to further parts of the Malaysian network has great potential to build local capability and achieve significant improvements in road safety.

The training program

The training material for the five-day program was developed from March to August 2010, in preparation for conducting the course in Kuala Lumpur, Malaysia, from 27 September to 1 October 2010. There were a number of essential objectives that needed to be met by those participating in the course. These included the ability to:

- understand the social, economic and human costs and impacts of road crashes
- identify the key causal factors involved in road crashes
- recognise the interplay amongst the components in the traffic network that underpin safe and unsafe road systems
- develop and apply the iRAP protocols of risk mapping, star rating and Safer Roads Investment Plans
- identify effective crash countermeasures, their social and economic benefits, and implementation needs
- identify resources that could be invested in local efforts to plan and implement crash countermeasures
- understand the critical importance of collaborative planning, implementation and evaluation
- understand the role of iRAP protocols within existing road safety strategies and action plans.

In addition, the course structure was set so that lectures and interactive sessions followed a logical sequence:

Day One: iRAP and the Decade of Action for Road Safety

- Global road safety and the Decade of Action
- The Safe System approach and managing energy
- Reconstructing crashes – how people die
- An overview of iRAP
- Panel discussion

Day Two: Risk Mapping

- Traffic and crash data in Malaysia
- How to produce Risk Maps
- Using Performance Tracking to identify the most improved roads
- Practical case study

Day Three: Star Ratings

- Road inspections and accreditation
- The inspection manual, rating and quality assurance processes
- The Star Rating formulae and risk factors
- Practical case study

Day Four: Safer Roads Investment Plans

- Estimating numbers of deaths and serious injuries
- Countermeasure triggers, hierarchy, optimization and costs
- Economic analysis including calculation of benefits, value of life and benefit cost ratios
- Practical case study

Day Five: Saving Lives[1]

- Positive use of iRAP Star Ratings and Risk Maps
- Implementing iRAP Safer Roads Investment Plans
- iRAP and the Decade of Action for Road Safety
- Presentation of course certificates

Participants

There were 38 participants from Malaysia, Central and South America, China, India and the UK. Those who participated were either road engineers, transport planners or policy makers. In addition, a number of high-level delegates from industry in Malaysia were present on the first day and took part in the presentations as well as the panel discussion at the end of the day.

Feedback and evaluation

Participants were asked to rate 18 course components from 1 (unsatisfactory) to 5 (very good). Twenty-seven participants responded, though not all components were rated. Overall, ratings were clustered around 4 (good) for all components.

Of the components related to course content and structure (nine items), all received an average rating above 4 (good). These items included “overview of course content”, “overall structure of course”, “relevance of case studies” and “applicability of course to work environment”, as well as individual questions asking the participant to rate the content of each day.

The components related to course delivery (five items) were more variable. “Opportunities to ask questions”, “use of audiovisual aids”, “style of teaching” and “handouts provided” all rated above 4; however, “variety in teaching methods” received a rating less than 4.

The final four items related to logistical issues, with “the lecture room”, “catering” and “timing of the course” receiving the lowest rating of all 18 items, well below the average rating of 4. “Frequency of breaks” was the only logistical item to rate above 4. The free text comments about the lecture room referred to the lack of facilities, i.e., there were more participants than PCs and desks, so some had to share.

Nineteen of the 27 participants supplied comments on their rating forms, while another four ‘Confidential Feedback’ sheets were submitted. There were numerous favourable comments about the presenters: their knowledge, enthusiasm and professionalism. There were a number of favourable comments about the content and other characteristics of the course, as well as suggestions for improvement.

There were several comments about the course being too ambitious, while comments about the case study exercises imply that it was the later part of the course that some participants found challenging. Conversely, other participants made favourable comments about the hands-on aspects of the course, which suggests that there was a significant degree of variation among participants in terms of prior knowledge and mathematical skills. Some participants expressed a desire for a more advanced and focused follow-up course.

There were suggestions about how to improve the course structure and delivery, mostly directed at increasing the variety in the presentations: mixing theory and practice throughout, breaking for group exercises (especially in the afternoon when people were sleepy), setting up some of the course as a computer game with the aim of saving lives (presumably through applying iRAP), etc.

The problem of insufficient PC access was addressed in two comments, which proposed that participants should bring their own notebooks (i.e., laptops/web-books) and be given DVDs containing all the data and presentations.

Conclusions

The planning, development and implementation of this five-day course can be considered successful in terms of the achievement of the stated aim and objectives. Thus, while further revision is required to tighten some of the issues that were raised as part of the evaluation, the overall program can be considered successful in terms of building the road safety capacity for Malaysia.

Notes

1. The final day was shortened to a half day for reasons related to religious observance and standard work practices in Malaysia.

Report on capacity-building workshops for road safety in Indonesia

by MJ King[1], BC Watson[1], D Brownlow[1], J Motha[2], E Robinson[3] and B Ernani[4]

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Abstract

In addition to the established problem of road safety in developing countries such as Indonesia, the agencies responsible for road safety often lack personnel with professional training in road safety. In Indonesia this is compounded by a need for more effective collaboration between agencies. In 2009, CARRS-Q was commissioned under the Indonesia Transport Safety Assistance Package to provide professional training in road safety for middle-level officers in Jakarta, the province of Jawa Barat, and the cities of Bandung, Bogor and Sukabumi, aimed at developing action plans and fostering collaboration between agencies. This was achieved through a workshop, which was followed up by a second workshop with the same participants. The course was very well received, action plans were successfully prepared during the first workshop, and most had progressed well by the time of the second workshop. Good

cooperation among agencies was also evident. There would be considerable benefits in extending modified workshops more widely in Indonesia.

Introduction

Road safety in developing countries is now widely recognised as a problem that is in urgent need of addressing [1]. While it is often quite clear that there is a need for a better road infrastructure, safer vehicles, and a mix of enforcement and education that promotes safer road use, the capacity of the organisations and individuals charged with this responsibility may be taken for granted. One of the strengths of the road safety discipline that has evolved in highly motorised countries is a scientific approach based on evidence. However, implementation of effective road safety measures on the ground requires a certain degree of knowledge on the part of people on the front line, and a willingness to be proactive and to cooperate with other agencies. It is necessary, but not sufficient, that government and leaders of key agencies are committed to road safety; translation of this commitment into reality requires the knowledge and commitment of officers further down the chain.

Indonesia is an example of a rapidly motorising country that is exhibiting a growing road crash problem and where the government has shown its commitment to improving road safety. Because of its high population and sprawling territory, a centralised approach to road safety is not possible, so implementation is reliant on middle-level officers at operating within delimited areas of responsibility in the provinces.

The key organisations in Indonesia are the Directorate-General of Land Transport (DGLT) and the broader transport agency (Departemen Perhubungan, or Perhub), Highway Construction (Bina Marga, a Directorate within the Department of Public Works - Departemen Pekerjaan Umum, or PU) and the National Traffic Police. This division of responsibilities at the top level is further complicated by a provincial/city administrative structure within departments, with differing degrees of devolution of responsibility, so it is not surprising that there is often a lack of cooperation between officers of the different organisations at the local level. There is also a lack of training in how to approach road safety, except for road safety audit training for engineers.

Project initiation

Australia has a strong relationship with Indonesia at government level, with transport as one area of focus. In 2008 the Australian Federal Government launched the Indonesia Transport Safety Assistance Package (ITSAP), a $23.9 million program managed by the former Department of Infrastructure, Transport, Regional Development and Local Government (referred to as 'Infrastructure' below). The great majority of the funding and activities undertaken through ITSAP were directed at capacity building in the aviation safety and (to a much lesser extent) marine transport safety areas.

However, Infrastructure initiated discussion with DGLT on the possibility of a road safety project and invited delegates from DGLT, PU and the Indonesian National Traffic Police to attend road safety seminars in Canberra and Sydney on 18 and 19 February 2009. As a result of these discussions, Infrastructure decided to include a project on the management of road safety in Indonesia. Accordingly, ITSAP commissioned the Centre for Accident Research and Road Safety – Queensland (CARRS-Q) to develop and deliver road safety training materials for Indonesia, with DGLT as the client.

The project's broad objectives were as follows:

- to improve the capacity of Indonesian agencies with responsibilities for road safety management (including officials from DGLT, PU and the National Traffic Police
- to foster relationships among these agencies, focusing in particular on sustainability.

The project was broken down into several stages, each with its own objectives, which were designed to contribute to the overall project objectives. These stages were as follows:

- initial visit to Indonesia for scoping and familiarisation (4-8 May 2009)
- development of training material (May-September 2009)
- delivery of first workshop (19-23 October 2009)
- preparation for follow-up workshop (February-March 2010)
- delivery of follow-up workshop (26-30 April 2010).

The scoping and familiarisation visit was preceded by discussions with DGLT and Infrastructure about the possible structure and content of the workshops. The visit itself involved meetings and consultation in Jakarta, Bogor and Bandung, primarily with DGLT and Perhub staff, but also with other agency and city officials, police and AusAID staff. Observations were undertaken of traffic and road use behaviour to provide additional context.

On the basis of this consultation and the observations, the following decisions were made:

- The training would be aimed at imparting knowledge and skills to enable participants to undertake road safety-related programs more successfully
- The workshops should involve representatives from Perhub, Bina Marga/PU and police
- Because agency responsibility has been decentralised (except for police), the workshop would involve participants from both the central agencies in Jakarta (which, although a city, is classified as a province with special status), the agencies in the surrounding province of Jawa Barat (West Java), and the agencies in the West Javanese cities of Bandung, Bogor and Sukabumi
- The workshops would include practical exercises aimed at fostering collaboration, with the intention of developing proposed actions at the local level that the participants could implement.

Course structure and content

The program involved two workshops: the first centred on the delivery of a course and the development of action plans, while the second was a follow-up. The course objectives were to provide participants with opportunities to:

- understand the social, economic and human cost of road crashes
- identify the key causal factors involved in road crashes
- recognise the interplay amongst the components in the traffic network that underpin safe and unsafe road systems
- identify interventions that can function as effective countermeasures to crashes
- develop skills in identifying resources that could be invested in their local efforts
- acknowledge the critical importance of collaborative planning, implementation and evaluation.

A five-day program was developed for the first workshop, comprising lectures and practical activities, with the following structure:

- The problem of road crashes
- Why crashes occur
- Addressing the crash problem
- Planning for action
- Evaluating our action.

Delivery and follow-up

The first workshop, titled 'Protecting people on our roads', was held in Jakarta from 19-23 October 2009. (See Figure 1.) There were 17 participants and 18 observers (many of whom attended only one or two sessions, although some were present throughout). Every province was represented by two Perhub staff and one police officer, while staff from Bina Marga/PU supplied one representative each for Jawa Barat and Sukabumi. Two observers from PU in Jakarta asked to become participants for the second workshop.

In addition to delivery by CARRS-Q and Infrastructure staff, arrangements were made for Indonesian guest presenters: Pak Suripno (Director of Land Transport and Safety), Pak Giri Suseno (Indonesia Global Road Safety Partnership, former Director-General of Land Transport), Ibu Besty Ernani (DGLT), Ibu Siti Malkamah (Universiti Gadjah Mada) and Pak Naufal Yahya (Police).

Figure 1. Opening day of the first workshop. All public servants have a uniform, worn here for the opening of the workshop sessions. After this, only police participants continued to wear a uniform.

A key output of this workshop was the development of action plans at the local level, involving cooperation among the agencies involved. The participants took to this task with enthusiasm and showed a high degree of familiarity with the use of information technology to support their planning activities. The action plans addressed issues including high crash routes, helmet-wearing campaigns and Black Spot treatments.

The second workshop was conducted in Bogor, 60km south of Jakarta, from 27-29 April 2010. Almost all the original participants attended again. There were differing degrees of progress on action plans, but much evidence of collaboration among different agencies in each location. In addition to reporting back, the workshop involved delivery of a case study on an Indonesian motorcycle helmet-wearing evaluation, field trips to look at successful implementation and a potential future project, and delivery of information on tools to assist in evaluation.

Both workshops were evaluated, and overall participants rated them highly. Language presented an issue – both workshops were delivered in Bahasa Indonesia with interpreters for the Australian presenters (all teaching materials and presentation slides were translated in advance), but the second workshop utilised professional interpreters with some knowledge of road-related terms and headphone equipment that gave the Australian presenters simultaneous translation of the proceedings. This had advantages in terms of time and immediacy.

A related issue, which is unavoidable in a country as diverse as Indonesia, was the use of local dialects among participants. For example, many West Javanese speak Sundanese in preference to Bahasa Indonesia, and the interpreters (who came from other parts of Indonesia) did not always understand what the participants were saying.

Recommendations for the future

A final report has been prepared for ITSAP on the workshops. It includes a detailed set of recommendations, which can be summarised as follows:

- Extend similar workshops to other regions of Indonesia, with the long-term aim of having them run by Indonesians themselves. By 'similar', it is meant that the multi-faceted approach should be maintained, rather than having specialised workshops, e.g., on road engineering safety
- Enhance the participation of all agencies, especially police
- Improve the workshops themselves by:
  - o assisting participants to prepare for them in advance
  - o using group development processes
  - o taking learning styles into account
  - o using experienced and knowledgeable translators for early distribution to participants
  - o optimising time allocations for activities
  - o increasing the visual content of presentations
  - o using respected Indonesian road safety experts, provided it is possible to ensure consistency across presentations.
- Develop higher-level road safety management capacity. Given the Indonesian promotion system, there is no guarantee that trained participants will be promoted into roles that maintain their connection with road safety, so there is a need to supplement the workshops with briefer training for higher-level managers.

A sad postscript

A few weeks after the second workshop was conducted, we received news from Indonesia that one of our participants, Pak Hotman Nainggolan, had been killed in a motorcycle crash as he travelled between Bandung and Jakarta. Pak Hotman was the police representative from Jawa Barat, and the reason he was on the road at the time of the crash was that he had been working on a road safety project with Perhub staff.

Pak Hotman was a committed participant in both workshops, frequently contributing to discussion with his very practical orientation. There is no doubt he would have made a contribution to road safety in Indonesia, and helped to further the collaboration between police and other agencies.

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Zenani Mandela Road Safety Scholarship

The family of Nelson Mandela has established a scholarship to support road safety initiatives following the death of the former South African president's granddaughter. Zenani Mandela, aged 13, died in a car crash just before the start of the 2010 football World Cup in South Africa.

Zenani's mother Zoleka and her grandmother Zindzi helped launch the scholarship as part of the UN Decade of Action for Road Safety. The aim of the scholarship is to help young policymakers tackle the increase in death and injury occurring on South Africa's roads.

The Zenani Mandela Road Safety Scholarship is being coordinated by the FIA Foundation in conjunction with the Nelson Mandela Foundation. For further information see http://www.fiafoundation.org/news/archive/2011/Pages/ZenaniMandelaScholarshiplaunchedtosupportUNDecadeofActionforRoadSafety.aspx

Peer-Reviewed Papers

Social influences on drivers in China

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Abstract

China is one of Asia's many rapidly motorising nations and recent increases in private vehicle ownership have been coupled with an escalation in novice drivers. Several pieces of road safety legislation have been introduced in recent decades in China. While managing the legal aspects of road use is important, social influences on driver behaviour may offer alternative avenues to alter behaviour, particularly in a culture where such factors carry high importance.

This paper reports qualitative research with Beijing drivers to investigate social influence factors that have, to date, received little attention in the literature. Findings indicated that family members, friends and driving instructors appear influential on driver behaviour and that some newly licensed drivers seek additional assistance to facilitate the transition from learning to drive in a controlled environment to driving on the road in complex conditions. Strategies to avoid detection and penalties for inappropriate road use were described, many of which involved the use of a third person. These findings indicate potential barriers to implementing effective traffic enforcement and highlight the importance of understanding culturally specific social factors relating to driver behaviour.

Keywords

Traffic law enforcement, Social influence, Driver behaviour, China, Novice drivers

Introduction

Reducing road crashes and associated trauma across Asia is critical as the Decade of Action for Road Safety commences in 2011. Increasing rates of motorisation in many Asian countries are a significant challenge, with many facing the serious consequences resulting from the mix of large numbers of high velocity, motorised vehicles (e.g., trucks, buses and cars) with high proportions of low velocity, non-motorised road users (e.g., cyclists and pedestrians).

China has experienced large-scale and unprecedented economic growth recently, coupled with one of the highest annual motorisation growth rates in the world [1]. This rapid growth in motor vehicles commenced in the late 1980s [2] and has occurred primarily in the huge and expanding 'mega-cities' (e.g., Beijing, Guangzhou, Shanghai) [3]. It is estimated that the number of vehicles in China had more than quadrupled since 1990 to a figure of over 55 million at the beginning of this century [4].

Road trauma, road use and road safety law in China

Road crashes have been reported as the number one non-disease killer in China ahead of other disasters, such as flood, fire and earthquake [1]. Further, road crashes have been identified as the leading cause of death for younger, productive members of society (those under 45 years of age) and thus, the leading cause of working-life years lost [2]. Traffic-related mortality has escalated by 81% in the two decades since 1987 [5].

However, in rapidly motorising countries like China, automobiles are not the predominant form of transport. Rather, it is pedestrians and two-wheeled vehicles, such as motorcycles and pedal and electric cycles, that predominate [6]. Hence, there is increasing competition for space on the oft-crowded lanes on multi-purpose roads and the competitor is, increasingly, a fast-moving motor car.

Yet owning a car is not common in China. For example, it has been reported that China's 1.3 billion people own approximately 2% of the world's vehicles, yet account for approximately 15% of global road fatalities [1]. Research indicates that in 2005 there were only 2.4 automobiles per 100 persons in China [7]. As a comparison, commensurate Australian data (for 2003) indicates a rate of 52.2 automobiles per 100 persons [8].

A key challenge facing China is the changing nature of car ownership over a relatively short time. Until recently, private ownership of vehicles in China was restricted by government policy [3]. However, there appears to have been a relaxation of these regulations in recent years. For instance, in Beijing in 2008, private vehicles reportedly accounted for approximately 76% of the total vehicles in that city [9], with the number increasing by an average of 1466 vehicles per day [10].

In addition, there was, until recently, a large proportion of professional drivers in the driving population [11]. However, these drivers are now reported to constitute less than half the driving population as the incidence of private vehicle ownership continues to rise. The surge in private vehicle ownership has been accompanied by increases in licensed drivers. In Beijing, for instance, approximately 1302 people on average are newly licensed each day, with the total number of drivers reported to number 5.2 million as at February 2009 [10]. These record numbers of first-time car owners and novice drivers represent unique challenges for authorities and road users alike.

There is a growing recognition in China that the issues of increasing motorisation and associated road trauma demand action. The Chinese government has developed and implemented a number of regulations in recent decades. In 1988, the People's Republic of China road traffic management ordinance was introduced and covered basic issues of road and vehicle use for drivers and pedestrians. Among other things, maximum speed limits for some roads and types of vehicles were outlined.

In 2003, the National People's Congress, China's highest state authority, adopted the Law of the People's Republic of China on road traffic safety, effective 1 May 2004 [12]. In conjunction with this law, the National Joint Conference on Road Traffic Safety was established to oversee the implementation process and coordinate communication among relevant agencies. These agencies included the Ministry of Public Security, the Ministry of Agriculture and the Ministry of Communication [13].

Minor revisions to this law were adopted at the 31st Session of the Standing Committee of the Tenth National People's Congress on 29 December 2007. While these legislative advances are important steps in addressing the road safety problem, there are other factors that also deserve attention to assist in reducing crashes and associated trauma. Social influence factors are one example.

The role of social influence factors on driver behaviour in China

To date, there is little research on the role of social influence factors on driver behaviour in China, yet we know that Chinese society is strongly based on social rules, customs and relationships. There is reason to assume, therefore, that road use and driving-related issues may also be strongly influenced by social relationships.

One study that did investigate such issues highlighted the need to consider culturally specific issues such as interpersonal networks and social hierarchy when examining driver behaviour in China [14]. The findings suggested that there are some concepts relating to Chinese driving culture that may not necessarily have been identified from research conducted in Western contexts and that research conducted in China (and other Asian countries) must be considered in light of such concepts. The information presented in the current paper reports findings from the qualitative component of a larger project examining a range of influences on the driving speeds of car drivers in Beijing in 2008.

Method

Participants

In total, 35 participants were recruited to participate in six focus groups (numbers ranged from four to eight participants per group). The majority of participants (n=27) were recruited from the membership of a large motoring support organisation, and eight participants were recruited from a graduate university population in Beijing. A direct approach via email to members of the motoring organisation was made by staff of that organisation. To recruit the convenience sample of university students, an advertisement was placed on student notice boards in the university.

The sole inclusionary criterion for participation was holding a current Chinese driver's licence for a car. The demographic data collected from participants indicates that they ranged in age from 21 to 49 years (Mean = 30.8 years, SD = 6.2) and that 71% were male. Participants had been driving for between 0.5 and 22 years (Mean = 6.9 years, SD = 6.7). Half of the sample had been driving for less than 5 years and 25% of the sample had been driving for more than 9 years (Mean = 6.9 years, SD = 5.66). Overall, these figures indicate a relatively young sample (i.e., mean age of 30.8 years) containing both experienced and novice drivers. Participants were paid RMB 150 (approximately $25 equivalent) each for participating.

Materials and procedure

In accordance with the Queensland University of Technology's Human Research Ethics approval conditions, written consent was obtained from all participants and included permission to audio record group discussions. During the recruitment process, all potential participants were advised that they would be participating in a discussion about driving in Beijing.

Semi-structured interviews lasting approximately 60 minutes were used to elicit information on issues relating to driving speeds, the influence of others on driving behaviour, and perceptions of speeding and speed enforcement. Open-ended questions were used to gain as much information as possible from participants in the allotted time and included the following: "As a driver, what does the word 'speeding' mean to you? Do you think that driving above the speed limit is dangerous? Think about the way you drive your car and the people who might influence you: Who influences your choice of driving speed (fast or slow)? How do they influence you? What do people do to avoid getting caught for speeding? Is there anything that people do to avoid the punishment when caught?"

All interviews were conducted in Mandarin and facilitated by a bilingual native speaker who was an associate of the research team. The first author was present during all group interviews but did not actively participate. The facilitator was able to refer to the first author during group discussions if necessary to clarify issues of interest to the research team. Transcripts of the discussions were later typed and translated (see below for description of this process).

Research strategy and analysis

Focus group interviews were selected as the research method because of their potential to reveal contextually relevant information that may otherwise not be discovered via quantitative inquiry [15]. Such qualitative methods are particularly appropriate where a field is relatively under-researched. Participant groups were intentionally heterogeneous in nature to allow the inclusion of as great a breadth of experiences and perceptions as possible. Allowing for greater breadth is regarded as particularly useful in preliminary stages of investigating a topic where little is already known [16].

There were a number of steps involved in translating the group discussions from Chinese to English before a thorough thematic analysis could be conducted. Firstly, two Chinese researchers associated with the research team transcribed the audio recordings into Chinese. Secondly, the group facilitator checked these translations for content accuracy. Finally, another two Chinese research associates translated the transcripts into English. These translations were also checked by the group facilitator for accuracy. The first author consulted regularly with the group facilitator during the analysis process to discuss unfamiliar concepts, clarify ambiguous statements, and confirm the understanding of findings and themes as they emerged.

Findings

Quotations from transcripts are presented as evidence for the interpretations made in these findings [17], and findings are presented to demonstrate the themes relating to social influence and driving that arose from the group discussions. As findings in relation to attitudes to speeding and speed limit compliance and to perceptions of speed enforcement and deterrence principles have been reported elsewhere [18], they will not be addressed here. Rather, the focus of the current paper is on social influence factors. Below, participants are identified according to their gender and age (e.g., F30 represents a 30-year-old female participant and M37 represents a 37-year-old male participant).

The influence of others – family, peers and driving instructors

The influence of family members on driving was evident, though not commonly discussed. There was evidence of the influence of fathers, but not of mothers. Given that the majority of Chinese drivers are male, this finding is not surprising. For example:

"I got my licence in Beijing, but my father has a great effect on me because I usually drive at home [another Province]. He will share his driving experience with me. The aim of the coach [driving instructor] is to just make you pass the exam. I learn a lot of other things from my father." M24

That quote suggests that the driving instructor (often referred to as a coach) was perceived as having limited influence beyond assisting this participant to obtain his licence. However, a contrary opinion was expressed by other participants who cited their coach/instructor as influential on their driving behaviour. The exchange between participants (below) illustrates this:

Speaker 1: "The first person [to influence you is] the coach. His driving habits will influence you." M23

Speaker 2: "Yes, you absolutely are influenced by his [coach] driving habit." M41

Beyond the roles played by father and coach, there was evidence that friends played a role in providing role models of speeding. For example:

"I learned to drive under the instruction of him [a friend]. He drives very fast, so I drove faster than others when I got my licence." M32

"When several friends drive out together[1] [in separate cars], if the car in front of you goes fast, you will follow it [copy its speed]." M26

The idea that being a good driver means that one must be competent when driving fast appeared in several groups and was reported as highly influential. The following quote illustrates how driving skill and managing a vehicle at speed were equated:

"Before I learned to drive, there was somebody I know who made comments about who has good driving skills. When I was a passenger in his car I realised that driving fast means good driving skill. This concept was in my mind. I agree that the environment will influence you when you are young. When I could drive by myself, I was affected by other comments that good driving skill means driving fast." F34

There was also an indication that some people actively sought to learn how to drive fast by observing other drivers when a passenger in their car. The example below demonstrates the efforts and rationale behind them of one woman who wished to become a competent (implied by her to mean fast) driver and sought information from others to achieve this aim.

"There are many girls around who drive very slowly, which makes me annoyed. You can learn how to drive fast. Maybe I don't know as much as men about cars, but I improve myself by asking others and participating in car clubs. I learned to drive fast when I was a passenger with others and then I practised when I drove by myself." F30

In addition, although less commonly expressed, there was discussion about the influence of the driving speeds of unknown other drivers on the road in setting an example of how fast to drive.

"Sometimes others will have a great effect on you. If most drivers [are] speeding on the road [I] tend to speed too." M21

However, there was evidence indicating the contrary situation, where drivers reported the belief that they were not influenced by anyone other than themselves and their personal experiences. For instance:

"It is just up to you. The speed is decided by your right leg and it has no relation with other people." M26

"I have my own principles. Both my friends and colleagues need to wait for me when we drive together. With my driving skills, I can drive fast, but I don't like to. I won't keep up with you if you drive at the speed of 110 on the highway. I have my own principles. Nobody can influence me." M31

The influence of others – Driving clubs

Participants described enjoyment received from driving together with friends in a group (i.e., in multiple cars) and often included descriptions of drivers racing each other on the road. For example:

"You can't drive slowly like a snail if you drive out to play together with friends who like to speed very much. We feel cool when speeding, especially in a race with boys." F26

This practice of racing others was discussed in every group and appeared related to shared enjoyment and encouragement from friends, as well as to feelings of thrill and excitement. Without being able to probe the topic with further questions at the time, it was unclear how often this racing occurs or how widespread it is among drivers. However, the information provided by several drivers suggests that it has been happening for many years and, further, that driving clubs may encourage and facilitate this behaviour. For instance, in response to the question about the social influences on driving speeds, one driver commented:

"Challenge, I like the competition. We used to drive out on a trip and we had a competition with others [to see who could drive the fastest to reach a destination first]. But this kind of thing happens less often when we have driven for many years. We [now] know that there is not much difference between the speed of 170 and 180. You just save about 10 minutes by driving at the speed of 180 [km/hour]." M41

Interestingly, one participant noted that he was envious of the opportunities available today for new drivers to be able to meet up with peers and enjoy racing:

"There were no clubs when I was young like there are now [for meeting people to race]. I am jealous of the younger generation [they have greater opportunities to race now]. I have raced with a policeman in the past because there were no clubs." M40

Role of others – Accompanied driving once licensed

There was also discussion about what happened once people had received their licence to drive. It is commonplace for novice drivers to receive instruction to drive on purpose-specific driving tracks/facilities, rather than on the road network. Thus, when they finally receive their licence, many new drivers are likely to have little or no experience driving on-road with other traffic [19]. It appears that once people have successfully obtained their licence, they can pay for the services of an instructor from a driving school (referred to as an accompanying driver) to accompany them as they gain on-road experience. For example:

"When I began to learn driving, I drove on the simulated road [a road at the driving school, not the actual road] under the direction of the driving coach. After I got my licence, I would ask a person (from the driving school) for accompany training. When I drive on the real road, I think the direction of this accompanying coach for training is more important [than the coach for teaching driving]." M28

Role of others - Avoiding detection and avoiding legal punishment once detected

Participants reported strategies to avoid detection for speeding that are similar to those reported in countries such as Australia, including site learning (awareness of speed camera locations), use of in-vehicle radar detectors, and less commonly, the practice of illegally tampering with vehicle licence plates by hiding, removing or changing them. While these practices of avoiding detection do not specifically involve the influence of other people per se, numerous examples of the influence of others to avoid legal punishment once detected were noted. These practices were widely and openly discussed in each group and fall into two categories: 1) strategies used when interacting directly with police at the time of apprehension, and 2) actions occurring after the event.

In relation to direct interactions, some drivers described their experiences of negotiation with police officers in an attempt to have legal penalties reduced or waived. Examples included being polite to police, making suggestions to police about how speed limits could be improved (i.e., increased) in the hope of receiving sympathetic/lenient treatment, and negotiating with police for a reduced penalty. Several drivers described this practice as "acting shamelessly" to avoid punishment. By this, they appeared to mean acts that are dishonest and that lead to improper avoidance of a penalty, as illustrated in their words:

"I acted shamelessly with the policeman when I was caught for not using a seatbelt. I didn't notice him [police officer] and he stopped my car to ask me to show my licence. I didn't give him my licence and asked him which regulations I had violated. He told me that I had not used a seatbelt. I suddenly put the seatbelt on and said that I had used seatbelt. He said he saw me not using a seatbelt and I asked him to show me proof. He didn't catch me on the spot and there was only one policeman, so I succeeded [in avoiding the penalty]. It is the first time that I had acted shamelessly." F28

Another strategy used to avoid punishment at the time of the offence involved the use of other people's business cards to influence the attending police officer. For example:

"One of my customers is from the traffic department. I have their business card. Whenever I am caught speeding, I use the card to show that I am in the same department as him. The policeman will let me go." M40

"Two years ago I was caught [speeding] on the highway. I took out a card to tell them [police] that this is a special guest card provided by the government. It was just a lie I made up. The policemen let me go. [Since then] I have escaped punishment many times with this card." M29

Together, these examples suggest that at the point of apprehension, drivers employ a range of strategies in an attempt to avoid legal sanctions.

The second group of strategies used to avoid legal penalties is employed after detection and does not involve direct interactions with police. The first of these was the use of demerit points belonging to another person. This strategy was discussed by each group and was described as easy to accomplish because "there are many people who have a licence but no car" M37.

The second strategy identified was seeking the assistance of acquaintances or police officers to have a penalty cancelled. It was noted that this strategy had become increasingly difficult with the introduction of speed cameras and that if it were to be successful, the intervention by another party must occur prior to the offence being posted by police on the internet. For example:

"You can ask for help from an important person. If you know some traffic policemen, you can ask them to cancel the record before you get traffic tickets. Before they [traffic police] put the information on the internet, they can cancel the record. You should ring the person as soon as you can." M24

"I know a person whose relatives are traffic policemen. He can [have them] cancel all records. If you know someone who is familiar with the traffic policemen, you will be okay. Maybe the traffic policemen don't know you, but they know the person you ask for help." M41

Discussion about the use of an important acquaintance to cancel a penalty was common, although the consensus was that for a minor penalty such as that attached to a speeding ticket, it was not worth the trouble because the cost of the penalty would be outweighed by the cost of the gift needed in return for the favour. The following exchange demonstrates this point:

Speaker 1: "You ask someone important to cancel the record." M37

Speaker 2: "Why do you ask for someone's help? It is too troublesome because you need to buy a present to express your thanks." F27

Speaker 3: "It is not easy now and it is not worthwhile for only 200 Yuan [the cost of the fine]." F29

Speaker 1: "Yes it's not easy to ask somebody important to do this, but it is worth asking someone if you are going to lose all your points." M37

Discussion

This paper reports findings relating to social influence and driving that were part of a larger research project investigating a range of factors influencing the driving speeds of car drivers in Beijing. Overall, a large range of social influences were reported by participants, many of which are found in the research literature from countries with a more extensive history of driver behaviour research.

As noted earlier, driving is still a relatively uncommon component of daily life for most people in China. Therefore, it would not have been surprising to find little evidence of the influence of others as role models because, unlike Australia and many other highly motorised countries, many parents, friends and work colleagues in China may not drive. However, this proved not to be the case, as a number of different groups of people were identified as driving role models including family (i.e., father), friends and driving instructors.

The finding relating to the influence of driving instructors was not surprising, given the substantial number of new drivers in China. As discussed above, driving instruction is conducted off-road in purpose-specific driving facilities rather than on the road network, and when licensed, new drivers are likely to have little or no experience driving on the road with other traffic [19]. This learning situation is unlikely to provide new drivers with all the skills necessary to successfully negotiate crowded city streets and assess the related risks associated with such driving.

Therefore, one commonly reported strategy to assist with this situation was to employ the services of an 'accompanying driver' to provide ongoing driving instruction once licensed. In more highly motorised countries, such as Australia, supervised practice is part of a graduated driver licensing system where new drivers must be supervised by a more experienced driver for a requisite period of time before progressing to solo driving (see Senserrick [20] for a summary of such requirements in each Australian jurisdiction).

However, as this system is not in place in China, it appears that some drivers seek out and pay for additional support once they commence driving on the road. It is encouraging that a pilot study to trial free on-road driving practice for novice drivers in Beijing is being conducted and evaluated [21]. It is hoped that the results of this randomised control trial will demonstrate the benefits of supervised practice for novice drivers and result in the introduction of greater support for the increasing numbers of new drivers in China.

Another finding that is absent from the wider road safety literature relates to the role of social outings and racing other drivers on the road. Membership of socially-based driving clubs was commonly discussed by the groups. Owing to the frequency of discussion about clubs and racing and the research team's limited understanding of such, staff members from the motoring support organisation used to recruit participants were consulted to assist with interpreting these findings.

They advised that there are many informal social clubs that advertise recreational driving events on their respective websites. In addition, there were also more formal structures offered by entities such as motoring organisations and car clubs for social networking opportunities for drivers. It was noted that such events seemed particularly popular with new drivers, especially if their peers did not yet have their own car. This avenue of more formally structured social influence, therefore, is one that might be particularly relevant for novice drivers in China.

Interestingly, several discussions provided information relating to the act of racing with friends or motoring club members at high speed on the road. It appears that in some instances, this activity is facilitated by motoring clubs. This is an area of concern, particularly for the development of ongoing speed management strategies in China.

It should be noted, however, that the majority of the sample was drawn from members of a motoring organisation in Beijing. At the time of data collection (2008), staff of that organisation advised that there were approximately 500,000 members in that city. The exact percentage of drivers who are members of motoring organisations in China could not be sourced. However, it is important to acknowledge that the sampling method used for this study may have produced responses that are not entirely consistent with the views of all Chinese drivers.

Another social factor discussed by participants was the use of social networks to negate speeding penalties. Firstly, the use of other people's demerit points was widely discussed. The group discussions suggested that in Beijing, locating a person who is willing to provide their demerit points to another person may be relatively easy compared to countries like Australia where a much greater proportion of the population drive. While there may be many licence holders in Beijing, there is likely to be a smaller proportion of this group who actually drive, owing primarily to the relatively high cost of vehicles.

Thus, the fraudulent use of another person's demerit points may be more widespread in places like China than in countries where driving is more commonplace. However, it is noted that this practice is not unique to China and while it compromises the integrity of a licensing regime, the extent of this practice is difficult to determine because it happens 'outside' the normal licensing and sanction systems [22]. Future research could shed additional light on the extent of such issues by surveying representative populations of drivers.

Secondly, the use of social networks was also discussed with regard to avoiding legal penalties at the time of apprehension (i.e., during direct interaction with police), as well as after being apprehended. From a Chinese perspective, the concept of *guanxi* (pronounced gwan-shee) is likely to be relevant here. *Guanxi* can be translated literally as 'relation' or 'relationship', although a functional translation to English is more difficult because this concept is not found in Western cultures [23].

The concept of *guanxi* encompasses many things, but primarily represents the build up and transfer of social capital via a network of people, which is central to every aspect of life in China [24]. This network is based on reciprocity, obligation and indebtedness, and members of the network rely on each other to promote mutual interest and benefit. Providing assistance to a network member inevitably leads to the expectation that this debt will be repaid at some point in the future [25].

This concept appears inherent in many of the strategies discussed above in relation to the involvement of other people, either directly or indirectly, to avoid legal penalties. The findings of the current study are consistent with those reported by Xie and Parker [14] with respect to using social networks to avoid legal punishments for traffic violations. To our knowledge, this work is the only other example of research that has investigated the link between interpersonal relationships and illegal driving in China. Since the concept of *guanxi* is central to everyday activities in China, there is good reason to expect that it would also be central to negotiating one's involvement with traffic police and traffic law and that it would represent a potential barrier to the implementation of effective traffic law enforcement strategies in future.

The extent of public education and road safety advertising about such matters in China is difficult to clarify. However, an observation made by the first author in Beijing during the 2008 Spring Festival period provides insight into a novel governmental approach to address this concept of using others to avoid legal penalties for improper road use. *Chun jie* (Spring Festival) marks the coming of the new lunar year and the Spring Festival Gala, a variety show presented in Mandarin with English subtitles, is broadcast on New Year's Eve night around the country and the world via the state-owned China Central Television station, CCTV. This program has developed the reputation of 'must-see' viewing as families gather to share the evening meal. It consists of a range of musical and comedy sketches, many of which appear to have a moral implication.

In 2008, one sketch related specifically to traffic law enforcement and the attempted use of interpersonal networks to avoid penalties. The plot involved an interaction between a police officer and a man who was obviously under the influence of alcohol and about to get into his car. The man suggested that the police officer should have waited until he was in his car so that the officer could have issued him a fine. The officer advises the man that he is not interested in fining him but interested in his safety.

A young woman driving at high speed then almost collides with the two men. As the officer starts to write a speeding ticket, she tells him that what she was doing was not a big deal and that he should let her go without penalty. When the officer disagrees, she begins to phone her boyfriend, a police officer, whom she says will come and remedy the situation by convincing him not to give her a speeding ticket. Although she has the phone number of her new boyfriend, she has not yet met him face to face and, therefore, does not know what he looks like. The attending officer's phone starts to ring; he is the new boyfriend. The sketch ends with the woman looking embarrassed and the officer telling both offenders that they need to understand and respect the police because they have a duty to keep everyone safe. The subtitle read:

'The recent increase in private cars has made the job of the Traffic Police even harder. During Spring Festival, the job of the Traffic Police is even more demanding as drivers visit family and friends for dinner and return home DUI (driving under the influence). This sketch shows how some drivers try to escape punishment by claiming to have 'connections'. The moral of the story is that we should respect the Traffic Police and obey the laws of the road.'

It is not known whether sketches in previous Spring Festival Galas have been used to draw attention to traffic law enforcement issues. It may be that the authorities chose 2008 to broadcast that type of message to coincide with the increased global attention on China because of their role as host of the Summer Olympic Games that year. Nonetheless, this example portrays one strategy used by the Chinese authorities to deliver an important road safety message to the broader community and signifies an attempt to negate the use of interpersonal networks in avoiding legal penalties.

Limitations and conclusion

A number of limitations should be acknowledged when considering these findings. Firstly, it is recognised that the use of qualitative research processes limits the extent to which the findings can be generalised to the greater population of Beijing drivers. However, the trade-off with this approach is that it provided an opportunity to gain a level of understanding about influences on driver behaviour that would otherwise not have been possible via quantitative investigations alone.

Secondly, the use of convenience sampling to recruit some participants (i.e., university students) also introduces a potential source of bias in the type of drivers who participated. However, the use of an additional sample source from the membership of a large motoring organisation was intended to help alleviate bias. Yet in doing so, it may be that the information received was biased towards the experiences of more educated drivers than if participants had been sourced from more general locations. Future research should aim to extend the sample population.

Finally, while this study appears to represent the first published qualitative exploration of factors relating to social influences on driver behaviour in China, it should also be noted that a potential limitation was the presence of the author at each interview. Despite no direct interaction in group discussions, the presence of a 'foreign researcher' could have introduced a level of uncertainty or apprehension among participants in relation to their level of disclosure. The extent of this phenomenon is unknown. However, the apparent openness of responses, particularly in relation to descriptions of illegal behaviours to evade detection and punishment, can be taken as an indication that participants did not feel the need to withhold information because of this presence.

In summary, these findings highlight the need to investigate and include culturally relevant issues and solutions in road safety policy and practice. They also indicate that other people play an important role in shaping driver behaviour in China, as in many other countries. The use of interpersonal networks to avoid legal penalty and the support needs of the vast numbers of novice drivers in China are important issues that require ongoing attention as the Decade of Action unfolds.

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Notes

[1]The term 'driving out' was used to describe the situation where people would drive in separate cars, usually with friends, for social occasions. Hence, this phrase does not refer to being a passenger but to being on the road as a driver with friends who are also driving.

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Development of a supplementary education and training program for novice drivers in China

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Abstract

The driver population is rapidly increasing in China and crash rates are expected to rise dramatically without effective preventative measures. The objective of this research was to develop a driver education and training program for China adapted from best practice. Based on review of the current system and stakeholder interviews, a program was developed to provide driving lessons in real-world traffic for newly-licensed drivers with a supporting educational manual. The present study aim was to evaluate whether the program could be successfully implemented with 64 pilot study participants. Post-training interviews and spot checks found the majority of participants received the program as intended, with early discrepancies readily overcome. Seventy-nine per cent completed additional recommended but not mandatory components and 100% reported benefiting from participation. It was concluded that the program was appropriate and acceptable. Further research will determine whether the program can help reduce novice driver road trauma in China.

Keywords

Novice drivers, Driver education, Driver training, China

Introduction

In recent years, China has established itself as the world's fastest growing automobile market. In the two decades between 1985 and 2005, the number of private passenger vehicles increased ninefold and motorcycles and other motorised vehicles 54-fold [1]. The World Bank has reported that Beijing alone has experienced a tenfold increase of private cars in the past decade [2].

Together with this growth, the number of licensed drivers has also increased rapidly. A 2010 publication cites 60 million new drivers in China in the previous three years [3]. The rapid pace of the transition to a private car culture has been supported by rapid growth in road infrastructure, but systems infrastructure, including effective driver education, training and licensing programs for novice drivers, is yet to match the pace of these developments [4, 5].

In accordance with this growth, road traffic crashes and mortality have likewise rapidly increased. Latest available fatality figures published in the *Ministry of Public Security annual report* cite a total approaching 68,000 deaths in 2009, although comparisons to death registration data collected by the Ministry of Health suggest this figure may be twice as high [6].

Furthermore, the rate of increase in road traffic injuries between 1985 and 2005 exceeded that anticipated against an earlier estimated increase of 92% by 2020 [1, 7]. Without effective preventive measures, both the social and economic costs for China will be excessive, with road traffic fatalities accounting for more than one-third of potentially productive life years lost from injury deaths in China due to the over-involvement of youth and young adults [8]. Insurance companies report that novice drivers (those licensed for three years or less) are over-represented in road crash statistics [9], as is true of high-income countries [10, 11]; however, no official figures or population-wide information on novice drivers in China is currently available.

The China novice driver training and licensing system

The driver licensing process is mandated by Central Government and documented by the Ministry of Communication. At the time of this study, driver licence applicants were required to undertake 58 hours of education and training at specialty off-road facilities run by local government licensing authorities [12]. (In the context of this paper, 'training' refers to in-vehicle driving by learners accompanied by an instructor or adult supervisory driver with the purpose of learning to drive.) No private supervised driving (e.g., with parents or friends) is allowed. The program includes group-based classroom education and smaller group in-vehicle training on specially built (off-road) tracks at the facility. Licence tests on completion of the program include a computer-based knowledge test and an in-vehicle parking test, also at the facility.

From 2007 an additional requirement was introduced: an on-road practical test, with 20% of tests to be conducted at night [13]. This driving now takes place on the roads immediately surrounding the driving schools. Driving school managers in Beijing report that 2-3 hours of the mandatory training program now takes place on-road; however, given that three learners are generally together in one training vehicle, it is unclear how much time an individual learner might spend behind the wheel or what proportion of this training, if any, is conducted at night.

Furthermore, the driving schools are located outside the Beijing city area. While the roads around these facilities are required to have a minimum traffic level of one vehicle per minute, this is extremely low compared to the real-world driving environments that the novices encounter once licensed. As a result, many newly licensed drivers pay for additional on-road driving lessons with professional instructors before driving unaccompanied. Specialised businesses are increasing to offer these services, which cannot be provided by driving school instructors during the learner period.

The new licence has a 12-month provisional status during which time new driver plates must be displayed on the rear of the vehicle and drivers are restricted from driving police, emergency, commercial and heavy vehicles (including commercial passenger cars, buses, tow trucks, tankers, lift trucks, engineering-wrecking vehicles, vehicles carrying dangerous goods, fire engines or ambulances). These are federal restrictions. Some cities have additional restrictions relating to certain parts of the road system; otherwise, the system is generally standard across all provinces. (For example, in Beijing, driving in fast lanes is not permitted, and in Shanghai, driving on certain roads during peak hours is restricted.) After 12 months, licences automatically update to full licence status.

New licensees in China are generally older than in high income countries (typically considered those under 25 years of age), likely due to the costs involved and issues regarding access to vehicles, although this is likely to change as vehicles become more accessible. The China Automobile Association [9], a leading driver training and roadside assistance body in China, reports that the average age of their newly licensed members is 30 years. It is also common, however, for young licensees to obtain a licence without necessarily intending to drive immediately, as it is a highly regarded addition in curriculum vitae.

Comparison to best practice

Best-practice licensing systems in developed countries include mandatory lengthy learner periods (typical minimum of 12 months [14]), comprising many and varied hours of private supervised driving with a licensed adult (such as a parent) in conjunction with several professional lessons [15, 16]. The aim is to expose the learner to increasingly complex driving conditions as experience is gained so that such complex conditions are not first encountered when driving unaccompanied on a provisional licence.

In recent years, several countries have increased supervised driving requirements to very high levels, either by distances travelled (e.g., 3000 km is mandated in several European countries [11]) or by number of hours (e.g., 100-120 hours in some Australian jurisdictions [14]). European evaluations have resulted in inconsistent findings on the effectiveness of such requirements, with some finding benefits and others no benefits (but no counterproductive findings [11]), while Australian changes are too recent to evaluate reliably. Nonetheless, research has more consistently shown that increasing the length of the learner period is protective against crashes when first licensed to drive independently [17].

In addition to these learner requirements, once drivers progress to an independent provisional licence, the most effective components are a zero blood alcohol concentration (BAC) requirement and restrictions on driving unsupervised at night or with multiple peer passengers [16, 18]. None of these measures currently apply in China, although all drivers are regulated to a 0.02% g/dl BAC [4]; however, little is known about the predominant risk factors that contribute to novice drivers' inflated crash risk in China. It is unclear therefore whether such restrictions would be appropriate for the Chinese context or whether alternative initiatives might have a greater impact on crash rates.

Aims and objectives

The long-term objective of this research program was to develop a driver education and training program for novice drivers in China that will be effective in reducing their over-involvement in road traffic crashes. The current paper reports on development of the education and training program and the process evaluation findings from a first implementation of the program in a pilot study conducted in Beijing during 2010. The aims of the process evaluation were to determine if the program was delivered as intended and to assess participants' perceptions of the program.

Methods

Program development

It was intended to determine the details of the current China novice driver and training system and risk factors for crash via public records in the Chinese literature; however, published information was scarce. Therefore a series of stakeholder interviews was undertaken with government ministers, driving school managers, insurance company managers and post-licence driving instructor companies, as well as a review of licensing materials and observations of training at driving schools during 2008 and 2009. Based on the information gathered and given the strict regulation of the learner driver period by Central Government and the lack of real-world driving experience, an education and training program was designed for new licence graduates; it focused on driving lessons in central Beijing and supported education not covered in current learner driver curricula.

Driving lesson protocols and feedback forms to participants were adapted from materials provided by the Australia Driver Trainers Association NSW. As post-licence driving lessons are typically two hours or longer in Beijing (to allow for congestion), three two-hour driving lessons were the maximum number possible within project resources. The lessons were designed to increase in complexity based on the skill level of the novice.

Given the extensive manoeuvring experience gained in driving school courses, the initial focus was on vehicle handling skills in traffic, commencing in lower traffic volumes at off-peak times when possible, to more complex traffic situations based on the skill level of the novice. Lessons progressed to increasing attention to the higher-order skills of situation awareness and hazard perception, promoting maintenance of a 'safety cushion' around the vehicle and constant wide and far visual searches to monitor potential hazards [19]. The final lesson was held during dark evening hours.

At the end of each lesson, the instructor provided individual feedback to the participant on their performance and the aspects that required practice prior to the following lesson. Supporting educational content was also developed to draw attention to the high crash risk of new drivers, high-risk scenarios (e.g., driving at night), and safety behaviours and strategies (e.g., seatbelt use in all seats and how to choose a safe car). Feedback could also include attention to educational content.

The protocol was adapted to Chinese appropriate phrases, images and formats by the Beijing Chinese-German Safe-Driving Technology Development Company, a company that specialises in developing driver education materials and training professional driving instructors. A succinct education manual was developed in print form accompanied by a DVD with repeated key messages and selected additional content and scenarios the company had previously developed.

The company also developed a manual for the driving instructors and trained local instructors with 10 to 30 years experience in providing post-licence driver training; all were members of a local, highly regarded organisation, the Luantai Club. One of the China-based researchers (Dr Yu) also attended a training program provided by the Luantai Club and inspected their training vehicles to ensure standard teaching and vehicles were commensurate with the high safety standards required for the project.

Participants and procedure

Participants were recruited in and around driving schools via posters and prominent stands with advertising brochures in driving school waiting rooms and large outdoor billboards in parking areas where participants arrived at the schools via bus shuttle services. One large driving school also included business–card size advertisements in the paperwork provided on successful licence completion. Inclusion criteria were having obtained a driver licence within the past four weeks, with access to a vehicle and intention to drive during the following months.

Applicants were invited to contact the George Institute China office to schedule a visit for an in-person interview. Informed written consent was first obtained, followed by a baseline interview, after which a block randomisation technique (blocks of five) was used to randomly assign participants to the intervention or to the control group. In lieu of the three free driving lessons provided to intervention participants, control participants were provided with a six-month roadside assistance membership with the China Automobile Association. Comprehensive driving insurance was also purchased for the intervention participants for six months to cover their involvement in the study.

In total, 127 participants were recruited during March to December 2010. Of these, 64 were randomised to the intervention. Intervention participants were provided with the educational package at this time. Research team staff scheduled all lessons with the participant, predominantly via phone, and relayed them to Luantai Club on a weekly basis or more often if needed, to ensure that the lessons occurred, at minimum, one week apart to allow practice time and that the final lesson was completed in the evening.

Spot checks were also conducted for a random selection of training lessons to ensure the protocol was followed, including ensuring that no additional passengers were in the training vehicle (a typical occurrence in Beijing) and that the participant was collected and returned to their designated location on routes identified as appropriate during the instructor training (a typical lesson in Beijing involves driving to the next participants' collection location rather than returning to the original location).

Following completion of the training program, intervention participants completed a brief interview over the phone to determine whether:

- the driving lessons increased in complexity over time
- the driving instructor completed the individual feedback form at the end of each lesson

- they drove between lessons to practice tasks recommended by the driving instructor
- they believed the education and training program was of benefit to them
- the lessons were sufficient for their needs
- they had any other feedback on positives and negatives of the program.

Responses were collated into a Microsoft Office Excel 2007 spreadsheet and total responses calculated. The study protocol was approved by the University of Sydney Human Research Ethics Committee and the Peking University Institutional Review Board.

Results

The total study sample of 127 participants comprised 69 females (54.3%) and 58 males (45.7%). Of the 64 trained participants, 36 (56.3%) were female and 28 (43.8%) male, showing a similar distribution to the overall sample. The age distribution is presented in Table 1. The average age overall and for the intervention group was 30 years, while the average age for the control group was 31 years. Both groups included a participant aged 51 years, with the youngest participant in the intervention group aged 21 and in the control group aged 20.

Table 1. Age of participants

Sample	n	Mean	Standard deviation	Minimum	Maximum
Control	63	31.1	6.6	19.6	51.4
Intervention	64	30.2	5.2	21.2	51.0
Total	127	30.6	5.9	19.6	51.4

Table 2 summarises responses to yes/no questions included in the post-training interviews. In process terms, 80% of the lessons increased in complexity over time and instructor feedback was provided to the participant in 95% of cases, as intended. Over 80% also undertook practice between lessons, which could include revising educational components as well as driving. It is unknown whether increasing complexity did not occur due to participant skills level or inattention of the instructor. While practice in between lessons was not mandatory, individual feedback should have been provided in all lessons for all participants. In terms of overall impressions, Table 2 shows that when directly asked, all participants believed they had benefited from undertaking the program and over three-quarters wished there were more lessons.

Qualitative feedback provided more varied responses. Fifty-one participants (79.7%) described the program as “good”, “helpful” or referred to improved skills, knowledge of safe driving or progress in driving ability (the most common response theme). Seven participants particularly commented that they now were prepared to drive independently, while one specifically stated that they had now overcome their fear of driving.

The second most common comment was a wish for more lessons (n=19, 29.7%), with two additional participants suggesting there was not enough training and that more was needed. Three participants specifically requested more attention to parallel parking, while one commented there should be less time on parking (notably not a focus on the program due to its extensive coverage in the driving school).

The third most common response was description of the instructor as “nice” and/or “patient” (n=9, 16.1%), although early in the program delivery period, one participant experienced instructor conflict with the collection location and one reported that the manual was not strictly followed. In practical terms, three respondents commented that they would have preferred a better selection of vehicles and one experienced difficulty finding a training time on weekends. In terms of the education component, three expressed wishes for additional enriched content and an additional participant suggested a theory test on this content would be beneficial. Two respondents suggested the program was “not that different” or “could be more advanced” compared to their experience in the driving schools.

Departures from the protocol identified by the participant comments or through spot checks occurred predominantly early in the program delivery period and were followed up with the manager of the Luantai Club. Issues identified during spot checks were smoking by the driving instructor during the driving lesson and requests to carry additional passengers. Once issues were identified and addressed by the Luantai Club manager, they were largely overcome for the remainder of the study.

Discussion

The results of the process evaluation suggest that a novice driver education and training program based on best practice in high-income countries was successfully developed for the China context, in that it was able to be implemented as intended, was appropriately targeted to the intended users, and was acceptable

Table 2. Perceptions of the education and training program for 64 intervention participants

Question	Yes n	Yes %
Did the lessons involve increasingly more difficult driving skills over time?	51	79.7
Did the instructor give you feedback at the end of each lesson?	61	95.3
Did you practice what the instructor taught you in between lessons?	52	81.3
Do you think the lessons benefited you?	64	100.0
Do you wish you still had more lessons?	49	76.6

and relevant. Participant reports and spot checks indicated that the protocol was followed closely and any deviations were able to be rectified in a timely manner. All participants reported benefiting from the program and the majority undertook optional supplementary driving practice or theory review as recommended by driving instructors, with more than three-quarters wishing they could have additional training. While further outcome evaluation (in progress) is required to determine if the program is also successful in improving road safety for China novice drivers, this is a positive example of transferring a promising program to a different cultural context.

Previous research has demonstrated varying levels of success when implementing road safety initiatives found to be successful in high-income countries to low- to middle-income countries. For example, introduction of laws mandating motorcycle helmet use in Thailand in 1993 increased wearing rates fivefold, but from an initial low rate of 4.5% to 22.6% [20]. In contrast, introduction of a mandatory motorcycle helmet law in Vietnam in December 2007, with strong government and non-government organisation support and extensive policing, was associated with near 100% compliance [21].

In China, the 1993 introduction of laws requiring mandatory fitting of front seatbelts and wearing by drivers and front-seat passengers resulted in an observed wearing rate below 10% and a self-reported wearing rate of 22% [22, 23]. However, a later more targeted intervention in one Chinese province that focused on enhanced police training and enforcement coupled with a publicity campaign effected an absolute increase in observed wearing rates of 20% [24].

These differences indicate that cultural differences can impact on the effectiveness of interventions transferred from one setting to another, which may be due to a variety of factors including how they are implemented. This study suggests the implementation of the present initiative was well received and valued, and was therefore culturally appropriate. Whether the program also results in increased safety is particularly of interest generally and due to the older average age of the China novice drivers compared to the age of typical novice driver populations in high-income countries, which typically peaks close to the minimum licensing age.

Limitations of the study include inability within the project resources to deliver more than six hours of individualised driving lessons. While the optimal amount of accompanied driving is currently unclear, the novice driver literature suggests a much greater number of hours is likely to be required. Such an increase could ensure that a range of conditions, including more complex conditions, is encountered, in order to have a significant impact on crash risk once licensed to drive independently [25, 26, 15].

Nonetheless, as China novices currently have a very low baseline level of experience, if any, of driving in typical Beijing traffic, it was anticipated that even six hours of lessons in such conditions, building on the driving school lessons and supplemented by the education program, would help alert new drivers to their uniquely high crash risk and the higher-order skills required for safer driving, and therefore promote safe driving practices.

In addition, participants were not able to be randomly selected and therefore the generalisability to the wider novice driver population in China is unknown. Many new licensees were reticent to discuss the project as they were suspicious there may be 'a catch', such as the need to agree to pay for additional lessons or insurance. Therefore, the experience of the participants may differ to those who were exposed to recruitment but chose not to participate. Nonetheless, so little information is available on novice drivers in China and on the potential applicability of initiatives developed in high-income countries that the results provide an important example to demonstrate such interventions can be successfully adapted and adopted.

Conclusions

Little is known about novice drivers in China and how best to enhance their learn-to-drive experience to improve their safety on the road. This study has demonstrated that an education and training program adapted from best practice in high-income countries was able to be developed for the China context, and that it was successfully implemented by trainers and instructors and followed by participants. This presents a promising approach to help reduce the current over-representation of novice drivers in road trauma in China. Further research is required to determine if that ultimate aim can be achieved.

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Fatalism and road safety in developing countries, with a focus on Pakistan

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Abstract

Road crashes are a significant problem in developing countries such as Pakistan. Attitudes are among the human factors that influence risky road use and receptiveness to interventions. Fatalism is a set of attitudes known to be important in Pakistan and other developing countries; however, it is rarely addressed in the road safety literature. Two broad types of fatalism are theological fatalism and empirical fatalism, both of which are found in developed countries as well as in developing countries. Where research has been conducted into the issue, fatalism is considered to interfere with messages aimed at improving road safety.

Pakistan has a serious road crash problem, and there is sufficient information to suggest that fatalism is an important contributing factor to the problem, but a better understanding of how fatalism operates in Pakistan is needed if effective prevention strategies are to be developed. A proposed study using an anthropological approach is described, which will be exploratory in nature and which is aimed at investigating fatalism and related concepts among Pakistani road users and those who develop and implement road safety policy.

Keywords

Fatalism, Superstition, Developing countries, Pakistan, Prevention, Road safety

Introduction

Road traffic crashes have emerged as a major health problem around the world. Road crash fatalities and injuries have been reduced significantly in developed countries, but they are still an issue in low- and middle-income countries (often termed

Table 1. South Asian countries vs Australia, 2007: Estimated fatalities, population and fatality rate per 100,000 population

Country	Estimated road crash fatalities 2007	Population 2007	Road fatalities per 100,000 population
Bangladesh	20,038	158,664,959	12.6
Bhutan	95	658,479	14.4
India	196,445	1,169,015,509	16.8
Maldives	56	305,556	18.3
Nepal	4,245	28,195,994	15.1
Pakistan	*41,494*	*163,902,405*	*25.3*
Sri Lanka	2,603	19,299,190	13.5
Australia	1,616	20,743,179	7.8

Source: Table A.2, *Global status report on road safety* [3]

developing countries) [1, 2]. The World Health Organization (WHO) [3] estimates that the death toll from road crashes in low- and middle-income nations is more than 1 million people per year, or about 90% of the global road toll, even though these countries account for only 48% of the world's vehicles.

Furthermore, it is estimated that approximately 265,000 people die every year in road crashes in South Asian countries (see Table 1). Due to the high degree of under-reporting of crashes in South Asian countries, all fatality rates presented in Table 1 (apart from those for Australia) are point estimates within confidence intervals derived from regression models that use WHO regional mortality data.

Although some of the confidence intervals overlap, the point estimates suggest that Pakistan has the highest rate of fatalities per 100,000 population in the region. It can be seen that Pakistan's road crash fatality rate of 25.3 per 100,000 population is more than three times that of Australia's (7.8). High numbers of road crashes not only cause pain and suffering to the population at large, but are also a serious drain on the country's economy, which Pakistan can ill afford. Unfortunately, research into road safety in Pakistan is scarce, as is the case for other South Asian countries.

Attention to all aspects of the Safe System approach to road safety is recognised as vital if harm from road crashes is to be reduced [4]. In developing countries especially, attention and resources are required in order to improve things such as vehicle roadworthiness and poor road infrastructure.

However, attention to human factors is also critical. Human factors that contribute to crashes include high-risk behaviours like speeding and drink driving, and neglect of protective behaviours such as helmet wearing and seatbelt wearing. Much research has been devoted to the attitudes, beliefs and perceptions that contribute to these behaviours and omissions, in order to develop interventions aimed at increasing safer road-use behaviours and thereby reduce crashes.

Fatalism is a set of attitudes that has received little attention in road safety research, but is potentially of great relevance to road user behaviours in developing countries. In 2004, a survey of personal values around the world found that Pakistan rated highest on a measure of fatalism (*World values survey,* 2004, cited in Acevedo [5]), and other developing countries also tended to be high. Social and cultural factors are argued to form an integral part of the context of road safety in a country, along with economic and institutional factors [6], and an understanding of these factors is necessary as part of the process of developing interventions that are likely to be effective [6]. It is therefore important that road safety professionals gain a better understanding of fatalism and its contribution to road crashes.

The aim of this paper is to clarify what fatalism means; to show how it overlaps with other concepts, attitudes and behaviours; to describe the ways it can influence road safety; and to outline a proposed program of research that aims to explore fatalism and related concepts in Pakistan.

Fatalism and related concepts

Fatalism, while a commonly used word, is employed in different ways and with different underlying meanings. Broadly, fatalism is the belief that life events are predetermined and inevitable, or (at the least) out of one's own control. In practice, fatalism can take more than one form, and several typologies have been developed [5, 7, 8]. While there is insufficient space to discuss these typologies, it should be noted that, when analysed, they appear to reflect the specific contexts and circumstances in which the studies were undertaken.

In our account of fatalism, the approach taken by Acevedo [5] is used. Acevedo discusses the approaches taken by Durkheim and other sociologists, and the more culturally oriented views of Weber and Elder, and opts for an approach using the first two of Elder's categories: empirical fatalism and theological fatalism. Empirical fatalism is a belief that observed events 'occur for no comprehensible reason and they cannot be controlled', while theological fatalism is 'the belief that God or some moral order such as karma controls man's destiny and the outcome of his actions' (Elder 1966:229, cited in Acevedo [5]).

There is an overlap between fatalism and superstition both conceptually and in practice. Superstition can be defined as 'a belief or practice resulting from ignorance, fear of the unknown, trust in magic or chance, or a false conception of causation' [9].

Like theological fatalism, superstition involves a belief in the working of supernatural forces, which could include magic, spirits, ancestors or vague concepts like luck. The main difference from theological fatalism is that there is no all-powerful supernatural agent (e.g., God) involved, and in fact, the effects of magic are often attributed to ordinary (though malevolent) human beings. A second area of overlap concerns the actions taken by people acting superstitiously, who may invoke religious acts and powers as a way of counteracting possible malevolent acts or bad luck. This can give the appearance of religion to a practice that is essentially magical.

Fatalism and developing countries

Cultures differ in a variety of ways, not only in how much they endorse the notion of the supernatural, but also in the ways that supernatural beings and forces operate, including fate [10]. All societies have some elements of fatalism, though it is put into practice differently [7, 11-18]. Indeed, according to the Safe System approach adopted in Australia, human error is acknowledged as an inevitable part of the system [4]. This acknowledgement highlights the need to focus on improving 'controllable' factors such as vehicles and roads, as well as high risk road user behaviours and attitudes in all countries.

Fatalism is also associated with various religions. For example, Christianity and Buddhism give similar explanations of life in terms of fate, although in Buddhism, fate is embedded in the different cultural belief of karma [7]. Islam has been implicated as especially associated with fatalism, although this is contested [5, 19, 20].

The survey of personal values cited earlier (*World values survey,* 2004, cited in [5]) identified Pakistan as the country highest on a measure of fatalism; however, the fatalism indicator used only measured empirical fatalism [5]. The full survey results have been used to compare (empirical) fatalism between religions and shows Muslims as highest and Protestants lowest in terms of fatalism [5]. However, other studies have reported results inconsistent with a one-dimensional view of Islam as fatalistic (e.g., [21]).

A survey that included measures of both empirical and theological fatalism has been conducted, although it was focused only on Islamic countries, and due to a lack of consistency in questions across countries, measures of both empirical and theological fatalism were only available for some countries (*Gallop Poll of the Islamic world,* 2003, cited in [5]). People identifying with religions other than Islam were also included, and the research tested hypotheses about expected differences in empirical and theological fatalism if Islam was a religion which, by its very nature, engendered fatalism.

The pattern of results did not support the hypotheses, but pointed instead to the importance of specific local and historical circumstances – the degree of empirical or theological fatalism in a particular group reflected their position in society and the historical experiences of their group. While it was found that, on average, Muslims were more fatalistic, the association between fatalism and both socio-economic status and education did not allow for any clear conclusion.

Socio-economic status and education are probably the key differences between developing and developed countries. It has been argued that the link between fatalism and poverty is not clear and may be more dependent on culture and education [22] or on the mindset of control over one's life, regardless of value and religiosity [5].

There is some evidence of a link between lower levels of education and greater fatalistic beliefs [17], and there has been speculation that an increased number of road accidents among superstitious drivers was a result of lower education levels [23, 24]. Other findings run counter to this, with evidence of fatalism and superstition not only in more educated developed nations [25-30], but also among more educated people within developed nations [31]. The current literature, though mixed on many of these issues, does signal the need to consider them when examining road user behaviour, particularly in developing countries.

Implications of fatalism for road safety

As discussed earlier, fatalism is the belief that events are predetermined or, at the very least, out of one's own control. The general concept here relates to the belief that a person is, therefore, unable to change the occurrence (and course) of an event and in turn, not personally responsible for what occurs. With respect to road safety, the implications of such beliefs can be that crashes may be viewed as inevitable and not preventable [17].

This thinking can act as a barrier to recognising factors associated with crash causation, as well as promoting the notion that crash investigation is unnecessary. Fatalism can also have an adverse impact upon road crash prevention because it may affect receptivity to messages about the need to change risky behaviour [32, 33]. In addition to an unwillingness to adopt safe behaviours, it has also been found that fatalism contributes to risky behaviour and consequent negative outcomes (e.g., people with greater fatalistic beliefs tend to take more risks and have been victims of road accidents on more than one occasion [24, 34]).

A small number of studies show that fatalism is implicated in road safety in developing countries. A study in Thailand indicated that ordinary people's constructions of Buddhism, karma and fatalism influenced their attribution of the causes of crashes, and hence their receptivity to safety messages [35]. Similarly, a study in the Ivory Coast (West Africa) into the importance of culture in risk taking and accident prevention discovered that fatalistic beliefs and mystical practices influence the perception of road crashes and consequently lead people to take more risks and neglect safety measures [34].

It has also been observed in Nigeria that some vehicle drivers believe in wearing charms or talismans to protect their vehicles from road crashes or to allow for a miraculous escape when a road crash occurs [36]. It was reported that people having such beliefs behave imprudently, disregard precautionary measures and believe that such amulets will keep them safe [36].

Superstitions have also been shown to play a role in road safety. Superstitions may take the form of attributing misfortunes like road crashes to transgression of taboos, the actions of ancestors, jealousy from others and what Westerners call witchcraft [37]. Drivers take precautions, which include the use of spells, rituals, amulets and other magical objects. If they experience a road crash in spite of this magical precaution, they may believe that witches, wizards, secret societies or demons are responsible [36].

A study to evaluate superstition, risk taking and risk perception of accidents among South African taxi drivers found that a considerable proportion of drivers believed in destiny, witchcraft or evil spirits as possible causes of road traffic accidents [24]. Participants also reported that protective medicines, consulting traditional healers or prophets, and cleansing procedures could be effective means to avoid future accidents. Similarly, high degrees of superstition have been identified among various categories of drivers in the Ivory Coast [34] and Nigeria [37].

Many developed countries have successfully reduced road crashes and casualties by adopting a systematic approach to road safety, which is a result of a balanced blend of road user interventions and, most importantly, logically focusing on the attitude and behaviour of the road users towards road safety and observance of laws. Initially, developed countries considered road crashes as acts of God and unavoidable; however, over time, the focus shifted to the contribution of human factors and the notion of road crashes as preventable [38]. This shift in focus has culminated recently with concepts such as Vision Zero (Sweden), Sustainable Safety (Netherlands) and the aforementioned Safe System approach, where human error is considered inevitable and every effort made to control for it [4].

Research into the psychology of fatalism indicates that it may have benefits in its own right or as a compensatory mechanism. Attributing responsibility for bad events to an external agency avoids feelings of guilt about personal responsibility [24, 39-41]. In most people's lives there are things that they can change and things that they cannot, and being fatalistic about the things that cannot be changed can remove sources of dissonance [42-45], while attribution of responsibility to God or another supernatural being can be comforting [46, 47].

Against this backdrop, it is important to find a way forward, as the presence of fatalism is a potential barrier to participation in health-promoting behaviours and thorough crash investigation, particularly among the populations of developing countries. It has been argued that, both more generally [48] and in road safety [6], programs that are highly successful in developed countries sometimes do not work in developing countries, in part because their appropriateness for the local culture may have been overlooked.

Interventions need to be adapted to exploit those cultural values and beliefs that are compatible with safe behaviours, and otherwise account for those that are not [6, 37, 48, 49]. Alternatively, they should be generated entirely locally [50]. The lack of such efforts is in some senses symptomatic of a tendency to avoid consideration of broader cultural issues, noted in several countries [37, 51, 52]. For this reason, an important fundamental step in approaching road safety in Pakistan is to develop an understanding of the nature and role of fatalism in the broader context of road safety in the country.

Fatalism and superstition about road safety in Pakistan

It is clear from Table 1 that Pakistan has a significant road safety problem. Unfortunately there is relatively little research about road safety in Pakistan, so it is not surprising that two sources comment that road crashes are neglected in both research and policy in Pakistan [53, 54]. It has also been noted that shortcomings in police data continue to make it difficult to determine the scale of the problem [53, 55-58].

Two systematic reviews of relevant information have been conducted under the direction of A. A. Hyder [54, 56]. The first, a thorough review of reports on road crashes in Pakistan, was conducted in the late 1990s [56] and was supplemented by interviews with hospital victims, which revealed high levels of under-reporting in police data. It was found that there had been a steady increase in traffic deaths and injuries from 1956 to 1996. An unexplained issue in the study was the disparity between vehicles on the road and registered vehicles, with only half the vehicles on the road being registered. Commercial vehicles made up 12-35% of registered vehicles across the period, but were involved in more than 60% of crashes (increasing over time) and 90% of fatalities. The vehicles concerned were primarily buses.

The second [54], conducted a few years later, involved a systematic review of the literature relevant to road transport in Pakistan, which included gaining access to government reports. The report notes a distinct lack of official policy statements about road traffic injuries and, when the issue was acknowledged, the lack of reference to any interventions. A thorough search of databases revealed only seven studies, most of which are cited here and most involving groups of authors with some members in common across the studies.

In a 1997 national household injury survey, it was found that the road traffic injury rate was 15.1 per thousand people [55], while an earlier National Health Survey conducted in Pakistan in the period 1990-94 showed a similar incidence of 17.0 road traffic injuries per thousand people per year [59]. Both studies found higher levels for men and in urban areas, while the 1997 survey found higher rates for people aged 16-45 years (21.6 per thousand), and very high rates for labourers (119.5) and vendors (104.6). Looking at transport mode, 34% of injuries were as vehicle occupants, 24% as pedal cyclists, 21% as motorcyclists, 12% as pedestrians and 9% recorded as 'other'. According to the study, most of the injured vehicle occupants were occupants of buses or larger vehicles.

Pakistan is one of the largest Muslim countries in the world, although (unlike Muslim countries in the Middle East) conversion to Islam followed centuries of Hinduism. As noted earlier, Pakistan scored highest in the world on a measure of fatalism in an international survey (*World values survey,* 2004, cited in [5]); however, this only measured empirical fatalism, whereas a high rating on theological fatalism would not be unexpected.

Pakistan also exhibits other characteristics associated with fatalism, such as lower education and socio-economic status. According to the *Pakistan social and living standards measurement survey* for 2007-08 [60], the overall literacy rate (age 10 years and above) is 56 per cent (69 per cent for males and 44 per cent for females). The *WHO global status report* [3] classifies Pakistan as a low- (rather than middle-) income country, with a gross national income (GNI) per capita of US$870 in 2007. This is not the lowest GNI per capita in the region (Bangladesh and Nepal have lower figures); however, it places Pakistan in the lower half of a region that is relatively poor already.

There does not appear to be any research into the role of fatalism in road crashes in Pakistan, which is perhaps not surprising given that there are so few publications on road traffic crashes in general in Pakistan. The principal author is an experienced police officer in Pakistan (with the National Highways and Motorways Police) who has given hundreds of presentations on road safety to fleet drivers, as well as being involved in traffic law enforcement. In his experience it is almost universal to attribute crashes to God (the literal translation being 'it was by God', i.e., God's will) and to use the same reasoning to justify not taking precautions to avoid crashes.

Drivers of public and commercial vehicles (which figure significantly in the available crash statistics) are mostly uneducated and fatalistic, and this overlaps with superstitions, such that they believe that spirits, black magic and evils can influence their daily life and activities [61]. Figure 1 shows examples of the protective actions taken to avoid such misfortunes among Pakistani drivers. It can be seen that scripture from the Koran is used in the form of an amulet or charm inside a vehicle, which is believed to provide protection from road crashes. This is an example of how religious fatalism and superstition can overlap.

There are further overlaps with other aspects of culture: in Pakistan (and other places such as India, Afghanistan and some African countries), some people wear headgear that has cultural and status significance and, therefore, they are not willing to wear bicycle or motorcycle helmets. The legislation does not take this problem into account, even though the social and cultural imperative for them to wear their headgear is taken for granted by the public, and their right to ride motorcycles or bicycles is not challenged.

As discussed earlier, fatalism and related constructs can interfere with the effectiveness of public health messages. The significant road crash problem in Pakistan, combined with information suggestive of a problem with fatalism in Pakistan and the principal author's own experiences, provides a strong rationale for research aimed at developing an understanding of the nature of fatalism among Pakistani road users (especially professional drivers) and policy makers in the road safety field. The next section outlines a research project that is currently under way to explore these issues.

Proposed research

Clearly, more research is warranted on the effects of fatalism in road safety, both in general and in Pakistan. The historical, cultural and locally specific aspects that are likely to emerge from such research point to an anthropological approach (using qualitative methods) as being the most appropriate way of collecting and analysing data [62-65]. This paper summarises some aspects of the first step in an exploratory research project, which is a systematic and extensive literature review to establish a general picture of the belief systems of Pakistani road users and the influence of these beliefs on risky behaviour in road safety (specifically religious and cultural beliefs).

The second step – data collection – will be undertaken through individual in-depth interviewing [66]. This is considered an appropriate method to use for the current work because of the nature of the subject being explored and the limited amount of

Drivers use holy verses in vehicles to prevent road crashes

It is common for drivers to attach cloth, horse hair and other materials to vehicles to protect against black magic, bad luck, and to prevent others from wishing harm on a driver (evil eye).

Figure 1. Examples of measures taken by commercial drivers in Pakistan to protect themselves from road crashes. It is noted that such measures may introduce distraction into the driving scenario owing to such things as restricted visibility from windscreens and unnecessary movement of objects (e.g., black cloth) at the rear of vehicles.

Source: Kayani et al 2010 [61]

published information in the literature to date. The sample size for this study is anticipated to be 20 to 25 participants. It is anticipated that the interviews will be conducted in Pakistan in the city of Lahore and possibly other locations. Participants will include policy makers (with responsibility for traffic law), experienced police officers, professional drivers and general drivers selected through convenience sampling. The interviews will take place at participants' offices, public libraries and offices in taxi/bus stands to ensure participant confidentiality and anonymity.

Participants will be interviewed individually using a semi-structured interview format with simple prompt questions. Face-to-face, in-depth interviews are valuable for exploring the meaning of risk and understanding the role of deeper issues [67, 68]. For example, community values and ways of life, which are recognised as important in the risk literature, may be expressed through language that indicates multiple meanings. A semi-structured questionnaire will be developed in a generic form, and will be adapted as issues emerge to allow for follow-up and deeper exploration of participant responses. The broad items will initially seek information on how participants define a road crash, their perceptions of road crashes and their causes. Drivers will also be asked about everyday driving activities and their attitudes and beliefs about them.

An advantage of this research is that the principal author is Pakistani and will conduct the interviews primarily in Urdu, thus avoiding a problem noted in previous research in Pakistan [55]. However, translation can influence validity and reliability when collecting and analysing qualitative data [69]. In this study, the audio recordings will be translated by the researcher, and another translator will be utilised to double-check the translations against the recordings for validity and reliability. Data will be analysed using a thematic analysis approach, searching for the expression of particular ideas within the overall context of the dialogue [70]. Important themes will be identified and reported and will be used to provide preliminary information to assist in better understanding the role of fatalism in road use in Pakistan.

Conclusion

Fatalism has not been widely discussed in the road safety literature, and limited research has been carried out in this area. Two main types of fatalism – empirical and theological – can be identified, and they overlap with superstitions and superstitious beliefs and practices to some extent. Direct information about fatalism in Pakistan is lacking. However, there is enough indirect information to suggest that it is likely to form a barrier to the success of public health messages aimed at road crash prevention, particularly for those who believe that crashes occur solely by God's will (i.e., theological fatalism) compared with those who may believe that crashes are uncontrollable (i.e., empirical fatalism). The proposed research aims to provide information to assist in understanding the operation of fatalism in Pakistan, which will assist in the development of effective and culturally appropriate interventions in future.

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Road fatalities in Brunei

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Abstract

This paper investigates the pattern of road fatalities in Brunei. Road fatalities reached a peak in 1993 when 79 people died on the roads. Various road safety initiatives were then taken to reduce the road toll; this worked well and reduced road fatalities until 2003, when they began to increase. This implies that there has been a recent change in the pattern of road fatalities in Brunei. This has been verified by testing long-term and short-term regression coefficients. The coefficient of a policy variable, lax enforcement of traffic laws, indicates that road fatalities are increasing due to non-implementation of traffic laws, together with a larger number of young drivers and new vehicle registrations.

In recent years Brunei's road fatality rates have not been significantly different from those in Victoria (Australia), and they are significantly lower than in Malaysia and Singapore. Brunei can thus be considered a model for the trajectory of road safety in South-East Asian countries. There is further scope to reduce road fatalities if Brunei introduces and implements additional effective road safety strategies incorporating the Safe System approach to road safety, together with enforcing the existing road safety measures more strictly.

Keywords

Road fatalities, Lax enforcement of traffic laws, Young drivers, Statistical models, Trajectory of road safety, Brunei

Introduction

Brunei is a small country with a population of approximately 400,000. In 2008, there were 780 vehicles per 1000 population, which can be considered very high. Brunei has a good road network system, which has helped to achieve lower fatality rates since 1995 compared to other South-East Asian countries. It has taken various road safety initiatives, dating back to 1924, to reduce the road toll [1].

There are many factors responsible for road crashes, viz., humans, vehicles, roads, environments and a random factor [2]. Car crashes probably happen due to a bad alignment of these factors. Initially, this study reviews the literature discussing possible factors related to crash fatalities, and those factors for which data are available are then used to test the situation in Brunei.

Background literature

An increase in the number of vehicles on the roads has been shown to increase the number of crashes and fatalities (see La Torre et al. [3] and many others). In his seminal work in 1975, Peltzman [4] analysed road fatalities incorporating many variables, among which speed, alcohol, income, youth and trend are important. Many other studies that incorporated a large number of safety, socio-economic, environmental and other policy variables, such as Long [5], Shibata and Fukuda [6], and Shankar and Mannering [7], have been undertaken since then. Soderlund and Zwi [8] found that increasing population density was associated with a proportionately greater number of traffic deaths among the young and elderly. Ayvalik [9] and Nguyen and Nguyen [10] used trend variables and found that road fatalities decreased over time.

Loeb and Gilad [11] and Loeb [12] used policy and many other variables to analyse the causes of road fatalities, while Haque [13, 14], Wibowo [15] and others showed that drivers aged less than 25 years constitute the highest number of fatal crashes and deaths. Besides these, Joksch [16], Partyka [17], Wagenaar [18], Loeb [19] and Haque [13, 14] used macroeconomic variables such as employment and unemployment to explain road fatalities.

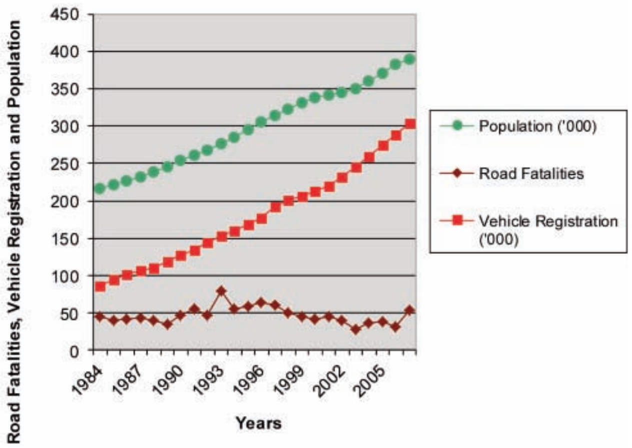
Smith [20] examined the effects of weather and climate on road crashes and inferred that wet days were associated with higher numbers of crashes. Owens and Sivak [21] showed that night-time fatality rates adjusted to mileage averaged three times higher than daytime rates. Jung et al. [22] analysed the effects of rainfall on single-vehicle crashes and found that rainfall intensity, wind speed, roadway terrain, driver's gender and safety belt usage were the most significant factors. Siddiqui et al. [23] investigated light conditions and pedestrian injuries and found that relative to dark conditions without street lighting, daylight reduces the odds of a fatal injury by 75% and 83% at mid-block locations and intersections, respectively.

Chang and Yeh [24] compared fatality risk factors between motorcyclists and non-motorcyclists and found that on average motorcyclists had approximately three times more fatality risk than non-motorcyclists after adjusting for driving mileage. Motorcycle fatalities are generally very high in most developing countries. For example, in 2008, 60% of Malaysia's total road fatalities were motorcyclists [25]. In fact it is a major challenge for most developing countries to reduce motorcyclists' fatalities. Besides these, there are many other studies on road fatalities, among which Dissanayake and Lu [26], O'Donnell and Connor [27] and Savolainen and Ghosh [28] can be mentioned.

Road crash trends in Brunei

To improve safety on public roads, road safety practitioners/researchers should collect appropriate road crash/casualty data, which is not an easy task. However, road fatality data collected by police is widely accepted in almost all countries in the world, although police fatality data are not immune from criticism. Collecting road fatality data is not a major problem, since most deaths occur on the spot or in hospitals, where data are accurately collected and recorded. The Royal Brunei Police Force collects road crash, fatality and other casualty data, which are reported in the *Brunei Darussalam statistical yearbook* [29]. This also provides other data, including various socio-economic, environmental and demographic data. All these data are used extensively for this study.

The patterns of road fatalities from 1984 (when Brunei became independent) to 2007 (when the latest completed road casualty data were available), together with population and vehicle registrations, are presented in Figure 1. It is clear that road fatalities have decreased since 1993, except in recent years, despite a significant increase in population and vehicle registration.



Source: Data compiled by Royal Brunei Police Force and taken from Brunei Darussalam statistical yearbook: 1996/97-2008 [29]

Figure 1. Road fatalities, vehicle registrations and population in Brunei: 1984-2007

Brunei undertook various road safety measures, and introduced and implemented many road safety initiatives, after road fatalities climbed to 79 (the highest ever in Brunei) in 1993. This was very high for a country that, at that time, had a population of 276,300. Brunei's road fatalities have decreased since 1993, except in recent years, as reflected by various media reports [30] and as can be seen from Figure 1.

Many important factors appear to have significantly reduced road fatalities in Brunei, among which are better road design and vehicle construction; medical advancement and improved medical facilities; better driving, education and road safety awareness among road users; and implementation of some effective road safety measures. Other factors, such as media publicity and road safety techniques such as clearly delineated road surface markings and road signage, have also helped to reduce fatalities. In Brunei, place names and directions are clearly written in each lane of the road at major intersections and roundabouts, so that drivers and riders can see them from a long distance and head towards their destination without difficulty.

Aims of this research

The main aim of this study was to investigate the change in the pattern of road fatalities in Brunei. More specifically, it investigated the following hypotheses:

- that the annual rate of road fatalities has decreased in Brunei since 1993
- that during recent years, lax enforcement of traffic laws is to blame for the rise in annual road fatalities
- that the proportion of road fatalities per vehicle in Brunei is similar to that of Victoria, Australia.

Brunei has achieved a lot in road safety and it can be considered a model for the trajectory of road safety in South-East Asian countries, which can be tested through the above hypotheses.

Brunei crash data - International comparisons

From 1995 to 2007, most countries experienced decreased road fatalities, even though the world saw a rapid increase in economic development and a greater number of cars. These decreased road fatalities were also observed in Brunei and surrounding countries in the region. Table 1 presents road fatalities per 10,000 vehicles in Australia, Brunei, Malaysia and Singapore. It shows that Brunei's road fatalities have reduced from 3.46 per 10,000 vehicles in 1995 to 1.78 in 2007.

Table 1. Road fatality rates per 10,000 vehicles for various countries: 1995 – 2007[a]

Road fatalities per 10,000 vehicles				
Year	**Countries**			
	Australia	**Brunei**	**Malaysia**	**Singapore**
1995	1.5	3.46	8.4	3.59
1996	1.4	3.60	8.20	3.4
1997	1.21	3.18	7.37	3.8
1998	1.23	2.49	6.28	3.2
1999	1.18	2.18	5.83	2.9
2000	1.24	1.92	5.69	3.1
2001	1.34	2.04	5.17	2.7
2002	1.16	1.72	4.90	2.8
2003	0.94	1.14	4.90	3.0
2004	0.96	1.39	4.52	2.7
2005	0.95	1.38	4.18	2.3
2006	0.90	1.11	3.98	2.4
2007	0.87	1.78	3.70	2.6

[a]*Sources:*

Victorian (Australian) data are supplied by VicRoads [31]

Brunei data are compiled by the Royal Brunei Police Force and taken from the *Brunei Darussalam statistical yearbook*: 1996/97-2007 [29]

Malaysian data are taken from Global Road Safety Partnership (GRSP), 2005 [25]

Singapore data are from *Monthly digest of statistics Singapore*, May 2008, and *TP road traffic accidents in Singapore*, 2005 [32]

Table 2. Estimated percentages of types of vehicles registered in various countriesa

	Countries			
Road user Groups	**Australia 2004**	**Brunei 2004**	**Malaysia 2005**	**Singapore 2008**
Cars and car derivatives	79.0	92.0	43.6	64.0
Goods vehicles and buses	18.0	5.0	5.6	17.0
Motorcycles and scooters	3.0	3.0	47.8	16.0
Other vehicles	< 1.0	<1.0	3.0	3.0

[a]*Sources:*

Australian Bureau of Statistics, Survey of Motor Vehicles Use Cat. No. 9208.0; all trucks included [34]

Brunei data are taken from ADB – ASEAN report (2005) [35]. They are based on an average of 2002-04.

Malaysian figures are based on JKR, 2005 taken from Mohd. Erwan (2007); Road Safety Annual Report [33]

Singapore figures are based on *Monthly digest of statistics Singapore*, March 2010; Singapore Department of Statistics [32]

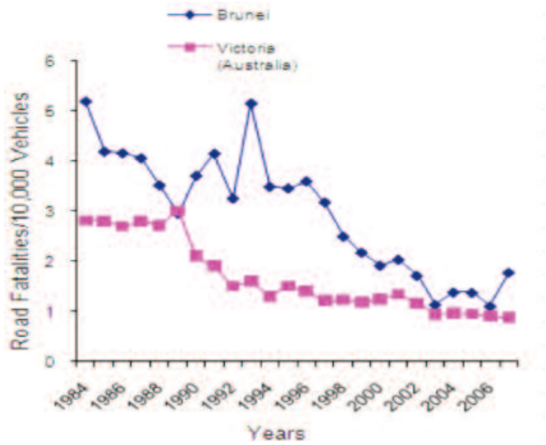
These figures are much lower than for Singapore and Malaysia. The difference between Brunei, and Malaysia and Singapore, could be due to differences in the vehicle mix. From Table 2, it can be seen that Malaysia and Singapore have 47.8% and 16.0% unprotected motorcycles and scooters on the road, respectively, compared to only 3.0% in both Australia and Brunei. As a result, there were 58% and 47.7% motorcyclist and pillion road fatalities in Malaysia and Singapore, compared to 15% and 11% in Australia and Brunei, respectively. Pedestrian and bicycle fatalities were highest in Singapore, compared to the very low number and percentage in Brunei, because most people in Brunei drive safer modern cars [31-35].

Victoria, a state in Australia, has a comparable vehicle-to-population ratio to Brunei, and it would be appropriate to compare road fatality rates between Victoria and Brunei rather than comparing Brunei with Singapore and Malaysia, both of which have lower vehicle-population ratios. Figure 2 presents the road fatality rates per 10,000 vehicles from 1984-2008, and it clearly shows that the road fatality rates in Brunei were always higher than in Victoria. A similar picture is observed for the fatality rates per 100,000 population. However, population proportion tests based on Z-statistic indicate that in recent years, these differences are not statistically significant.

Brunei crash data – Linear regression analysis

Many methods can be used to analyse road fatalities. For example, Xin Pei et al. [36] used a joint-probability model for analysing car crash prediction. Kim et al. [37] and Milton et al. [38] used the mixed logit models to analyse pedestrian injury and highway crash severities, respectively. Ma et al. [39] used a multivariate Poisson regression model for predicting crash counts, using Bayesian methods, and Malyshkina and Mannering [40] analysed crash-injury severities using Markov switching multinomial models. Besides these, Carlo et al. [41], Leveson [42], Anastasopoulos and Mannering [43] and others also used a number of techniques to analyse road crashes/fatalities.

However, because of data limitations in this study, we used the regression method. The regression model is good to identify the factors that are responsible for road fatalities and to test changes in road fatality patterns. Previously, many authors such as Haque [13, 14], Loeb [19], Partyka [17] and Evens and Graham [44] have used the regression method to analyse road fatalities.



[a]*Sources:*

Brunei data are compiled by the Royal Brunei Police Force and taken from the *Brunei Darussalam statistical yearbook*: 1996/97 – 2007 [29]

Victorian (Australian) data are supplied by VicRoads [31]

Figure 2. Road fatalities per 10,000 vehicles in Brunei and Victoria, Australia: 1984-2007[a]

Specification of the functional form is important to determine the factors that are responsible for road fatalities. There is no unique functional form that can satisfy all the desired properties. Therefore, options are given to the researchers to choose the functional form to analyse road fatalities. A linear function is often taken as a first approximation to a class of regular curve. Haque [13, 14], Loeb [19] and Partyka [17] all used linear functional form to investigate the relationship between road fatalities and various socio-economic variables, which were also used for this analysis.

Long-term road fatality analysis

In this study the Ordinary Least Square (OLS) method has been used to estimate a linear regression model. The number of road fatalities is used as the dependent variable, while the number of vehicles ('000), fuel sales for cars (proxy for travel exposure), total improved road length, total population ('000), people aged between 18 to 24 years, yearly number of rainy days, average number of bright hours per day, gross domestic product, number of employed and unemployed persons, number of new vehicles registered and a trend variable from 1993 to 2007 are used as independent variables to analyse road fatalities in Brunei. Justification for using these variables is given below.

From Figure 1, it is clear that both the population and the number of vehicles have increased in Brunei over time. It is expected that these will continue to rise with economic growth, which will increase the risk of crashes and fatalities, as indicated in the 2005 ADB-ASEAN report [35].

Another ADB-ASEAN report also pointed out that the numbers of young drivers are expected to rise in Brunei. It is estimated that in 2007, approximately 80% of the people aged between 18 to 24 years in Brunei held driving licenses [29, 45]. Furthermore, in 2008 their involvement in road fatalities was more than 41%, even though they represented less than 14% of the total population [29]. Hence, there is enough justification to investigate this group for the analysis. Fuel sale is used as a proxy for vehicle mileage travel, which is also expected to grow with the increase in population and number of vehicles. Rain is very frequent in Brunei and makes the roads hazardous in wet conditions, especially on highways. All of these factors can lead to an increase in road crashes and fatalities.

Brunei is developing faster than many developing countries; its per capita GDP is increasing at a rapid pace, and its economic condition is much better than in surrounding countries. Hence, road fatalities are likely to fall as GDP grows, due to the use of more modern and safer cars.

At present, Brunei has more improved road length, in the sense that many ill-maintained and unimproved one-way roads have been converted to two-way roads, additional two-way roads have been built, and many black spots and roadside obstacles have been eliminated. This is also expected to reduce road crashes and fatalities. In addition, lower unemployment numbers may lead to a higher number of road fatalities and vice versa (see Haque [13, 14], Loeb [19], Partyka [17]). A yearly trend variable is used to cover the combined effects of all the road safety measures implemented so far to reduce the road toll.

In addition to the above variables, we also investigated the effect of average bright hours per day on road fatalities in Brunei. Most of the days in Brunei are bright, but sometimes due to cloudiness or rain, the bright daylight hours are cut short. Hence, vehicles are more likely to be involved in crashes on those days with shorter hours of bright light. Obben [46] used some of these variables to analyse road casualties in Brunei.

To see the impact of non-implementation of traffic laws in recent years (2004-2007), a dummy variable was created: NITL = 1 (for 2004 to 2007) if traffic laws are not fully implemented and NITL = 0 (1993 – 2003) if traffic laws are fully implemented. From Figure 1, it is clear that road fatalities were decreasing from 1993 to 2003 when only 23 people died on the roads in Brunei. Road fatalities then began to increase from 2004 when 36 people died. This is the beginning of the recent increasing trend, which continues up to 2007 (most recent available fatality data).

Probably due to this change in trend, the Asian Development Bank (ADB) investigated the road safety situation in Brunei in 2004 and indicated that Brunei needed to: (i) review laws and compliance in the general population, (ii) improve law enforcement through more and better equipment and training, and (iii) monitor law compliance for drivers under the age of 25 years [35]. For this reason, 2004 was used as the beginning year of non-implementation of traffic rules for our study.

Figure 1 clearly shows that the data are non-stationary. To reconfirm this, the Augmented Dickey-Fuller (ADF) test was carried out, which shows that the data are non-stationary and therefore have unit root. The behaviour of the autocorrelation (ACF) also indicated that the data are non-stationary. To make the data series stationary we have differenced the data both at seasonal and non-seasonal levels before estimating the parameters of the model. Stationary data series means a stable (no ups and downs) data series, which is smooth and does not have high variations from previous observations. Stationary data are essential for accurate model estimation and prediction.

The SPSS computer software package was used to estimate various statistics and parameters of the model. The Durbin-Watson DW-statistic showed no problem of autocorrelation. The model was also tested for heteroscedasticity according to the procedure given in Glejser [47], and again no evidence of this problem was found. Multicollinearity was highly pronounced among some independent variables for the original observations. In order to avoid this problem, we re-ran the regression after withdrawing some variables that were related to each other.

We then selected only the following important variables, and the final long-term estimated regression coefficients (both standardised and un-standardised) for road fatalities in Brunei are presented in Table 3. The p-values of the different estimated parameters of the model are given in the last column. Unstandardised estimated regression coefficients are generally reported instead of standardised coefficients, because a change in standard deviation in one variable can make similar change in other predictors. However, it removes the 'scale of unit' and allows ordering the importance of various independent variables, which are included in the model.

The summary statistics indicate that the model explains road fatalities very well. The F-statistic shows that there exists a very high significant association between road fatalities and all the independent variables considered in our model, except Vehicles and Rainy Days. The coefficient of determination, adj-R^2 = 0.908 which is very high, indicates that the fit of the model is very good.

Table 3. Estimates of multiple regression coefficients

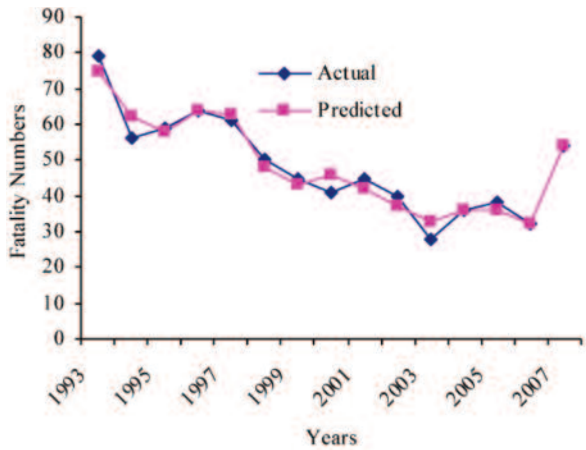
Independent variables	Unstandardised coefficients	Standardised coefficients	p-values
Constant	-72.468	-	0.001
Trend	12.580	9.45	0.000
Age 18-24 Years	6.781	4.03	0.001
New Vehicles Registered	1.544	0.98	0.035
NITL	2.010	1.07	0.047
Unemployment	-0.180	-0.145	0.050
Vehicles	2.054	1.85	0.570
Rainy Days	0.021	0.018	0.720
$F_{6, 8} = 20.190$; DW-statistics = 2.72 and Adj-R^2 = 0.908			

Source: Data compiled by Royal Brunei Police Force and taken from *Brunei Darussalam statistical yearbook*: 1996/97 – 2007 [29]

Plots of residuals against time showed that all important variables are taken care of in the model. This implies that not many separate additional factors would contribute in reducing road toll. Hence, a package of road safety measures is suggested for implementation to further reduce road fatalities in Brunei. The coefficients of all the independent variables of the estimated model have expected signs, and their interpretations are given below.

- **– 12.580 Trend** means that there will be a significant reduction of 12.58 road fatalities every year due to the introduction of a number of road safety laws, police initiatives, better road and motor vehicle design and construction, medical advances and better medical facilities for road victims, and public road safety awareness and care in driving vehicles, provided other factors remain constant.
- **+ 6.781 Age 18-24 Years ('000)** means that there would be a significant expected 6.781 more road fatalities if there were an increase of 1000 people aged 18-24 years in Brunei. From vital statistics it is observed that there is an annual increase of approximately 1500 people aged between 18 to 24 years, indicating that every year Brunei would expect 6.781 x 1.5 = 10.17 additional road fatalities due to the increase in the number of young people, which is observed from the normal expected behaviour (not by a chance factor) of the young people as road users, if other factors remain constant.
- **+ 1.544 New Vehicles Registered ('000)** means that there would be a significant expected 1.544 more road fatalities for an increase of 1000 new vehicles registered in Brunei, if other factors remain constant. At present, there is an average yearly increase of 15,000 new registered vehicles in Brunei, which can increase 1.544 x 15 = 23 more road fatalities per year due to new vehicles registered.
- **+ 2.010 NITL** means that there was a significant increase of 2.01 more fatalities in each year from 2004 to 2007 due to non-implementation, compared to full implementation, of traffic laws in Brunei if other factors remain constant.
- **– 0.180 Unemployed ('000)** means that there would be a significant expected 0.18 fewer road fatalities if there were 1000 more unemployed people in Brunei, provided other factors remain constant. Currently, the unemployment number is quite stable in Brunei and hence the number of road fatalities is not expected to change due to the unemployment factor.
- **+ 2.054 Vehicles ('0000)** means that there would be an insignificant increase of 2.054 road fatalities for an increase of 10,000 more vehicles on roads in Brunei.
- **+ 0.021 Rainy Days** means that there would be an insignificant expected increase of 0.02109 more road fatalities, if there were one more rainy day in a year in Brunei, provided other factors remain constant.

We then checked the robustness of our results, meaning whether the estimated parameters of our model differ significantly due to a small change in our data series. This has been examined by re-running a regression without the observations of 1993 and 1994. The results obtained from this new regression were not significantly different from the results of our estimated regression model, presented in Table 3. This shows that our results presented in Table 3 are fairly robust. On the whole, there is good agreement between the actual and fitted road fatality numbers, which can also be seen from Figure 3.



Source: Data compiled by Royal Brunei Police Force and taken from *Brunei Darussalam statistical yearbook*: 1996/97 – 2007 [29]

Figure 3. Long-term road fatality model for Brunei: 1993-2007

Short-term road fatality analysis

A short-term model was then considered to see the recent pattern of road fatalities in Brunei. This is because recent variation in the number of road fatalities can be better understood by incorporating all the current events, including road safety activities. Recent monthly data can be used to show the current pattern of road fatalities. Here we used monthly road fatality data available from January 2007 to July 2008 as a dependent variable, and the number of vehicles and trend as independent variables. In order to avoid seasonality, which is common in monthly road fatality data due to a number of identified factors (traffic volumes for a certain month, weather, darkness, etc.) and unidentified factors, we smoothed the monthly data by a moving average method using 12 points.

The same OLS method was used to estimate the parameters for the short-term linear regression model. Significant variables of the final estimated model are presented below with t-values given in parentheses.

$$\textbf{Fatalities} = \underset{(4.28)}{\textbf{22.315}} + \underset{(3.72)}{\textbf{0.710}}\ \textbf{Vehicles ('000)} + \underset{(5.23)}{\textbf{0.163}}\ \textbf{Trend}$$

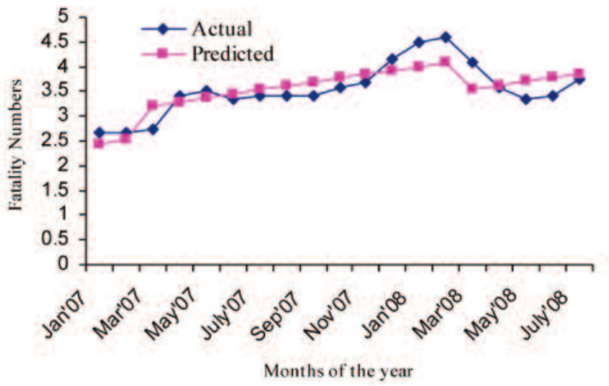
$F_{2, 16} = 16.60$; Adj-$R^2 = 0.668$; DW-statistic = 1.50

The above estimated short-term model shows that the regression coefficient of the Vehicles variable has an expected positive sign, but the regression coefficient for the Trend variable has a positive rather than a negative sign, which was observed earlier in the long-term model (Table 3). This shows that a change of pattern of road fatalities occurred in Brunei from 2004. The summary statistics indicate that, overall, the short-term model fits well for our data, which can also be seen from Figure 4. The interpretations of the estimated regression coefficients of the short-term model can be explained in a similar way to the long-term model and are provided below.

- **+ 0.710 Vehicles ('000)** means that there would be a significant monthly average increase of 0.710 road fatalities for an additional monthly increase of 1000 vehicles in Brunei, provided other factors remain constant. Currently, on average, 1200 vehicles per month are added to the roads and hence 0.71 x 12 = 8.5 more fatalities are expected per year due to the Vehicles factor, which is higher than the long-term yearly figure observed from Table 3.
- **+ 0.163 Trend** means that there would be a significant monthly average increase of 0.16 fatalities, indicating that there is an upward trend of fatalities in recent months provided other factors remain constant, which is consistent with media reports (see the *Brunei Times*, 9 January, 6 and 27 February, and 16 March 2009 [30]).

This is in contrast to the long-term road fatality model (Table 3), which showed a negative coefficient for the Trend variable. This means that road fatalities have increased in recent months in Brunei, confirming that there is a change in the pattern of road fatalities in Brunei; a decreasing road fatality trend has now changed to an increasing trend, probably due to non-implementation of traffic laws, which can also be seen from the positive coefficient of the NITL variable (Table 3).

It is confirmed from recent media reports that road crash fatalities have increased in recent years and months. The Brunei government should now make sure that all traffic laws are fully implemented, in order to return the recently increasing trend to the more normal long-term decreasing trend, so that Brunei continues to have lower numbers and rates of road fatalities in future years.



Source: Data compiled by Royal Brunei Police Force and taken from *Brunei Darussalam statistical yearbook*: 1996/97 – 2007 [29]

Figure 4. Short-term road fatalities with seasonally adjusted monthly data: January 2007 - July 2008

Discussion

It can be seen from this study that road fatalities have reduced significantly in Brunei since 1993, except in recent years, even though the numbers of people and vehicles have increased significantly during this period. However, when we compare road fatality rates per 10,000 vehicles in Brunei and Australia (Figure 2), it is clear that Brunei's road fatality rate was consistently higher than Australia's. This indicates that there is significant scope to reduce road fatalities in Brunei. To make a significant improvement in road safety, we must first identify the causes of road fatalities. Most road crashes happen due to multiple causes (see Treat et al. [48], Rumar [49], Harry and Reagan [50] and others).

Rumar [49] used American and British crash reports as data and found that 57% of crashes were due solely to the driver factor, 27% to combined roadway and driver factors, 6% to vehicle and driver factors, 3% solely to roadway factors, 3% to combined roadway, driver and vehicle factors, 2% solely to vehicle factors, and 1% to combined roadway and vehicle factors. Analysing these reports he found that driver error, intoxication and other human factors contribute wholly or partially to about 93% of crashes, which is consistent with the earlier finding of Treat et al. [48].

Therefore, to achieve a significant reduction in road fatalities, Brunei should now adopt the new Safe System approach to road safety, which emerged initially from the Netherlands' Sustainable Safety Approach in the 1990s and later resurfaced from Sweden's Vision Zero road fatalities (see National Road Safety Council [51] and Langford [52]). Subsequently, this new Safe System approach to road safety has been adopted by many countries around the world (see Langford [52], Peden et al. [53] and International Transport Forum [54, 55]).

The new Safe System approach to road safety aims to avoid deaths and serious injuries by reducing crash forces. It advocates that crash forces remain below a threshold level, so that they cannot cause any serious injuries to the human body in the event of road crashes. It allows for human error, irrespective of the level of education and compliance in obeying traffic laws, rather than blaming the road users for crashes.

This Safe System approach deals with road and vehicle designs and travel speed; it recognises that there will always be some crashes, but it tries to avoid deaths and serious injuries by reducing crash forces to a level that the human body can tolerate without any serious injuries. The main goal of the Safe System approach is to eliminate deaths and injuries by allowing for human error, lowering crash forces to those that the human body can tolerate and minimising unsafe road user behaviour. It is a shared responsibility among road and vehicle designers and users at local, regional and national levels.

In this respect, it promotes a comprehensive approach to road safety that involves identifying the interactions between the road user, the vehicle and the road environment, i.e., the potential areas of intervention. This approach recognises that the human body is highly vulnerable to injury and that humans make mistakes. A safe road traffic system is therefore one that accommodates and compensates for human vulnerability and fallibility, which is shown diagrammatically in WHO's [56] *Global status report on road safety*.

Brunei could reduce road fatalities further by adopting this new Safe System approach to road safety, and could make a successful road safety strategy more effective by introducing and implementing the following important road safety initiatives:

- setting appropriate safety speed limits and monitoring and punishing offenders
- setting lower speed limits near schools, colleges, and shopping and community centres
- using movable speed cameras for detecting driving speeds at different locations
- legislating and enforcing lower driving speeds at night and during darker hours, particularly for young drivers
- adopting and implementing laws related to drugs, alcohol, etc.
- adopting and implementing laws related to fatigue
- using red light cameras for the detection of light violation offenders
- introducing a demerit point system to deter traffic offences
- educating traffic offenders who accumulate certain demerit points
- making and maintaining better roads and vehicles for safe driving
- developing a better public transport system to reduce car use.

Conclusions and limitations

In this study we investigated road fatalities in Brunei and found that road fatalities have significantly declined since 1993 (the worst road safety year), even though the population and the number of vehicles have increased manyfold. Thus, Brunei has achieved an impressive record of road safety during the last couple of decades. Furthermore, the study shows that Brunei has the lowest fatality rate per 10,000 vehicles compared to Malaysia and Singapore, and possibly to most South-East Asian countries.

However, when we compared road fatality rates with Australia, we found that Brunei's road fatality rate was consistently higher, even though not that significant from 2004 to 2007. Therefore, Brunei can be seen as the trajectory of road safety in South-East Asian countries. We believe that there is scope to reduce road fatalities in Brunei, similarly to Australia, if Brunei were to introduce and implement some of Australia's successful road safety strategies [57] and adopt the new Safe System approach to road safety.

On the whole, this study has attempted to underpin the causes of road fatalities in Brunei. It introduced a number of road safety, socio-economic, environmental and demographic variables and inferred that young drivers (80% of people aged between 18-24 years have driving licenses in Brunei), new vehicle registration and non-implementation of traffic laws are the main causes of road fatalities in Brunei.

The model developed can measure the effects of various factors on road fatalities, which can assist policy makers to take necessary actions in order to reduce road fatalities. It can also forecast the road fatalities for future years based on predicted changes in the economy, various road safety measures, and socio-demographic and environmental factors.

This is the most comprehensive study of the kind yet attempted to analyse road fatalities in Brunei. Thus, it can help policy makers to take necessary decisions on how to use limited funds to achieve the maximum benefit for the community. Generalisation of our model is straightforward, and many explanatory variables can be incorporated to explain road fatalities without any difficulties. It is recommended that this type of statistical model should be used to analyse road fatalities in other countries.

There are several limitations for our study. First, most data are taken from the *Brunei Darussalam statistical yearbook* [29], which may be subject to criticism, because these data are compiled for general use. Second, a general Box-Cox type function should be tried to predict road fatality numbers more accurately in Brunei. Due to unavailability of longer monthly data for a number of important variables, we used only Vehicles and Trend as independent variables for our short-term model; these are neither enough nor complete. Thus, our short-term results may be subject to criticism, but are still good enough to show the start of an increasing road fatality pattern from the beginning of 2004, following a downward trend.

The present analyses also did not consider road fatalities for specific road user groups, viz., pedestrians, motorcyclists, bicyclists and novice drivers, who face different risks of death on the roads. For that reason the new Safe System approach, which allows for human error and tries to avoid death and serious casualties due to road crashes, should be adopted by Brunei. This is because many countries have made significant improvement in road safety by adopting the Safe System approach. More details on the Safe System approach can be found in WHO's [56] *Global status report on road safety*.

It is thus recommended that Brunei should adopt the new Safe System approach to road safety, which builds on the existing road safety system, but adopts a new approach in managing the entire road safety system with shared responsibilities by road and vehicle designers and road users. Thus, all people living in Brunei should share overall responsibilities and accountabilities for road safety, and should aim to achieve zero road fatalities in future years.

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Understanding speeding in school zones in Malaysia and Australia using an extended Theory of Planned Behaviour: The potential role of mindfulness

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Abstract

Speeding in school zones is a problem in both Malaysia and Australia. While there are differences between the countries in terms of school zone treatments and more generally, these differences do not explain why people choose to speed in school zones. Because speeding is usually an intentional behaviour, the Theory of Planned Behaviour (TPB) has been used to understand speeding and develop interventions; however, it has limitations that can be addressed by extending the model to incorporate other constructs. One promising construct is mindfulness, which can improve the explanatory value of the TPB by taking into account unintentional speeding attributable to a lack of focus on important elements of the driving environment. We explain what mindfulness is (and is not), how it can assist in providing a better understanding of speeding in school zones, and how it can contribute to the development of

interventions. We then outline a program of research that has been commenced, investigating the contribution of mindfulness to an understanding of speed choice in school zones in two different settings (Australia and Malaysia) using the TPB.

Keywords

School zones, Speeding, Theory of Planned Behaviour, Mindfulness, Malaysia, Australia

Introduction

There has been growing concern associated with the increasing number of fatal road crashes in Malaysia in the last two decades. This concern has been shown in the extent of media discussion focused upon road safety, involving concerned citizens, academics and members of non-governmental organisations, such as Malaysians Unite for Road Safety (MUFORS). In 2009, out of a population of 28.3 million, 6745 road users died in road crashes, compared with 4048 in 1990 [1]. Among those who die on Malaysian roads, almost 10% are pedestrians. Of these, school children are among the victims.

Figure 1 shows that, in 2009 alone, 1146 crashes occurred around school zones and 28 crashes occurred at crossing points in school zones [2]. These crashes resulted in 124 child pedestrian casualties (for children aged 6 to 16 years) and seven child pedestrian fatalities [2]. The involvement of children in road trauma in and around school zones generates concern at all levels, and such concern has led to several research efforts directed at engineering approaches to the problem [3, 4].

In contrast, Australia appears to have had fewer problems in relation to child pedestrians in school zones. In 2008, 1464 people died in road crashes in Australia [5]. Of these, 193 were pedestrians, with only 13 of these pedestrians being aged 16 years or under [5]. The limited studies available indicate that child fatalities rarely occur in school zones.

In Queensland, only 17 child pedestrians died and 366 were hospitalised in the10-year period from 1991 to 2000. This figure is likely to overestimate school zone casualties, since it includes all casualties in the periods during which children are travelling to and from school, regardless of where the crash occurred [6]. Similarly, in New South Wales, only two child pedestrian fatalities occurred in school zones over a period of 10 years from 2000 to 2009. Further, the data suggests that speeding was not a contributing factor in any of these fatal crashes. Speeding was associated with only two out of 166 vehicle-child pedestrian crashes in school zones, neither of which resulted in a fatality [7].

Although the absolute number of speed-related crashes in school zones in which child pedestrians are fatally injured is, fortunately, low in Australia, parents and the community more broadly are understandably concerned about the safety of school children. Young child pedestrians are less visible and more vulnerable in traffic due to their small physical size, and they have less well-developed cognitive, attentional, perceptual and visual skills compared with older children and adults, which has implications for their ability to safely negotiate traffic situations [8]. Older children may also represent a safety concern, however, to the extent to which they fail to apply safe pedestrian skills [9].

There appear to be greater levels of speed compliance in school zones in Australia than in Malaysia, even when a vulnerable group is involved and 'hard' traffic engineering measures are employed, e.g., the speed humps used in all school zones in Malaysia. There is limited evidence on speeds in school zones in Malaysia, with one study finding 85th percentile speeds of 78km/h, 87km/h and 96km/h in three different school zones (two primary schools and one secondary school) [10]. In Australia, 85th percentile speeds of 59.7km/h and 60km/h have been recorded in school zones [11, 12].

It is notable that the 85th percentile speeds are much higher in Malaysia than in Australia, even though the typical speed limit in school zones is higher in Australia (40km/h vs 30km/h) and only 'soft' engineering measures are used (signs and pavement markings). These findings raise questions about the nature of speeding in school zones in Malaysia and Australia, and suggest that a better understanding of the reasons for speed choice in school zones in both countries is needed, as a way of informing countermeasures in Malaysia and Australia. As speeding is usually considered an intentional behaviour on the part of drivers, the widely used Theory of Planned Behaviour (TPB) provides an appropriate framework for research investigating such behaviour. The application of the TPB to speeding is outlined in the next section.

Source:
Malaysian Royal Police [2]

Figure 1. Road crashes in school zones in Malaysia 2000-2009)

Table 1. Conceptualisation of mindfulness in relation to speeding behaviour research

Author	Mindfulness definition	Usage in speeding behaviour
Kabat-Zinn, 2003	'paying attention in a particular way, on purpose in the present moment and non-judgementally to the unfolding of experience moment by moment'	Not appropriate – judgement needed
Baer, 2003	'a non-judgemental observation of the ongoing stream of internal and external stimuli'	Not appropriate – judgement needed
Langer & Moldoveanu, 2000	'a process of drawing novel distinctions'	Not appropriate – sees mindfulness as unmodifiable trait
Brown & Ryan, 2003	'enhance[d] attention to and awareness of current experience or present reality'	Appropriate concept

Source: Derived from Hanan, King and Lewis [21]

Since the TPB applies to intentional behaviour and speeding in school zones may also be undertaken unintentionally by a driver (failing to notice the school zone sign, the presence of children, etc.), the use of the TPB could be extended by incorporating a construct that attempts to account for these unintentional factors. As explained below, the proposed construct is mindfulness, which is beginning to be used more widely in a number of settings. The discussion of mindfulness will clarify what the term means, how it applies to speed behaviour in school zones and how it can be incorporated into the proposed future research program to be undertaken in both Malaysia and Australia.

Understanding why people speed – The Theory of Planned Behaviour (TPB)

The TPB has been applied widely in social behavioural research. In simple terms, the TPB states that actual behaviour is predicted by intended behaviour and the degree of control people believe that they have over the behaviour. In turn, intended behaviour is predicted by the combination of attitudes towards the behaviour, perceptions about how the behaviour would be regarded by others (social norms) and perceptions about how much one can control the behaviour.

In relation to speeding, across a range of settings, the TPB variables have been found to predict between 36% and 85% of intention to speed and between 32% and 77% of self-reported speeding behaviour [13-18]. However, while the TPB initially claimed to be a complete model of social behaviour, the intention-behaviour relationship might be affected by other variables [19, 20]. For instance, in relation to speeding behaviour, evidence shows that there are drivers who intend to speed but who do not perform the behaviour and also drivers who intend to comply with the speed limit but who ultimately exceed the speed limit [15, 18]. Such anomalies suggest that additional constructs should be considered to bridge the gap between intention and behaviour, thus improving the predictive power of the TPB.

As mentioned above, one of the constructs that may hold promise in this regard, but which has not yet been tested as an additional predictor in the road safety context, is mindfulness.

The origin and meaning of the concept are discussed in the next section, with an emphasis on the application of mindfulness to driving in general and speeding in particular. We have previously published a more detailed account of the history of mindfulness and its application to driving to which interested readers can refer [21].

Mindfulness and its conceptualisation in relation to speeding behaviour

Mindfulness is a concept derived from Buddhist philosophy, which has been used widely in studies of consciousness. More recently, mindfulness has been applied to the understanding of behaviours in areas including clinical psychology, meditation, physical activity, education, business and social behaviour [21].

Most of these studies have attempted to conceptualise mindfulness in relation to the particular context in which the research is being conducted [refer to 21]. As a consequence, more than one definition of mindfulness can be found in the literature, and not all can be applied to driving. Table 1 presents a summary of these definitions and an assessment of their usefulness [see 21 for futher detail].

As noted in Table 1, it is considered that the most relevant way to conceptualise mindfulness is borrowed from the ideas of Brown and Ryan [22]. They describe mindfulness as 'enhance[d] attention to and awareness of current experience or present reality', where a core characteristic of mindfulness is described as open and receptive awareness and attention that may be reflected in a sustained consciousness of ongoing events and experiences (pp. 822-23).

In this definition, Brown and Ryan emphasise awareness and attention as the central features of mindfulness. Awareness refers to the monitoring of the inner and outer environments, which involves the capacity to be aware of internal and external events or phenomena at any given moment. Attention is the process of focusing conscious awareness and being sensitive to

Table 2. Mindfulness and similar constructs

Construct	Definition	Example
Mindfulness	Recognising what is happening in the present moment, and being aware and attentive to events and experiences.	A driver travelling through an urban area needs to be aware of potential risks, which may change instantly (e.g., when entering a school zone, the speed limit changes at certain times of the day, thus requiring a driver to be aware of the changing speed limit in school zones and to pay attention to the presence of child pedestrians).
Situational awareness	On-going process involving judgement of happenings in the environment so as to provide meaning regarding the information at hand and to aid decision making.	While driving, the driver needs to know where other vehicles and obstacles are, as well as the status and movements of the vehicle being driven. For example, drivers must predict child pedestrian movement in school zones (e.g., running across the road) so that they know when to stop or to speed.
Mindlessness	The human tendency to operate on autopilot without concern for consequences or outcome, whether by stereotyping, performing mechanically or simply by not paying attention.	A driver, when driving on a familiar route, and who arrives at their destination without recalling anything about their journey.
Distraction	An activity or event that diverts the attention of the individual away from the given task and, thus, compromises performance.	A driver's attention is not focused on the road, such as tuning the radio, eating, using a mobile phone or attending to a child.
Inattention	Important elements of the situation or environment that have not been attended to (which could be due to a range of factors including, for example, fatigue or intoxication).	Failure to notice a pedestrian crossing the road or a decelerating vehicle may result from fatigue or intoxication/impairment.

Source: Derived from Hanan, King and Lewis [21]

the present reality of that particular time, capturing 'figures' and holding them up for closer examination. It appears that, although there is a conceptual distinction between awareness and attention, they are intertwined within this conceptualisation of mindfulness.

Driving is a multitasking activity that requires drivers to manage their attention between various driving and non-driving-related tasks. The driving activity is one where both situational responsiveness and the capacity for changing one's degree of awareness and attention are important, thus highlighting the particular value of the definition of mindfulness provided by Brown and Ryan [22] for use in driver behaviour research.

An individual driver needs to stay focused, pay attention to the surrounding dynamic traffic environment, and be aware of what is happening around him/her in the present situation so that he or she can reflect on that information and take the right action. A driver travelling through an urban area needs to be aware of the unfolding environment, which includes being aware of potential risks that may change instantly – for example, when entering a school zone, where the speed limit changes and when at certain times of the day there are increased numbers of child pedestrians who could be at risk if the driver does not slow down. It is evident that this situation (entering a school zone) involves not just the awareness of one's own behaviour, but also the focusing of one's attention on important elements of the environment.

In order to assess the potential role of mindfulness within the TPB model, some way of operationalising mindfulness in the driving context is required. There are several instruments based on differing conceptualisations of mindfulness. The scales include the Freiburg Mindfulness Inventory (FMI) [23], the Toronto Mindfulness Scale (TMS) [24], the Kentucky Inventory of Mindfulness Skills (KIMS) [25] and the Mindfulness Awareness Attention Scale (MAAS) [22]. We have argued [21] that the most appropriate mindfulness scale for use in speeding-related behaviour research is the Mindfulness Awareness Attention Scale (MAAS) developed by Brown and Ryan [22]. See Hanan, King and Lewis [21] for more detail.

(a) (b) (c) (d)

Figure 2. Typical countermeasures in school zones in Malaysia: (a) tranasverse bar, (b) speed hump, (c) traffic light with zebra crossing, and (d) school zones and 30km/h speed limit sign

In conceptualising the mindfulness construct, it is important to distinguish it from other seemingly similar constructs. As well as situational awareness (SA), the constructs of distraction and inattention have, on the surface, some similarity to an individual being less mindful, or exhibiting mindlessness. Table 2 presents a summary of these different constructs and examples of their application.

To date, there has been minimal research linking the concept of mindfulness with safety behaviour and specifically driver behaviour. For instance, Demick [26] assessed the effects of cognitive style and other variables on driving behaviour. Interestingly, he found that the results could be reframed within mindfulness theory, as the task required a heightened cognitive state of mindfulness characterised by actively drawing distinctions. Similarly, Kass, Cole, and Legan [27] reviewed literature on driver distraction focusing on situational awareness (SA). To improve SA, these authors recommended mindfulness training, as it may assist in educating drivers on how to be more aware of external and internal stimuli that are relevant to driving, stress and distraction.

A recent study by Ledesma et al. [28] examined the validity of the newly developed Attention-Related Driving Errors Scale (ARDES) in terms of several psychological variables that may be related to attention failure, among which they included mindfulness. They found that driver attention error is closely related to the lack of attention and awareness in the everyday lives of an individual driver.

In relation to school zones, in Malaysia 'hard' engineering measures (i.e., traffic calming) have been implemented (see Figure 2), and in Australia 'soft' engineering measures (i.e., 40km/h speed limit signs and school zone signs) have been applied to attract the attention of and build awareness among drivers when they enter the school zone.

However, these measures appear to have limited success in raising drivers' awareness and reducing speeds in school zones. As noted earlier, the number of crashes in school zones remains high in Malaysia in comparison with Australia. This raises questions about whether, in addition to differences in the TPB constructs that predict intention and behaviour in each country, mindfulness might also differ between Malaysian and Australian drivers when they go through school zones.

Of the studies that are available, the evidence suggests that research on mindfulness in driving and similar situations is still in its early days, and that the role of mindfulness in relation to other constructs is far from clear or established. One important area in which clarification is needed was identified by Demick [26], who argued that there is a need to explore the relationship between intentionality and action in the driving context and to consider integrating mindfulness theory within any theoretical orientation, which may help in understanding the complexity of behaviour.

As noted above, the TPB is one of the primary theoretical approaches that posits a link between intention and action and that has demonstrated applicability in the road safety context. As such, Demick's comments highlight a belief, similar to ours, that there is possibility for mindfulness to be considered in relation to the TPB and speeding-related research, particularly speeding in school zones.

Ultimately, it is intended that the research will contribute to the development of interventions. If it can be demonstrated that the use of the TPB explains a practically important proportion of the variance in speeding behaviour in school zones when mindfulness is added, then interventions can be developed in accordance with the key factors that motivate the behaviour.

Outline of proposed research

The proposed program of research will utilise qualitative and quantitative methods in two countries (Australia and Malaysia) to examine drivers' general beliefs, individual and situational predictors of intentions, as well as (self-reported) behaviour in relation to speeding in school zones. While school zones were chosen for the reasons outlined at the beginning of the paper, their use will help to increase road safety knowledge in other ways because understanding speeding in such contexts has attracted limited attention in previous research.

For example, Parker, Manstead, Stradling, and Reason [14, 29] developed a speeding scenario in residential areas. Elliott and Armitage [18] and Elliott, Armitage and Baughan [30] focused on 20mph, 30mph and 40mph roads in a built-up area. Forward [31, 32] also investigated speeding in an urban area, and Warner and Aberg [15, 33] explored speeding behaviour in urban and rural settings. In addition, the school is a centre for a child's daily activity and is intended to be safe for children during school times. A range of measures has been introduced to improve school zone effectiveness and these measures have evolved over time as a means of enhancing safety around schools.

The proposed program of research will be underpinned by the TPB, and each of the three studies will be informed by and build upon the preceding studies. Specifically, the research will seek to elicit beliefs, examine a range of predictors of behavioural intentions, and finally explore the association between intentions and behaviour within an extended Theory of Planned Behaviour.

Specifically Study 1, underpinned by the TPB, will examine the general beliefs associated with speeding violations in school zones, as well as a range of potential individual and situational factors influencing this behaviour. This examination will be conducted in both Australia and Malaysia and, as such, the research will be able to investigate similarities and differences between the beliefs and other factors influencing speeding in school zones between the two countries.

In accordance with standard practice for the usage of the TPB, which is to elicit relevant beliefs, Study 1 will utilise focus group discussions. The focus group methodology functions as an important and effective means of eliciting relevant and appropriate TPB-based beliefs, as well as initial exploration of the extent to which mindfulness may influence driver speed choice across a range of driving contexts.

Further, given that the study is investigating the proposed theoretical framework within Australian and Malaysian contexts, it is important to ensure that the beliefs and constructs explored are relevant and appropriate within these different contexts. The TPB's predictive capabilities are greatest when researchers take care to develop all measures in accordance with the TACT principles (i.e., Target, Action, Context and Timing - see Ajzen [19]), so these principles will be observed in the research.

Study 2 will examine a range of independent variables contributing to intention to speed in school zones via a scenario-based study, where the variables will include mindfulness in addition to the standard TPB constructs. The dependent variable in this study will be intention to speed in school zones.

Study 2 will be a cross-sectional study, which will utilise a self-report questionnaire. The questionnaire will seek drivers' responses in relation to a series of driving scenarios. An example of scenario is as follows: "It is a school day. You are driving alone through a school zone. The time is 8.30am on a fine and dry day. The road has a 40km/h speed limit and you are driving at 40km/h. You drive this route every day at this time. A car approaches you from behind at a higher speed, and cars travelling the other way are doing about 60km/h".

It is anticipated that there will be four different driving scenarios, thus reflecting a 2 x 2 manipulation of factors (e.g., other driver and person-related factors). These factors will be determined from the results of Study 1 and the literature review. This study will therefore be a 2 x 2 between-groups design involving approximately 500 drivers.

Finally, Study 3 will examine the intention – behaviour relationship (how intentions translate into actual behaviour) and, in particular, the extent to which this relationship may be moderated (or mediated) by the mindfulness construct. It will represent an important extension of Study 1 and Study 2, given that it will be a larger quantitative study based upon self-report questionnaires that will include a follow-up (self-reported) measure of behaviour. In this study, the dependent variable will be speeding behaviour in school zones.

As mentioned previously, all of the studies within the program of research will measure mindfulness according to Brown and Ryan's [22] Mindfulness Awareness Attention Scale (MAAS), in addition to the TPB questions. At the time of preparation of this paper, the first author is undertaking focus group research in Australia and will later conduct focus group research in Malaysia.

Conclusion

In summary, speeding in school zones remains a pervasive problem in Malaysia despite the implementation of a range of interventions. Such behaviour needs to be better understood if more effective countermeasures are to be developed. While in Australia school zones rely more on driver compliance, in Malaysia they rely more on the countermeasures actively forcing drivers to slow down through 'hard' engineering features. Thus, the comparison between driver motivations for speeding in school zones (as well as those factors that reduce/ prevent speeding) in both Australia and Malaysia may provide insights into the best way to proceed with future countermeasures in Malaysia.

Because of the intentional nature of speeding, the TPB is an appropriate model for understanding speeding behaviour in school zones, yet there is still a considerable amount of variance in the intention and behaviour relationship that remains unexplained. As outlined in this paper, the concept of mindfulness can be applied to driving, and has some promise as a complement to the TPB, provided that definitional issues are clarified. This paper has proposed a definition of mindfulness that can be used to conduct research, and has outlined a proposed program of research. It is anticipated that the research will lead to a better understanding of drivers' speeding in school zones, the development of interventions that incorporate consideration of mindfulness and, ultimately, a reduction in child pedestrian casualties in both countries.

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Vulnerable road user safety: A comparison between a middle-income and a high-income country

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Abstract

The study set out to compare crash and injury patterns of Vulnerable Road Users (VRU) between a high- and a middle-income country to illustrate relative outcomes between such countries. Several analyses of crash and casualty crash patterns were undertaken using real-world crash databases from Australia and Malaysia. The factors examined included the type of vulnerable road user, the vehicle involved, the primary crash cause, age of the road user, injury outcome (fatal or casualty), crash location and single/multi-vehicle collisions. The findings from this study highlighted emerging and severe road crash problems currently not being addressed in existing safety initiatives within these countries by governments or vehicle manufacturers.

A number of potential solutions to these problems were identified including engineering countermeasures for vehicles and road infrastructure, greater use of protective equipment for riders, enhanced police enforcement efforts and technologies, and improved training and licensing practices. Public policy response to this growing epidemic in low and middle-income countries has been muted at national and international levels and policy makers need to recognise this growing problem as a public health crisis and design appropriate policy responses. With growing usage of VRU transport in developing countries, this burden is expected to become even larger in the years ahead unless action is taken.

Keywords

Road safety, Middle-income countries, Motorcyclist, Pedestrian, Cyclist, Countermeasure

Introduction

Road transportation provides real benefits to society. It is associated with economic growth and enhanced mobility for populations, including the provision of improved access to education and health services. The benefits, however, come at a severe cost: around 1.3 million people die on the world's roads each year from road crashes. Even more alarming is the injury rate associated with road trauma: each year up to 50 million people are injured or disabled worldwide in road traffic crashes [1]. Moreover, the World Health Organization [2] reported that a high proportion of these deaths (up to 90%) occur in the world's poorest countries and this number is still on the increase, even though low and middle-income countries have less than half the world's vehicles [2]. Indeed, it has been estimated that, unless immediate action is taken, road deaths will rise to become the fifth leading cause of death by 2030, resulting in an estimated 2.4 million fatalities per year [2]. Coupled with this are enormous costs to individuals, families and the community, with an estimated economic cost of USD518 billion each year from road crash fatalities.

Vulnerable road users (VRU) represent a sizeable annual trauma burden internationally. The road safety community typically define VRUs as either those who are inexperienced or fragile (i.e., children, adolescents or seniors) or those who are more exposed to injury in the event of a crash, such as pedestrians, motorcyclists or bicyclists [2]. It is generally accepted that these road user groups are more vulnerable compared to occupants of cars, small and large trucks and buses as they are less protected due to their mode of transport or personal characteristics.

The protection of vulnerable road users is a critical area of road safety, particularly in low and middle-income countries given their high presence on the road and the particular risks associated with these modes of travel. There are various ways of defining a country's development and it is most commonly measured with statistical indexes such as income per capita (GNI), life expectancy, the rate of literacy, etc. Lists of countries by development can be found at http://data.worldbank.org/about/country-classifications and http://www.imf.org, http://unstats.un.org).

It is reported that in high-income countries, the majority of deaths occur amongst car occupants, while in many poorer countries, over half of those killed are pedestrians, cyclists or motorcyclists [3]. As examples, in Australia, there were approximately 6.8 deaths per 100,000 population in 2007, with 71 per cent being vehicle drivers and passengers, and smaller proportions of pedestrian deaths (13%), cyclist deaths (2%) and motorcyclist deaths (15%). Similar trends are apparent in other high-income countries including the US, the UK and Western Europe. In contrast, in Bangladesh, there were approximately 12.6 deaths per 100,000 population overall in the same year and pedestrians deaths made up over half of road deaths (54%). Interestingly, car occupants contributed to only 26 per cent of road deaths, and motorcyclists and cyclists to 11 per cent [2].

Even in middle-income countries, the majority of those injured or killed are vulnerable road users. For instance, Malaysia, a middle-income country that has a rapidly growing economy, has an associated high level of road trauma (24.1 deaths per 100,000 population), where 58 per cent of road deaths are motorcyclists and 23 per cent are vehicle occupants. Pedestrians and cyclists account for 10 per cent and 3 per cent of road deaths, respectively [2].

The numbers of deaths and serious injuries involving VRUs are not decreasing and appear even to be on the rise in some middle-income countries. Indeed, there are suggestions that the economic development of regions and nations is associated with an increase in the number of injuries and deaths from road traffic crashes [4, 5].

This paper therefore set out to examine trends in VRU casualties in more detail to illustrate differences in crash patterns, types of crashes and crash victims, using data from Malaysia (a middle-income country) and Australia (a high-income country). It is expected that this will identify potential road safety priorities, countermeasures and safety initiatives, of relevance in these differing countries. These countries were chosen as they represent a good contrast in traffic characteristics and mobility patterns for which representative data were available.

Data analysis

Police-based mass databases were available for analysis from the M-ROADS database in Malaysia, the police data maintained by the Malaysian Institute of Road Safety (MIROS), and police data collected from five Australian states: Victoria, New South Wales, Queensland, South Australia and Western Australia (95% of the Australian population). These two databases comprise crash records and were expected to reveal different patterns of crashes and injury outcomes for VRUs given their varying levels and types of motorisation.

Individual analyses were performed on these data by representatives of each country, using a common analysis format. The data period for the years 2005 to 2008 was selected for analysis and reported separately by each country. An overall analysis was then assembled, comparing each of the three countries to highlight similarities and differences.

Analysis procedure

The dependent variable in these analyses was the proportion of crashes by each road user type. Each analysis focused on a number of common variables, including (i) outcome severity (killed or casualty crash, i.e., requiring hospital treatment), (ii) type of vehicle involved (motorcycle, pedestrian, bicycle, passenger car, and bus or truck), (iii) area of the crash location (urban/rural), (iv) who hit who, and (v) age group of the crash victim (all ages and young drivers/riders). Different levels of risk for fatal and all casualty crashes were also computed for the various VRU groups in each country using the numbers of victims per registered vehicle for further comparison.

These databases were predominantly crash-based and inclusion criteria were applied across all of them for consistency. Where a collision occurred between a passenger car and a motorcycle for instance, each was counted twice, once for the passenger car and again for the motorcycle. If the collision was between two passenger cars, however, it was only counted once. However, for the analyses considering which vehicle hit which road user, all the vehicles have been considered. The risk analyses, though, were person-based, as is the conventional practice for computing these figures.

The number and percentage of crashes included those involving both a fatal and casualty crash outcome, as determined by the attending police officer. Fatal crashes were defined as those where at least one of the crash victims was killed within 30 days of the crash, while casualty crashes comprised those where no one was killed but where at least one victim was injured and recorded as a casualty. It was expected that fatal crashes would differ from those where someone was a casualty, as this reflects different levels of crash severity. No distinction was made between severe and moderate injuries to keep the analyses manageable.

No attempt was made to evaluate these differences statistically because of the sizeable number of cases involved in the two countries. Moreover, while we acknowledge the importance of exposure measures, comparative exposure data was not available. Hence, the findings comprised a purely descriptive analysis of differences between these two countries. The analysis, however, is useful as an overview of crash trends and helpful in setting the research agenda in these countries.

Results

Proportion of VRU crashes

Fatal and casualty crashes were analysed by road user type and outcome severity in both countries (Table 1) to illustrate proportional differences.

Table 1. Proportion of crashes by road user type, country and outcome severity

Road user type	Malaysia		Australia	
	Fatal	Casualty	Fatal	Casualty
Trucks & buses	6.9%	9.8%	11.7%	7.3%
Passenger vehicles	26.9%	41.0%	72.0%	78.5%
Pedestrians	12.0%	4.8%	7.3%	4.7%
Motorcycles	50.7%	42.6%	7.7%	6.5%
Bicycles	3.4%	1.7%	1.3%	3.0%
Total	100%	100%	100%	100%
Total proportion	7.4%	92.6%	3.4%	96.6%

Most strikingly, the proportion of VRU crashes varied between the two countries, from 16 per cent for fatal and 14 per cent for casualty cases in Australia to 66 per cent and 51 per cent, respectively, for Malaysia. Passenger vehicle crashes were the predominant vehicle type among Australian fatal and casualty crashes, while motorcycles predominated among Malaysian fatalities and casualties.

To some degree, these findings most likely reflect differences in vehicle numbers and type, VRU exposure rates and maturity of the trauma system in the two countries. Interestingly, the higher overall proportion of fatalities in Malaysia compared to Australia (7.4% vs. 3.4%) might suggest a higher risk among VRU over other forms of transport and/or differences in data recording. This is examined in more detail in later analyses.

Differences in urban and rural crash distribution

Differences in the proportion of crashes across urban and rural crash locations are illustrated in Table 2. These figures are for fatal and casualty crash outcomes combined.

Table 2. Proportion of crashes by road user type, country and urban/rural environment

Road user type	Malaysia		Australia	
	Urban	Rural	Urban	Rural
Trucks & buses	7.7%	10.1%	1.3%	7.1%
Passenger vehicles	41.3%	39.8%	71.2%	79.0%
Pedestrians	6.3%	4.6%	10.4%	1.4%
Motorcycles	42.9%	43.5%	10.0%	11.5%
Bicycles	1.9%	1.9%	7.0%	1.0%
Total	100%	100%	100%	100%
Total proportion	23%	77%	82.3%	17.7%

The proportion of urban and rural crash locations varied considerably between the two countries. Urban crashes were most frequent in Australia (82.3%) and rural crashes in Malaysia (77%). The proportion of VRU crashes also differed between the countries where the proportion of VRU urban crashes was higher in Malaysia (51%) compared with Australia (27.4%). While not shown here, the proportion of fatal crashes for VRUs in rural areas was higher for Malaysia (7.4%) compared with Australia (5.6%). This may reflect again the possible increased vulnerability and risks of VRUs in these higher speed locations and/or differences in recording criteria.

Differences between single and multiple collisions

Next, the proportions of single and multiple collisions for fatal and casualty crashes combined were examined between countries and the results shown in Table 3.

Table 3. Proportion of crashes by road user type, country and single/multiple vehicles

Road user type	Malaysia		Australia	
	Single	Multiple	Single	Multiple
Trucks & buses	10.0%	9.5%	7.3%	7.4%
Passenger vehicles	42.5%	39.3%	68.8%	79.7%
Pedestrians	0%	6.8%	0%	5.6%
Motorcycles	45.9%	42.5%	21.4%	4.3%
Bicycles	1.6%	1.9%	2.4%	3.0%
Total	100%	100%	100%	100%
Total proportion	20.7%	79.3%	13.5%	86.5%

The proportions of single and multiple collisions were relatively similar in the two countries, although Malaysia recorded a slightly higher proportion of single-vehicle crashes compared with Australia (20.7% vs 13.5%). Overall, in both countries, proportions of single- and multi-vehicle crashes involving passenger vehicles were high, and especially multi-vehicle crashes in Australia. The biggest difference was found in the proportions of motorcycle collisions where higher proportions of both single- and multi-vehicle collisions were found in Malaysia (46% and 43%, respectively), compared to Australia (21% and 4%, respectively), with the difference being most marked for multi-vehicle collisions (43% in Malaysia and 4% in Australia).

Collision configurations

The next series of analyses focuses on 'who' collided with 'whom' in multi-vehicle collisions for the fatal and casualty cases combined. Tables 4 and 5 present the proportions for Malaysia and Australia separately.

In Malaysia, passenger vehicle collisions with all other partners were the most predominant, accounting for almost half of all multi-vehicle crashes, and the most common crash partner for a passenger vehicle collision was another passenger vehicle (around 29% of all cases). A relatively high proportion of multi-vehicle passenger car crashes involved colliding with a motorcycle (17%). VRU collisions with other vehicles accounted for over 61 per cent of all multiple-vehicle crashes and more than 35 per cent of crashes among themselves. The most common collision partner for a motorcycle was another motorcycle (32%), roughly twice as frequent as with a passenger vehicle. This may be explained to some degree by the high level of exposure (47% of all vehicle registrations were motorcycles in 2007 [15]), but also may be attributed to the higher risk that VRUs have to being injured when involved in a crash.

Table 4. Proportion of multi-vehicle crashes by road user type, Malaysia

Multi-vehicle crashes	Trucks & buses	Passenger vehicles	Pedestrians	Motorcycles	Bicycles
Trucks & buses	6.8%	-	-	-	-
Passenger vehicles	3.3%	28.7%	-	-	-
Pedestrians	0.6%	2.5%	0%	-	-
Motorcycles	4.6%	17.0%	1.5%	32.1%	-
Bicycles	0.2%	0.9%	0.1%	0.6%	1.2%
Totals	15.5%	49.1%	1.6%	32.7%	1.2%

Table 5. Proportion of multi-vehicle crashes by road user type, Australia

Multi-vehicle crashes	Trucks & Buses	Passenger vehicles	Pedestrians	Motorcycles	Bicycles
Trucks & buses	1.0%	-	-	-	-
Passenger vehicles	9.2%	62.5%	-	-	-
Pedestrians	0.9%	9.5%	0%	-	-
Motorcycles	0.6%	6.9%	0.2%	0.5%	-
Bicycles	0.9%	7.4%	0.2%	0.1%	0.1%
Totals	12.6%	86.3%	0.4%	0.6%	0.1%

In contrast to Malaysia, practically all multiple-vehicle collisions in Australia involved passenger vehicles and trucks (99%). VRU collisions accounted for only 27.3 per cent of these crashes, most of which were with a passenger vehicle (23.8%). Pedestrians and cyclists seemed to be the most common VRUs involved in these figures, accounting for 10.8 and 8.7 per cent of these crashes, respectively, while motorcycles were involved in 8.2 per cent of these crashes. Given that motorcycles in Australia comprise around 3 per cent of the total motor vehicles registered in 2006 [16], this also confirms their vulnerability and potential over-involvement rates in casualty crashes.

Age group

The final analysis investigating VRUs in the two countries was to compare the proportions of fatalities for all ages with those involving only younger road users (0-25 years). The fatality proportions are shown in Figure 1. The equivalent all injured proportions are not presented, but show a similar trend to the fatality figures.

The figures for those fatally injured in Australia show a higher proportion of car and truck deaths for all ages and younger road users than for Malaysia as reported earlier, with slightly fewer young occupant deaths than those for all ages. However, there was a noticeably higher proportion of deaths among

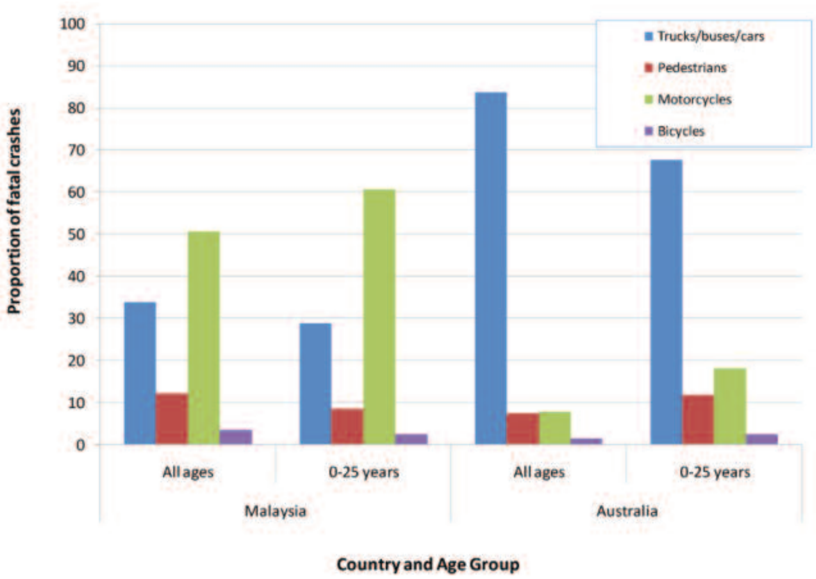

Figure 1. Proportion of fatalities by age group and road user type, Malaysia and Australia

younger motorcyclists in both countries, irrespective of differences in the level of crash involvement. While clarification using exposure measures is desirable, clearly, preventing motorcycle fatalities, particularly among young riders, must be a priority in both countries, but especially so in Malaysia.

The proportion of pedestrian deaths in Malaysia was higher among all ages, yet in Australia was higher among younger road users. It has been reported previously that the risk of a pedestrian death per population is higher among the elderly [6], which may help to explain this finding in Malaysia. However, the different finding for fatal crashes in Australia is difficult to explain by the pedestrian's age, and the availability of appropriate exposure data may shed more light on this. Of interest though, this difference is not so apparent among casualties, suggesting younger pedestrian fatal crashes may be occurring at higher speeds in this country – speed limits in urban areas in Australia being among the highest in the world [7] and young pedestrians having been reported as taking higher risks when crossing the road [8, 9].

Relative risk

An analysis of the relative risk by mode of travel per registered vehicle was also conducted as shown in Figure 2. It was not possible to do a comparative analysis for pedestrians and cyclists, as the relative risk denominator is presumably quite different and unknown. Rate per registered vehicle was chosen, as it was the only available and reliable measure in both countries. It would also have been interesting to compare the rate by distance travelled, but unfortunately, these exposure figures were not available in both countries.

Overall, these figures show a downward trend of fatalities from 1998 to 2007/08, especially in Australia, with some improvement also in motorcycle fatalities over this period. The risk of being killed in a crash is much higher for motorcyclists compared with vehicle occupants on a per registered vehicle basis (more than four times on average in both Malaysia and Australia). Interestingly, comparisons between these two countries shows that, while crash rates for car occupants are markedly higher in Malaysia, the relative crash risk for motorcyclists is similar in both countries, particularly in more recent years.

Of interest also are the proportional differences of fatal crashes involving motorcycles and cars between the two countries. In 2007 in Malaysia, 75 per cent of these vehicle-type fatalities involved motorcycles (only one-quarter were car occupants), while in Australia, the equivalent figures for motorcycles was 17 per cent. This clearly reflects differences in the frequency of use of motorcycles in these countries and the inherent risk motorcycle riders face.

It should also be noted that the real risk in the use of motorcycles in both these countries is somewhat masked by the exposure measure used (per 10,000 registered vehicles). In Europe, for example, motorcyclists are 18 times more likely to be killed than car occupants when measured on a distance travelled (per kilometre) basis [21]. It would have been preferable to have used a distance travelled measure for this analysis had these exposure measures been available, as per registered vehicle ignores the real usage rates of these vehicles.

General discussion

Death and serious casualties to vulnerable road users represents a sizeable trauma burden internationally, especially in low- and middle-income countries. This study set out to analyse trends in vulnerable road user casualty crash involvement in Malaysia and Australia to examine differences in crash patterns, types of crashes and crash configurations. The analyses highlighted both expected and unexpected findings.

The overall finding was that the proportion of VRU crashes varied considerably between the two countries. The lowest

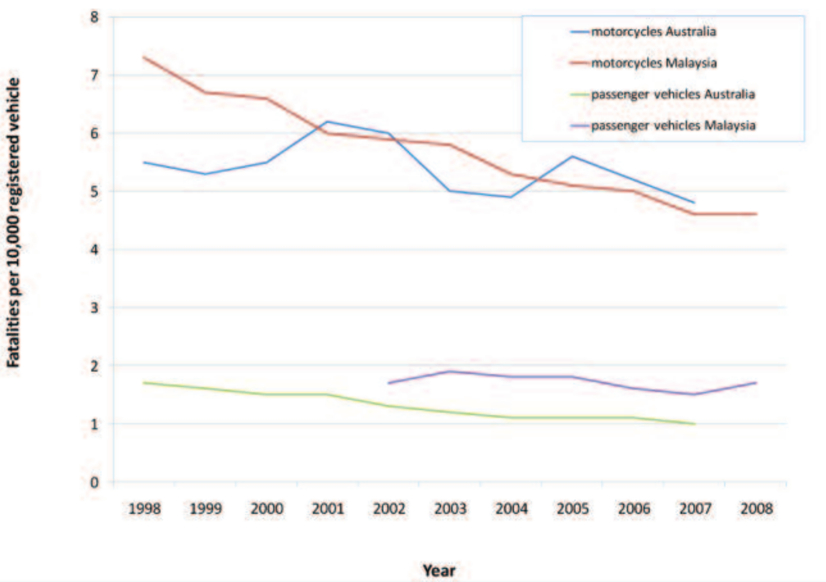

Figure 2. Fatal crash rate per 10,000 vehicles, Australia and Malaysia

involvement rate was in Australia where VRUs accounted for just 16 and 14 per cent of fatal and all casualty cases, respectively, compared with Malaysia, where the proportion was much higher (66% of fatal crashes and 51% for all injured VRUs).

These findings may reflect differences in vehicle and VRU exposure rates between the two countries, especially regarding motorcyclists, as there is a substantially greater proportion and use of motorcycles in Malaysia. The implementation of an effective trauma care management system in Australia may also contribute to the lower rate of death and serious injury in Australia [10, 11]. Regarding pedestrian and bicyclist safety, the proportions of fatalities were somewhat higher in Malaysia compared with Australia, but casualty crash proportions were similar.

With regard to location and crash configuration, there were also country differences. Overall, crashes in Australia seemed to be more an urban phenomenon (mainly amongst passenger vehicles), while Malaysia experienced more rural crashes (involving both motorcyclists as well as passenger car occupants). This was a somewhat surprising finding given the urban density in Malaysia in cities like Kuala Lumpur, but may be reflective of Malaysia's high traffic density and infrastructure in urban areas, which leads to a higher rate of gridlock and hence lower-speed crashes. Our finding that crashes in Australia seemed to be an urban phenomenon was also surprising, given the substantially higher proportion of rural crashes reported by the BITRE (estimated 57% in rural areas) [12].

While there are some possible explanations for this discrepancy, including that our data reported on fatal and serious injury crashes while the BITRE data focussed on fatal crashes only, this finding warrants further investigation. Interestingly, though, when VRU crashes were examined separately, Malaysia showed a substantially higher proportion of urban crashes involving VRUs compared with Australia (51% vs 27%). Again, the high number of urban motorcycle crashes and behavioural differences may have contributed to this finding.

Moreover, there was a high incidence of single-vehicle crashes in Malaysia compared with Australia, although there was a low number of multiple-motorcycle crashes in Australia. As the split in single- and multiple-vehicle crashes in Malaysia was closer to 50 per cent, these findings are difficult to explain without further in-depth analysis of the crashes to pinpoint possible causes. Nevertheless, these findings have ramifications for where priority setting for intervention should lie.

Pedestrian collisions in urban and rural areas are also of concern in both Malaysia and Australia, where these crashes comprised up to 12 per cent of all fatalities. Of special note, Malaysia experienced a higher proportion of rural pedestrian crashes involving a collision with a passenger vehicle, despite a general trend for less frequent pedestrian movements in rural areas than in urban areas. Many of these people have variable road crossing skills, especially young children, the elderly and those with disabilities.

Clearly, more needs to be done to reduce these numbers in both locations. From observation, it seems that failure on the part of motorists to pay greater respect to pedestrian movement may contribute to this level of trauma, but also, there is the need for pedestrians to cross and walk on roads at safe locations. That means the provision of traffic light intersections or statutory road crossing points, in addition to well maintained footpaths, and reduced vehicle speeds in areas where there is high pedestrian activity.

Of interest was the finding that there were substantial country differences in collision partner. By far the greatest trauma to VRUs in Australia was when they collided with a vehicle (truck, bus or passenger vehicle), accounting for 99 per cent of pedestrian, motorcyclist and bicyclist collisions. These findings point to the need to separate transport modes further, reduce vehicle speeds in areas where there is a mix of vehicles and VRUs, and improved vehicle technology to reduce speeds, enhance braking and provide better pedestrian protection of vehicles.

While fatal and casualty collisions between motorcycles and passenger vehicles were relatively high in Malaysia, those with another motorcycle were prevalent in this country (around one-third of all collision partners). While high exposure may contribute to this finding, the high prevalence of these crashes suggests there are other factors at play here. One potential factor may be the introduction of exclusive motorcycle lanes on some of the major highways in the Kuala Lumpur and Klang Valley areas. While the introduction of these designated motorcycle lanes is reported to have achieved substantial overall reductions in motorcyclist fatalities, particularly those involving collisions with vehicles [13], this may have resulted in an increased proportion of motorcycle-motorcycle crashes.

This suggests that, although designated motorcycle lanes provide a safer environment for motorcyclists, their safety could be further enhanced. The lanes could be widened to accommodate the number of motorcycles, the points at which they merge into the main traffic flow could be improved through appropriate design, and maintenance of lanes could be improved. Indeed, a study modelling motorcycle and non-motorcycle flows entering an intersection showed an increase in motorcycle crashes as traffic density increased [14]. It was also noted in this study that approach speed, lane width, number of lanes, shoulder width and land use were statistically associated with these crashes.

It is also possible that rider behaviour contributed to the increased proportion of motorcycle crashes in general, in addition to the high rate of motorcycle-motorcycle collisions. It was argued recently by the Director of MIROS, Professor Ahmad Farhan Sadullah [15], that transportation policies in Malaysia have a culture that generally does not put road safety first. Hence, there is a need to instil in motorists and professionals in Malaysia a greater sense of the importance of safety and safe behaviour on their roads.

While the current analysis involving mass data was unable to elaborate further on these findings, they could reflect a different driving and riding population in Malaysia to that in Australia or other traffic or behavioural differences. The motorcycle is regarded as an important mode of daily transport for commuting and running daily errands in Malaysia: it is estimated that there were 7.9 million motorcycle registrations in Malaysia or 47.3 per cent of total vehicle registrations [15].

By contrast, motorcycle ownership in Australia only represented around 3 per cent of the total motor vehicles registered in 2006 [16]. Furthermore, motorcycle ownership and use is popular in Malaysia for a number of reasons including low vehicle purchase price and insurance surcharge rates, low running costs, the ability to obtain a motorcycle licence as young as 16 years old, and ease of travel on congested roads. In contrast, in Australia, the motorcycle is often ridden for recreational purposes and therefore rider characteristics are very different.

With regard to age effects, the representation of younger VRUs was examined in this analysis across the two countries. In Australia, there were fewer young driver deaths than for all ages, but a higher proportion among younger motorcyclists and pedestrians. In Malaysia, there were higher proportions of motorcycle deaths and injuries compared with those in Australia, reflecting their higher exposure. However, young motorcycle riders in Australia were injured proportionally less than for all ages (compared to Malaysia), but more likely to be killed. This could suggest that their crashes tend to be at higher crash speeds in Australia than in Malaysia and may possibly involve a higher proportion of older riders. It may also reflect lower helmet-wearing rates in Malaysia.

Implications

The findings from this analysis raise a number of potential opportunities for countermeasures to address this growing burden of death and injury to Vulnerable Road Users in both middle- and high-income countries. It should be noted that the databases chosen for these analyses are representative samples of police-reported real-world crash data in these countries. While they are the best available databases for conducting analyses of crash and injury outcomes, they nevertheless differ in terms of their data collection procedures, the criteria applied and the level of comprehensiveness. Thus, these analyses need to be viewed with some caution in the light of these potential deficiencies. In particular, the under-reporting of serious and minor injured VRUs is claimed to be as high as 50 to 65 per cent of cases for pedestrians and 80 per cent for cyclists [17].

Nevertheless, for Malaysia, the key issues to be addressed relate to reducing motorcycle crash incidence and injury risk, not only for collisions between motorcycles and vehicles, but for motorcycle-motorcycle collisions. For Australia, the VRU group that contributes substantially to road trauma is pedestrians, and countermeasures to reduce pedestrian injury should be a priority.

Motorcyclists

There are a number of potential countermeasures to address motorcycle crashes. Training programs to better prepare riders (especially novice ones) seem to have met with some success [18] and could be considered for Malaysian riders. Motorcycle riders in Malaysia are often very young riders who would seem to be a particular target group for improved training prior to licensing. Graduated licensing for these road users would be worthy of further consideration. Moreover, rider assist technologies, particularly ABS technology, appears to be beneficial in preventing crashes from occurring as well as better positioning the motorcycle if a crash in unavoidable [19].

There are also engineering countermeasures to improve outcomes such as roadside barriers, increased use of exclusive motorcycle lanes (ensuring adequate width, maintenance and merging facilities at intersections), and Black Spot motorcycle road treatments. Riders' helmets that provide superior head and face protection, chest vests and protective riding equipment are also critical for mitigating injury. Finally, reducing travel speed, which will reduce the likelihood of a crash and/or reduce injury through better energy management, would also be very helpful, although achieving compliance may prove difficult.

Pedestrians

Countermeasures to aid pedestrian safety should focus more on crash prevention, given the low speeds generally involved in fatal pedestrian crashes [20]. Creating environments and infrastructure in areas of high pedestrian activity that enhance pedestrian safety are important, and treatments need to include those aimed at reducing vehicle speeds (reduced speed limits, in the order of 30-40km/h, traffic calming measures, barrier fencing, median strips, road narrowing and realignment, etc.). In addition, provision of more distinctive and frequent pedestrian crossings can help stream pedestrians. Traffic signals at pedestrian crossings on busy roads can also aid the elderly and disabled to cross at busy city roads and intersections. Education and training of children and the elderly to adopt safe crossing practices can also aid pedestrian safety.

All road users

The analysis of relative risk suggests that passenger vehicle occupants in Malaysia are at higher risk than their Australian counterparts. While it is difficult to highlight possible causes from the current analyses, it is probable that a number of factors are at play here, including limited occupant protection from vehicles, high and inappropriate speeds, low seatbelt-wearing rates, poor road design, differences in road user behaviour and lack of an effective trauma care management system. Indeed, the Malaysian government [15] has recently acknowledged that to achieve their mission of a road safety level in Malaysia at par with high-income countries, they see the need for greater education, awareness and advocacy programs, and improved legislation and policies to reduce injury crashes and fatalities to the minimum level.

Adopting a Vision Zero or Safe System approach is necessary to help achieve this mission. Australia and many European countries have long adopted such a model in addressing road safety targets with reasonable success. Legislation that establishes traffic law, as well as corresponding sanctions for infractions, needs to be framed so that the factors that most increase crash risk are targeted. Sanctions applicable for exceeding urban speed limits need strengthening – the practice that most endangers vulnerable road users.

Conclusions

It is argued that injury and deaths due to road traffic crashes are a major public health problem in low- and middle-income countries. More than 85 per cent of all deaths and 90 per cent of disability adjusted life years lost from road traffic injuries occur in these countries, and it appears that the highest burden of injuries and fatalities is borne disproportionately by vulnerable road users. The findings of these analyses confirm the high proportions of VRU crashes and injuries in a middle-income country compared with a high-income country and point to the requirement for a public policy response to the issues surrounding vulnerable road users, particularly motorcyclists.

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Helmet use amongst injured and non-injured motorcyclists in Malaysia

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Abstract

This paper describes an investigation of helmet wearing and type of helmet worn amongst crash-involved and non-crash-involved riders. Participants who attended an outpatient oral and maxillofacial clinic for treatment took part in a survey on helmet-wearing behaviour and crash involvement. Overall, there was a high reported wearing rate; however, the findings showed that many riders did not wear a helmet for very short trips, and a substantial proportion did not fasten the buckle. More importantly, relatively high proportions of motorcyclists wore helmets that may not offer them optimal protection in a crash.

For those who have been involved in a crash, the most frequent injuries sustained were to the lower limbs. Comparisons between crash-involved and non-crash-involved riders also revealed some demographic and behavioural differences such as age, gender and licensure. Implications for the overall safety and reduction of head and facial injuries are discussed, including the protective features of different types of helmets, wearing status, programs aimed to increase wearing rates of helmets that will offer optimal protection, and rider sub-groups to whom initiatives should be targeted.

Keywords

Motorcyclist safety, Helmet, Crash risk, Behaviour, Countermeasure

Introduction

Road-traffic crashes are a major public health issue worldwide. Each year, an estimated 1.3 million people die on the world's roads, and a further 20 to 50 million people are injured while using the road transport system [1]. The WHO also reports that a high proportion of these deaths and injuries (up to 90%) occur in low- and middle-income countries, and this number is increasing. Indeed, it has been estimated that unless immediate action is taken, road deaths will rise to the fifth leading cause of death by 2030, resulting in an estimated 2.4 million fatalities per year [2]. Coupled with this are enormous costs to individuals, families and the community, with an estimated economic cost of USD518 billion each year.

Malaysia, a middle-income country, is a rapidly developing multi-racial nation. Over the last 10 to 15 years, Malaysia has experienced significant economic expansion with growth in population, industrialisation and motorisation. Private vehicle ownership has increased dramatically and a high proportion of privately owned vehicles are motorcycles: between 1997 and 2007 there was a significant increase in the number of registered motorcycles from 4,328,117 to 9,433,640 [3]. The high number of motorcycles is also seen in neighbouring countries - for example, in Thailand, Singapore, Vietnam and Taiwan.

The motorcycle is regarded as an important mode of daily transport in many nations, particularly in Asian countries, and is mainly used for commuting and running daily errands. Motorcycle ownership and use is popular in Malaysia for a number of reasons, including low vehicle purchase price and insurance surcharge rates, low running costs, the ability for drivers to obtain a motorcycle licence as young as 16 years old, and ease of travel on congested roads (riders can reach their destination faster and cheaper than in a car or on public transport). A recent survey on motorcyclists' receptiveness towards changes in various transport policies and vehicle ownership showed that many Malaysian road users still favour motorcycles as a mode of transport and, although the Government increased the motorcycle insurance premium recently, this did not discourage them from owning motorcycles [4].

Unfortunately, Malaysia has an associated high level of road trauma, approximately four to five times higher than countries with good road safety performance (such as Sweden, the Netherlands, the United Kingdom, etc.), and much of the trauma is due to motorcycle crashes. Road crashes have become one of the major causes of mortality and morbidity and are the second leading cause of deaths in males between the age of 15 and 64 years [5]. In 2008, 6527 people died on Malaysian roads and close to 25,800 were injured, and 3898 (59.7%) of these deaths were motorcyclists (even though they make up approximately 50 per cent of the vehicle fleet).

Motorcyclists are an extremely vulnerable road user group due to their lack of protection and they carry a high risk of death. Per vehicle mile travelled, motorcycle riders have approximately 30 times the relative risk of death in a crash than people driving other types of motor vehicles, and they are also approximately eight times more likely to be injured [6-8]. Despite the many efforts the Malaysian government, industry and community organisations have made to reduce motorcycle crashes, motorcycle-related trauma remains high.

One of the most effective ways of reducing fatalities and serious injuries and improve outcome amongst motorcyclists (particularly as a result of head injuries) is to increase helmet wearing [9-14]. Helmets significantly reduce the probability of head and neck injuries by 53 per cent and lead to a 72 per cent reduction in the probability of death [15]. In contrast, unhelmeted motorcyclists sustained a substantially higher rate of facial and brain injuries compared to helmeted riders [16].

Helmet laws were introduced in Malaysia in 1973 and it is compulsory for all motorcycle users (both riders and pillion passengers) to wear them whenever they are on the road. In addition to legislation, standards for helmet type were also introduced and set by the Standards and Industrial Research Institute of Malaysia (SIRIM). To date, SIRIM has issued two certifications for helmets, the MS.1:1969 in 1969 and MS.1:1996 in 1996, and is currently updating test criteria. Since the introduction of these initiatives, helmet usage increased tremendously and a reduction of 30 per cent in number of motorcycle fatalities from time of legislation to 1980 was reported [17]).

Despite their demonstrated effectiveness, there seems to be a limit to the protection afforded by helmets against head and facial injury. Design characteristics of helmets have been shown to affect the severity of head injuries even amongst helmeted motorcyclists [18]. In addition, a helmet is only effective if it is fitted and worn properly. Non-helmeted riders usually sustain more serious forms of head injury and are three times more likely to sustain craniofacial soft tissue injuries compared with helmeted riders [19]. Moreover, there is evidence to suggest that many Malaysian riders and pillions do not wear a helmet, and for those who do wear a helmet, there is a high proportion of non-buckling of the strap [20].

To date, there is little literature addressing helmet-wearing behaviour and the possible impact on overall safety in Malaysia. This paper aims to provide a better understanding of helmet-wearing behaviour amongst riders and to examine some factors associated with helmet choice and wearing status.

Methods

Patients who were attending an out-patient university-based oral and maxillofacial surgery clinic, Universiti Kebangsaan Malaysia, for (any dental or facial) treatment were randomly selected and invited to take part in this study. The only inclusion criterion was that they were currently a regular motorcycle rider, riding at least three times a week. From a total of 150 invited patients, 115 participants completed a questionnaire (a participation rate of 77%).

The questionnaire was divided into three sections and was designed to elicit information on i) demographic characteristics (e.g., ethnicity, age, gender, education level), ii) riding information such as travel patterns and license status, helmet wearing behaviour and attitudes to helmet purchase, and iii) motorcycle crash history and details of any previous collisions.

Results

The findings of the survey are described below. First, the overall characteristics of the sample are presented. This is followed by descriptions of riding patterns, helmet-wearing behaviour and licensure. Last, some contributing factors to crash involvement are presented.

Sample characteristics

Participants were asked some general demographic questions. They were also asked to report if they had been involved in a motorcycle collision in the previous two years, and a high proportion of the total sample (62%) indicated that they had. Demographic characteristics of both groups and overall are presented in Table 1.

Overall, the majority of the sample was male (with a ratio of 4.3 males to 1 female) and young, aged between 21-30 years, with another 20 per cent aged between 31 and 50 years. Further, most participants were Malay and either a university student or government/other organisation office worker.

The crash-involved group consisted of a high proportion of young riders (most were aged between 21 and 30 years) and a high proportion of males (87%). Compared with the non-crash-involved group, crash-involved riders were younger ($\chi^2(5)=11.8$, $p<0.05$), and more likely to be male ($\chi^2(1)=4.99$, $p<0.05$).

Riding behaviours

With regard to riding behaviours and experience, the majority of riders (94%) reported that they had a current and valid licence, and over half of them (56%) obtained their licence when they started riding. A substantial proportion (44%), however, reported that they did not have any legal licence when they started riding.

The majority of participants were experienced riders, riding their bikes daily either to work or study places or to run daily errands, and most of their trips (70%) were made in urban environments, within the metropolitan area of Kuala Lumpur. The remainder of the sample lived and worked within the Klang Valley, which is a relatively urban and densely populated area of Malaysia.

Analyses were undertaken to determine differences between the crash-involved and non-crash-involved groups. Generally, there were no differences between the two groups regarding helmet use and type of helmet worn. With regard to licensure, two factors were examined: the duration of time between obtaining licensure and starting to ride, and riding experience prior to the crash. The crash-involved group started to ride 0.8 years (SD: 3.92) before obtaining their licences. This was slightly less than the non-crash-involved group, who started to ride approximately 1.3 years before obtaining their licences. This difference was not significant ($p>0.05$). In addition, the mean duration between the year of obtaining the licence and the collision was 6.6 years. Together, these findings suggest that both groups were fairly experienced riders.

Table 1. Summary of demographic characteristics of survey participants by group

Demographic variable	Proportion (%) of non-crash-involved riders (n=44)	Proportion (%) of crash-involved riders (n=71)	Proportion (%) of all riders (n=115)
Age group:			
11-20 years	2.3	4.2	3.5
21-30 years	61.4	70.4	67.0
31-40 years	9.1	8.5	8.7
41-50 years	22.7	4.2	11.3
51-60 years	2.3	11.3	7.8
61-70 years	2.3	1.4	1.7
Gender:			
Male	70.5	87.3	80.9
Female	29.5	12.7	19.1
Ethnicity:			
Malay	65.9	64.8	65.2
Chinese	22.7	26.8	25.2
Indian	6.8	5.6	6.1
Indonesian	4.5	2.8	3.5
Education level:			
Primary school	2.3	1.4	1.7
Secondary school	38.6	28.2	32.3
Tertiary	56.8	54.9	55.7
Other	2.3	15.5	10.4
Employment status:			
Professional	6.8	12.7	10.4
Gov./office worker	27.0	31.0	29.6
Self-employed	9.1	11.3	10.4
University student	45.5	36.6	40.0
Unemployed	11.4	8.5	9.6

Note: While desirable to include demographics of the general population of riders in Malaysia to gauge representativeness of the study sample, these data are not available in Malaysia.

Participants were then asked some questions regarding their helmets and use of the helmet. Approximately 70 per cent of the study participants reported that they wore their helmet every time they rode their motorcycle, regardless of trip distance. In contrast, a substantial proportion (27%) reported that they preferred to wear their helmet only when they travelled more than five kilometres per trip. In addition, a small proportion (3%) wore their helmets only when riding on main roads.

It is also interesting to note that a higher proportion of males reported wearing their helmet every time they rode, compared with females (72% vs 63%), and more females indicated they only wore their helmet on long distance trips compared with their male counterparts (36% vs 25%). These differences were not statistically significant.

In response to questions regarding type of helmet, the majority (71%) wore open-face helmets, and over half of them were equipped with visors, while 22 per cent did not have any visor attached. A high proportion (82%) of these riders confirmed that their helmet was SIRIM-certified as conforming to standards. An additional 16 per cent were not sure if their helmets reached minimum standards, while a small proportion (2%) wore non-SIRIM-approved helmets. The remainder of the sample reported that they wore half-shell (non-standard) helmets.

A series of questions regarding criteria used when purchasing a helmet were asked. Figure 1 shows the reported primary reason for choosing helmets by both groups. The most important decisive factor in purchasing a helmet was safety and this was observed in 68 per cent of the participants. Other decisive factors included aesthetics (14%), low price (7%) and brand name (6%). A further five per cent of participants did not need to make any decision about helmet purchase as the helmets were given as free gifts on purchase of their bike.

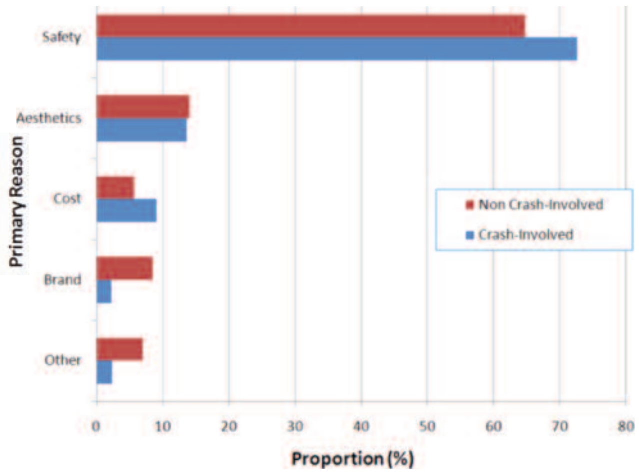

Figure 1. Primary reasons for choice of helmet type at purchase

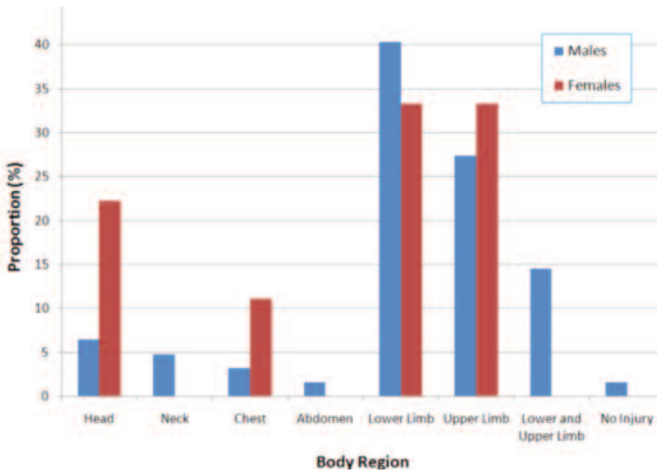

Figure 2. Body region injured by gender: crash-involved group

Interestingly, the crash-involved group were more likely to report that safety was the primary reason for helmet purchase compared with the non-crash-involved group (72% vs 65%), more concerned with cost (9% vs 6%) and less likely to be concerned about the brand of the helmet. These differences were not significant, however.

Collision experience

Of those participants who reported having crashes within the last two years, some additional questions were asked regarding the circumstances and outcomes of the crash. All crash-involved participants sustained some form of injury. Figure 2 shows the proportions of body region injured.

By far, the most frequently injured body region was the lower limb, with up to 40 per cent of the crash-involved group reporting sustaining these injuries. Upper limbs were also most frequently body region injured, with smaller proportions of head, neck, chest and abdominal injuries.

Gender differences are noted here. Females were more likely to have sustained head, chest and upper limb injuries compared with males. These differences did not reach significance, however, and may be due to the small number of female crash-involved participants (n=9).

General discussion

Motorcycle helmets are effective in protecting the head from serious injury; however, there are many types of helmets available and some may not be as protective as others. Moreover, helmets are only effective if fitted and worn properly. This study set out to understand in more depth some of the issues surrounding helmet wearing by Malaysian motorcycle riders, and to examine differences between groups of crash-involved and non-crash-involved riders.

The groups of riders in this study were relatively experienced riders, having had a licence, on average, for 6 to 8 years, and rode frequently in urban environments. There was a reported high rate of helmet wearing, with the majority of riders reporting wearing a helmet; however, a substantial proportion also failed to buckle their helmets. The majority of riders wore open-faced helmets, some equipped with a visor. While many of these were reported to be SIRIM-certified helmets, it is doubtful that all helmets complied with national standards. A substantial proportion also reported wearing non-standard half-shell type helmet. It is of some concern that, first, no full-faced helmets were worn amongst this group, and, second, many wore non-standard helmets.

The evidence is clear that full-face helmets offer the best protection to the cranium as well as the face compared with open-face or half-head helmets. For example, Rocchi et al. [21] showed that the most severe form of craniomaxillofacial injuries with neurological complications occurred in patients who did not wear any helmet at all, and the majority of facial fractures occurred in patients wearing open-face/half-head helmets.

Full-face helmets offer facial protection in addition to impact protection. The principal feature is a chin bar that extends outwards, wrapping around the chin and jaw area. The vision port allows the wearer a maximum range of sight, in line with the requirements for peripheral and vertical vision. In contrast, open-face helmets offer only limited protection for the jaw and chin and may or may not have retractable visors to protect the eyes. Similar to the open-face helmet, the half-head helmet does not protect the chin or the jaw area and is rarely equipped with a visor. It may or may not have ear flaps attached to the retention system.

It was of concern, however, that at least 30 per cent of the participants wore a helmet that did not reach government standards, and many of these were half-shell helmets (also known as 'tortoise' helmets). These helmets have never achieved SIRIM standards. In fact, most of these half-shell helmets have stickers that indicate 'Not for motorcyclist use', and sale of these (and any other non-standard helmet) was prohibited in Malaysia in 2009. However, these helmets are still currently on the market and used widely.

In Malaysia, a full-face face is not as popular as other types of helmet. This is probably due to the hot and humid climate and the congested feeling when wearing a full-faced helmet. An additional reason for its non-popularity is likely related to cost, as full-face helmets are over five times more expensive than open-face helmets. Interestingly, our sample of riders indicated that safety was the overriding reason for purchasing a helmet, with cost being of primary concern to only seven per cent of riders. However, none of these riders had full-face helmets. Perhaps if they had been asked specifically about reasons for not purchasing a full-face helmet, cost may have been a more predictive factor.

Differences in the effectiveness among various types of helmets have not been well examined. Moreover, factors that determine the dislodgment of a helmet during a crash, apart from not securing it properly, has not been very clear [22]. While there are suggestions that type of helmet worn and securing of the strap may contribute to injury risk [21, 22], there is a clear need to understand more fully the protective nature of different helmet types as well as performance of helmets when not secured correctly.

Our findings also demonstrated that, while the majority of riders reported wearing their helmets every time they went out riding, almost a third reported wearing their helmets only during long distance riding or when they were using main roads. This confirms previous findings showing reduced helmet compliance for short distance travel [20]. A common scenario in this country is not wearing a helmet when on short trips running daily errands near residential or working places. Higher compliance is observed during longer distance trips and may be related to fear of enforcement activities, as well as fear of crash involvement [20].

In addition, our results showed that, surprisingly, female riders were less likely to report wearing their helmet during every trip and more likely to wear it only on longer distance trips, compared with their male counterparts. While this difference did not reach statistical significance, it is an issue that is worth further investigation, particularly as our injury data suggest that female riders were more likely to suffer head injuries.

Dislodgement of a helmet during a collision is also of concern. A substantial proportion of the current sample reported not buckling their strap. These findings confirm previous findings amongst Malaysian riders. Compliance is only accomplished when motorcyclists have their helmet properly secured; however, Kulanthayan et al. [20] reported that more than 50 per cent of adult riders do not fasten their helmets properly. They also noted that helmet non-compliance was more common amongst young males with limited riding experience (riding less than a year and travelling short distances). In addition, recent roadside surveys on restraint and helmet use in the Klang Valley revealed low compliance, with up to 40 per cent of riders and pillions not fastening their helmets [23].

Regarding factors that may be associated with increased crash risk, we found few differences between the crash-involved and non-crash-involved group. Both groups were experienced riders, rode in similar environments, reported similar helmet-wearing rates, and were similar demographically. Two factors, however, emerged as predictive of crash involvement; these were gender and age, with the crash-involved group more likely to have been younger and male, compared with the non-crash-involved group.

Implications and conclusions

The findings from this study confirm previous studies and add some new information on helmet-wearing behaviour, despite limitations of a small sample size and potential recruitment bias. Head injuries are a leading cause of death, even in helmeted riders, and the type of helmet worn can affect the severity of injury. Moreover, for optimal head and face protection, helmets must be worn and worn properly. The findings of this study suggest, however, that proper wearing of effective helmets is not widespread in Malaysia.

Programs that raise the awareness of the benefits of 'buckling up' and purchasing a good helmet that will protect the head and face in the event of a crash should be considered. These can be incorporated in the licensing procedure and training programs to better prepare riders for on-road riding. Moreover, they should target young male riders. In addition to education and training programs, increased enforcement of helmet wearing and proper fastening on all roads, including minor roads in residential areas, should be a priority. Without adequate enforcement, it is a more difficult task to change behaviour. Any effort to promote the use of well designed helmets that reach standard criteria will be beneficial for Malaysian riders.

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iRAP assessment of risk on national highways in Bangladesh

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Abstract

Bangladesh faces significant road safety challenges. As many as 55 people are reportedly killed in traffic crashes each day. Like many low-income countries, vulnerable road users (including pedestrians, motorcyclists and bicyclists) account for a large proportion of road deaths. In 2010, with the support of the FIA Foundation and local road safety organisations, iRAP undertook a risk assessment of two of Bangladesh's main highways, the N2 and N3. These roads experience death rates in the order of 10 times higher than equivalent highways in Australia. In the case of the N2, this is despite the fact that major upgrades were undertaken as recently as 2005.

This paper provides an overview of the iRAP project; it includes an explanation of the iRAP approach to assessing risk and proposing countermeasures, and provides a summary of key results. The assessments showed that the majority of the N2 and N3 are rated 2 stars or less (out of a possible 5 stars) for car occupants, pedestrians, motorcyclists and pedestrians, indicating a relatively high level of risk of death or serious injury. To mitigate this risk, a series of investment plan options were developed for each road. These generally focused on the provision of wider shoulders, safety barriers, pedestrian footpaths and crossings and safer intersections. The most comprehensive of the plans identified the potential to reduce deaths and serious injuries by 36% on the N2 and by 44% on the N3.

Keywords

Bangladesh, iRAP, Road safety, Risk assessment, Countermeasures.

Introduction

Although road safety in Australasia has steadily improved in recent decades, the same cannot always be said of the Asia Pacific. It is estimated that around half of the world's deaths – more than 3500 each day – occur in the region [1]. Without preventative measures, the number is projected to increase by 144% in South Asia and 80% in East Asia and the Pacific between 2000 and 2020 [2].

One country that is facing a considerable road safety challenge is Bangladesh, where as many as 55 people are killed in traffic crashes daily. Like many low-income countries, vulnerable road users (including pedestrians, motorcyclists and bicyclists) account for a large proportion of road deaths. It is estimated that pedestrians account for more than half (54%) of all reported road deaths in Bangladesh [1].

The challenge of catering for a vast mix of road users in a country that has little more than half the land area of Victoria, Australia, a population of 160 million and an economy that is growing at 6% to 7% per annum, is evident in the results of recent iRAP assessments [3]. The iRAP Bangladesh Pilot Project was initiated by the FIA Foundation for the Automobile and Society as means of supporting the Roads and Highways Department (RHD), Bangladesh University of Engineering and Technology (BUET), BRAC (formerly the Bangladesh Rural Advancement Committee), the Centre for Injury Prevention Research Bangladesh (CIPRB) and Chevron in their road safety efforts.

The project involved an assessment of risk on National Highway 2 (N2), which connects the capital of Bangladesh, Dhaka, with Sylhet, and National Highway 3 (N3), which connects Joyedpur and Mymensingh. These are two of Bangladesh's busiest highways, carrying between 10,000 and 85,000 motorised vehicles per day (vpd) , as well as catering for significant numbers of pedestrians, bicyclists and other non-motorised vehicles (see Figure 1) [4].

Figure 1. High pedestrian movements on the N3 at Joyedpur

According to data provided by BUET, 180 people and 89 people were killed in traffic crashes on the N2 and N3, respectively, in 2008. Compared to Australasian roads, these figures are enormous; the death rate on the N2 (0.6 deaths per km) is ten times higher than that of the Pacific Highway in NSW, Australia (0.06 deaths per km) [5]. However, there is evidence to suggest that these numbers are understated. The World Health Organization (WHO) estimates that the total number of deaths in Bangladesh is 20,038, which is almost five times higher than official figures [1]. Similarly, following a survey of more than 80,000 households, Transport Research Laboratories (TRL) concluded that actual number of deaths is four times the number officially reported by police, and the actual number of serious injuries 75 times greater [6].

Observations during the iRAP road inspections also revealed the enormity of the road safety challenge. School children, factory workers, farmers and people visiting markets all vie for limited road space with faster moving trucks, buses and cars. At numerous locations, hundreds of people spill out of textile factories onto the highways at the end of their shifts. There are no footpaths, no pedestrian crossings and inadequate space for buses. At times it's like watching traffic race through a pedestrian mall.

This paper provides an overview of the iRAP project. It includes an explanation of the iRAP approach to assessing risk and proposing countermeasures, and provides a summary of key results. The approach described in this paper is typical of iRAP's globally consistent approach to projects, which are now underway in countries in every region of the world. In the Asia Pacific region, iRAP projects are underway in Australia (led by AusRAP), Bangladesh, India, South Korea, New Zealand (led by KiwiRAP), Indonesia, China, Malaysia, Singapore and the Philippines.

About the N2 and N3

In its current form, the 229km-long N2 is a relatively new highway, with major rehabilitation and widening completed as recently as 2005 at a cost of US$150 million with financing from the World Bank [7]. The improvements included:

- rehabilitation or widening of about 154km of existing highway;
- construction of a new alignment (Auskandi-Jagadishpur section) with a length of 69km
- a new toll road section
- 38 bridges, two vehicle underpasses and three pedestrian underpasses
- provision of 18.5km of service roads on some sections of the road for local low-speed traffic.

The Government of Bangladesh has plans to significantly upgrade the 90km-long N3, beginning early in 2011. These works precede the potential construction of a new airport along the route. The planned improvements include:

- six-lane dual carriageway between Tongi and Joyedpur
- four-lane dual carriageway between Joyedpur and Mawna
- standard two-lane single carriageway between Mawna and just south of Mymensingh
- four-lane dual carriageway at Mymensingh
- standard median and service road at significant bazaars.

Road inspections and coding

Road inspection data for the N2 and N3 was collected by Indian Road Survey and Management (IRSM) with the support of ARRB Group in March 2010, using a vehicle specially equipped with digital cameras to record panoramic images of the road and roadsides and location data as it travelled at highway speed. The images were calibrated to enable on-screen measurements of the road features, and the system enabled automated measurement of horizontal curvature and vertical grades.

Representatives from RHD and BUET had the opportunity to participate in the inspections, which were completed over three days (see Figure 2). In addition to the formal inspections, further site visits were undertaken separately during the project to help ensure the subsequent risk analysis properly reflected local conditions.

After the inspection data was collected, an iRAP expert rater based in Germany used the ARRB 'Hawkeye Processing Toolkit' to review the images and 'code' attributes for each 100-metre section of road. A complete list of the attributes that are recorded in iRAP projects is provided in Table 1.

Figure 2. The inspection vehicle and participants in the inspections

Risk assessment

Following the inspections and coding of the road infrastructure attributes, a Road Protection Score (RPS) was calculated for each 100-metre section using iRAP's online software (which is made freely available to project partners). A separate RPS is calculated for car occupants, motorcyclists, pedestrians and bicyclists. The RPS forms the basis for generating the Star Ratings (and, in turn, Safer Roads Investment Plans).

The approach taken was consistent with the methodology described in *Safer Roads Investment Plans: The iRAP methodology* (which is available at http://irap.org/media/9573/irap504.04_star_rating_roads_for_safety.pdf) [8].

The RPS is based on a series of risk factors that relate road infrastructure with the relative likelihood of crashes and their severity. An example of such research is shown in Figure 3, which plots crash rates versus horizontal curvature [9]. It shows that the relative risk between a road segment with a very sharp curve (radius less than 100 metres) and one with a very mild, or no curve, is approximately 5.5. At the radius range of 100-200 metres, where the greatest number of crashes was observed, the risk ratio is 3.5. This finding is supported by published literature (see, for example, [10]). Notably, the RPS is independent of traffic volumes and actual crash rates on the road being assessed. These factors are taken into account later, in the Safer Roads Investment Plan stage.

Figure 4 shows the underlying level of risk (RPS) for car occupants for each 100-metre section of the N2 (the higher the score, the greater the risk). It also illustrates the Star Ratings along the road, whereby 5-star (green) roads are the safest while 1-star (black) roads are the least safe. It illustrates the variation in risk as the vehicle travels along the road (from Dhaka to Sylhet). Although some very short sections of road (which are typically new bridges built with roadside and median safety barriers) score in the 4- and 5-star range, the majority of the risk line is within the 2-star category. This is concerning, given that as recently as 2005, major upgrades had been made to this road.

Table 1. Road attributes recorded by iRAP

	Road user types affected			
Road attribute	**Car occupants**	**Motor-cyclists**	**Pedes-trians**	**Bicy-clists**
Bicycle facilities				•
Delineation	•	•		•
Intersection road volume level	•	•		•
Intersection type[a]	•	•		•
Lane width	•	•		•
Median type[b]	•	•	•	•
Minor access point density	•	•		•
Number of lanes	•	•	•	•
Passing demand	•	•		
Paved shoulder width	•	•		•
Pedestrian crossing facilities [c]			•	•
Quality of crossing[d]			•	•
Quality of curved	•	•		•
Quality of intersection[d]	•	•		•
Radius of curvature	•	•		•
Pavement condition	•	•		•
Roadside design /obstacles[e]	•	•		•
Shoulder rumble strips	•	•		
Side friction/ roadside activities			•	•
Sidewalk provision			•	
Speed[f]	•	•	•	•

[a] Intersection types includes 3-leg, 4-leg, roundabout, grade separation, railway, median crossing, provision of turning lanes and signalisation.

[b] Median type includes centerlines (no median), centerline rumble strips, two-way left-turn lanes, and various width of raised, depressed or flush medians with and without barriers.

[c] Pedestrian facilities include unsignalised and signalised crossings, median refuges and grade separation.

[d] The quality of crossing, curve and intersection includes consideration of pavement markings, advance signing, advisory speed limits and sight distance.

[e] Roadside design/obstacles includes non-frangible objects such as trees and poles, drains, embankments, cuts, cliffs and the distance of objects from the side of the road.

[f] Speed is currently based on speed limit; consideration of measured operating speeds is a planned enhancement.

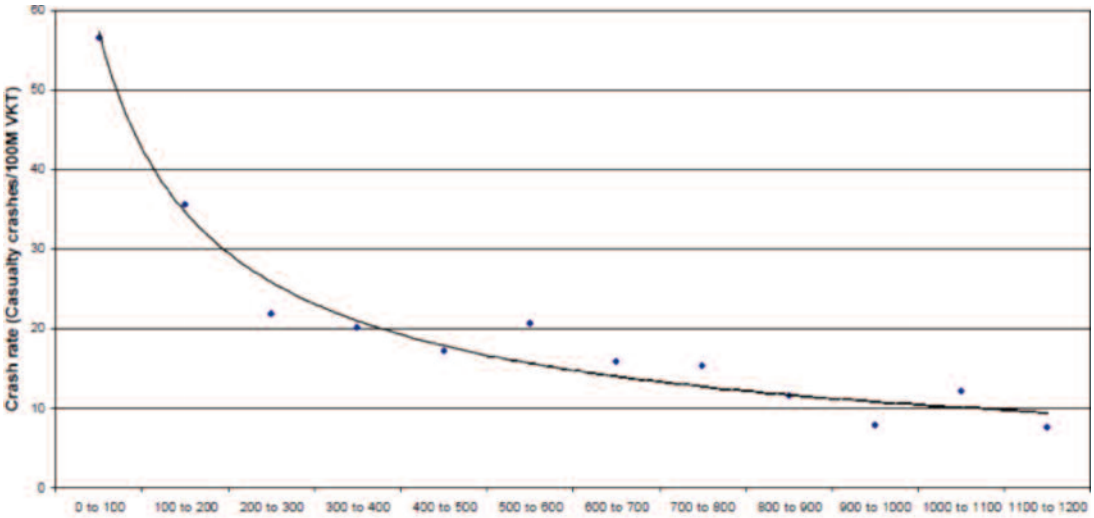

Figure 3. Casualty crash rates and curve radius [8]

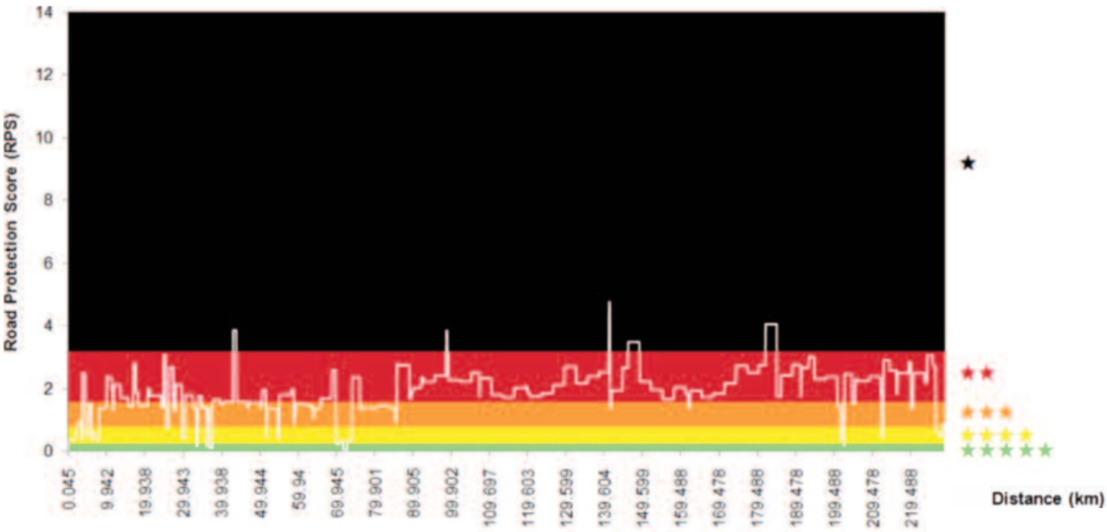

Figure 4. Road Protection Scores for car occupants, N2

Table 2 provides a summary of the Star Ratings for each of the roads by road user type. The majority of the N2 and N3 are rated 2 stars or less (out of a possible 5 stars) for all road users. It is noted that Star Ratings are not assigned to roads where there is very low use by that type of road user. For example, if no bicyclists use a section of road, then a bicyclist Star Rating is not assigned to it.

Figures 5 and 6 show examples of sections of roads, their Star Ratings and the road attributes that influenced the Star Rating (green-coloured attributes are associated with a relatively reduced level of risk; yellow-coloured attributes are associated with a relatively moderate level of risk; and red-coloured attributes are associated with an relatively increased level of risk). Some of the factors driving the relatively poor Star Ratings are as follows:

- High pedestrian flows along and across the roads and poor provision of footpaths and crossings mean the risk of serious pedestrian crashes occurrng is high (see Figure 5). More than 90% of the N2 and N3 do not have footpaths in place, and the average distance between zebra crossings is 9km. (It may also be argued that zebra crossings are inappropriate for roads carrying this volume of traffic.)
- High overtaking demand (caused by large speed differentials between vehicles) and very little median separation (96% of the N2 is undivided and 98% of the N3 is undivided) contribute to a high risk of serious head-on crashes (see, for example, Figures 6 and 7)
- 97% of roadsides on the N2 and all roadsides on the N3 are coded as severe, having fixed objects or steep embankments within 10 metres of the pavement. This increases the risk that a 'run off road' crash will result in severe injuries
- Poor quality, at-grade intersections are frequent (on average 1 every 1.6km). This increases the likelihood of severe intersection crashes occurring.

Overarching these factors is the speed limit, which is set at 80km/h along most of the roads. Based on research reported by the OECD, the risk of death and serious injury in most crashes is very high at this speed [11].

Table 2. Overall Star Ratings for the N2 and N3

	Vehicle occupants Length (km)	%	Motorcyclists Length (km)	%	Bicyclists Length (km)	%	Pedestrians Length (km)	%
				Highway N2				
5 stars	2	1%	1	0%	0	0%	0	0%
4 stars	14	6%	11	5%	2	1%	0	0%
3 stars	45	20%	7	3%	4	2%	4	2%
2 stars	160	70%	147	64%	213	93%	225	98%
1 star	8	3%	63	28%	5	2%	0	0%
Not rated	0	0%	0	0%	5	2%	0	0%
Total	229	100%	229	100%	229	100%	229	100%
				Highway N3				
5 stars	0	0%	0	0%	0	0%	0	0%
4 stars	6	7%	6	6%	0	0%	0	0%
3 stars	13	15%	1	1%	2	2%	2	2%
2 stars	60	67%	47	53%	49	55%	88	98%
1 star	10	12%	36	41%	38	43%	0	0%
Not rated	0	0%	0	0%	0	0%	0	0%
Total	90	100%	90	100%	90	100%	90	100%

Note: Percentages may not add to 100% due to rounding.

Figure 5. A section of Highway N2 rated 2 stars for pedestrians

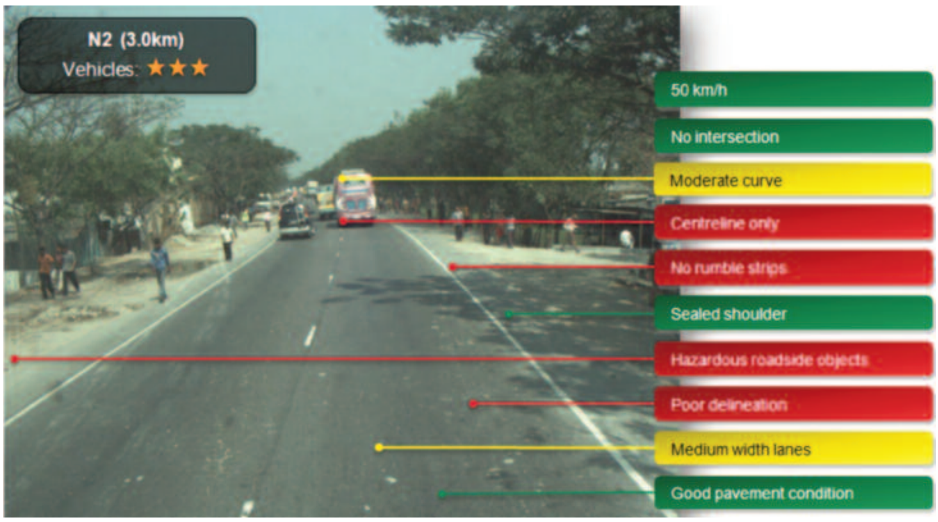

Figure 6. A section of Highway N2 rated 3 stars for car occupants

Figure 7. The result of a head-on crash between two trucks on the N2, which occurred during the inspections

Safer Roads Investment Plan methodology

The purpose of a Safer Roads Investment Plan is to provide an appreciation of the types of countermeasures that could affordably and economically reduce risk – and therefore prevent deaths and serious injuries. To do this, iRAP considers the suitability of various countermeasures from a list of 70 countermeasures, ranging from low-cost road markings and pedestrian refuges to higher-cost intersection upgrades and full highway duplication (more information on the countermeasures in the iRAP list is available in the Road Safety Toolkit (http://toolkit.irap.org) [12]).

The process used to generate Safer Roads Investment Plans in the Bangladesh project was consistent with the approach described in the paper titled *Safer Roads Investment Plans: The iRAP methodology* (available for download at http://irap.org/ media/10503/ irap504.05_safer_roads_investment_plans.pdf [13]). In general terms three steps were taken, as summarised below.

Estimating the number of deaths and serious injuries on road sections

To enable economic evaluation of various countermeasure options, an estimate of the number of deaths and serious injuries under existing conditions on each 100-metre section of road was made. As discussed previously, 180 people and 89 people were killed in traffic crashes on the N2 and N3, respectively, in 2008. However, there is strong evidence that many deaths are likely to have been under-reported. As a result, the reported numbers of deaths were scaled up by a factor of four, which is consistent with WHO and TRL reports, and advice provided by BUET and the RHD [1, 6].

Since the number of deaths was available only in aggregate form (that is, for the entire length of each road), the deaths needed to be distributed among the 100-metre sections of road. The number distributed to each section was a function of the product of each section's Road Protection Score (RPS) and exposure (in the case of car occupants, exposure is measured as the annual average daily traffic). Hence, it is feasible that a road with a 1-star rating (indicating high risk) can still experience very few deaths if its traffic volume is low, and the reverse is also true.

An estimate of the number of serious injuries on each section was then made by assuming that for each death, 10 serious injuries occur. This approach is based on research by McMahon and Dahdah (2008) [14].

Selecting countermeasures

For each 100-metre section of road, a series of countermeasures that feasibly could be implemented were identified. This was achieved by considering the ability of each countermeasure to reduce risk (as measured by the RPS) and 'application' and 'hierarchy' rules. For example, a section of road that has a poor pedestrian RPS and high pedestrian activity was likely to benefit from the installation of a pedestrian refuge, pedestrian crossing or signalised pedestrian crossing. Similarly, a section of road with poor delineation and a high car occupant RPS was likely to benefit from better delineation.

'Application' rules were used to help ensure that the countermeasures identified align with reasonable engineering practice. For example:

- Grade-separated pedestrian crossings should be at least one kilometre apart. Hence, a grade-separated crossing was not considered feasible if one had already been identified for the previous 100-metre section.
- New signalised pedestrian crossings (non-intersection facilities) should be at least 600 metres apart.
- Additional lanes (such as overtaking lanes or 2+1 cross section) should be required for a minimum length of one kilometre.

'Hierarchy' rules were used to ensure that more comprehensive countermeasures took precedence over less effective countermeasures. For example:

- If a grade-separated pedestrian facility was feasible, then it took precedence over other pedestrian measures (such as a pedestrian refuge or signalised crossing)

Table 3. Overview of investment plan options for the N2

	Plan N2-1	Plan N2-2	Plan N2-3
Investment	Tk 7,500 million	Tk 3,400 million	Tk 1,300 million
Deaths and serious injuries prevented (20 years)	31,330	22,950	14,370
Economic benefit (20 years)	Tk 29,400 million	Tk 21,600 million	Tk 13,500 million
Cost per death and serious injury prevented	Tk 240,000	Tk 150,000	Tk 90,000
Benefit cost ratio	4	6	10
Reduction in deaths and serious injuries	36%	26%	17%

Note: 1 USD = Tk 69.60 (29 August 2010)

Table 4. Overview of investment plan options for the N3

	Plan N3-1	Plan N3-2	Plan N3-3
Investment	Tk 3,800 million	Tk 2,300 million	Tk 1,400 million
Deaths and serious injuries prevented (20 years)	22,460	19,250	15,760
Economic benefit (20 years)	Tk 21,100 million	Tk 18,100 million	Tk 14,800 million
Cost per death and serious injury prevented	Tk 170,000	Tk 120,000	Tk 90,000
Benefit cost ratio	6	8	11
Reduction in deaths and serious injuries	44%	38%	31%

Note: 1 USD = Tk 69.60 (29 August 2010)

- If a horizontal realignment was feasible, then redundant countermeasures were not considered (for example, curve delineation and shoulder widening)
- If a segregated motorcycle lane was feasible, then other motorcycle lanes (such as an on-road motorcycle lane) were removed from the plan.

Economic analysis

Each countermeasure option identified was then subject to a benefit cost ratio (BCR) analysis. Countermeasures that failed to achieve a BCR of at least 1 were excluded from the analysis. However, higher BCR thresholds were also used to develop less expensive plans.

The benefit of a countermeasure was determined by calculating the net present value of deaths and serious injuries that would be avoided over 20 years if the countermeasure was installed (a discount rate of 7% was used). The reduction in deaths and serious injuries was determined by replacing the RPS used in the original estimate (made in the process of distributing deaths among 100-metre sections of road) with a new, lower RPS.

For the purposes of this project, the economic value of a death and a serious injury was determined by following guidance from McMahon and Dahdah (2008) [14]:

- economic cost of a death = 100 x Gross Domestic Product (GDP) per capita (current price) = Tk 4.34 million (USD $62,400)
- economic cost of a serious injury = 0.25 x economic cost of a death = Tk 1.09 million (USD $15,600).

The cost of a countermeasure was determined by estimating the net present cost of installing and maintaining each countermeasure over 20 years. These costs were estimated in consultation with the RHD.

Proposed countermeasures

Three investment plan options were generated for each highway, based on benefit cost ratio thresholds of 1, 3 and 5. The investment plan analyses were performed using iRAP's online software. The purpose of providing a series of investment plans was to enable the government (and development banks) to select a program of works that is both affordable within budget constraints and economically viable.

Tables 3 and 4 summarise the results of the Safer Road Investment Plan analysis for the N2 and N3. As just one example, Plan N2-1 (based on a BCR threshold of 1) identifies an investment of Tk 7.5 billion ($105 million). It is estimated that this could prevent 31,330 deaths and serious injuries over 20 years (36% reduction) and generated a BCR of 4:1.

Table 5 lists countermeasures types proposed in Plan N2-1 and Table 6 lists countermeasure types proposed in Plan N3-1. For each countermeasure type, the tables also summarise:

- the length or number of sites to be treated
- the number of 'KSI saved' (KSI is killed and seriously injured)
- the economic benefit (based on the net present value of the reduction in the cost of deaths and serious injuries)
- the net present cost of the countermeasure
- the cost per KSI saved
- the benefit cost ratio.

Table 5. Overview of countermeasures for Plan N2-1 (costs and benefits over 20 years)

Countermeasure type	Length / Sites	KSI saved	Economic benefit (Tk million)	Cost (Tk million)	Cost per KSI saved ('000 Tk)	BCR
Duplication	90 km	14610	13700	4100	280	3
Roadside safety - barriers	320 km	5060	4800	1300	260	4
Pedestrian crossing	180 sites	3740	3500	400	90	10
Intersection - grade separation	9 sites	1940	1800	500	260	4
Pedestrian footpath	130 km	1630	1500	400	260	4
Roadside safety - hazard removal	70 km	1070	1000	200	190	5
Intersection - roundabout	7 sites	960	900	20	20	59
Additional lane	30 km	740	700	500	660	1
Shoulder widening	5 km	560	500	20	40	26
Delineation	30 km	320	300	30	30	9
Intersection - signalise	4 sites	240	200	10	40	22
Rumble strip / flexi-post	2 km	180	200	2	5	109
Central hatching	5 km	140	100	3	10	47
Lane widening	2 km	60	60	30	290	2
Median barrier	1 km	40	40	5	70	8
Bicycle facilities	2 km	10	10	4	370	3
Central turning lane full length	1 km	10	9	8	510	1
Traffic calming	1 km	10	7	1	40	14
Regulate roadside commercial activity	1 km	10	7	1	120	5
Total		31330	29400	7500	240	4

Note: 1 USD = Tk 69.60 (29 August 2010)

KSI = Killed and seriously injured

Table 6. Overview of countermeasures for Plan N3-1 (costs and benefits over 20 years)

Countermeasure type	Length / Sites	KSI saved	Economic benefit (Tk million)	Cost (Tk million)	Cost per KSI saved ('000 Tk)	BCR
Duplication	40 km	8390	7900	1700	210	5
Shoulder widening	60 km	3400	3200	200	60	16
Roadside safety - barriers	170 km	3390	3200	700	210	4
Pedestrian crossing	100 sites	2610	2400	200	70	13
Pedestrian footpath	70 km	2250	2100	300	120	8
Additional lane	20 km	690	600	300	420	2
Lane widening	20 km	510	500	100	170	3
Delineation	40 km	510	500	30	20	14
Intersection - grade separation	3 sites	240	200	200	690	1
Intersection - roundabout	4 sites	200	200	10	50	18
Intersection - signalise	3 sites	100	90	9	90	10
Bicycle facilities	30 km	80	70	30	330	3
Regulate roadside commercial activity	1 km	40	40	2	30	20
Parking improvements	1 km	30	30	2	30	20
Roadside safety - hazard removal	1 km	20	20	2	130	7
Total		22460	21100	3800	170	6

Note: 1 USD = Tk 69.60 (29 August 2010)

KSI = Killed and seriously injured

As can be deduced from Tables 5 and 6, the countermeasures proposed in the plans focus on:

- reducing the likelihood and severity of 'run off road' and head-on crashes by widening shoulders, installing roadside safety barriers and median barriers
- reducing the likelihood and severity of pedestrian crashes by installing crossing facilities and footpaths
- reducing risk at intersections through grade separation, roundabouts and traffic signals.

Because the Safer Road Investment Plan analyses are based on 100-metre sections of road, it is possible to provide local engineers with a detailed listing of the countermeasures for each section along the road. This aids in reviews of the appropriateness of the countermeasure and detailed design. The engineers are also able to make use of interactive maps within the iRAP software that plot the exact location of proposed countermeasures. The iRAP plans are supplemented by the Road Safety Toolkit (http://toolkit.irap.org), which provides additional information on what is meant by each countermeasure, typical benefits and implementation issues.

Safe System approach

Although the plans summarised in the previous section identify opportunities to significantly reduce deaths and serious injuries, in order to make the N2 and N3 truly safe, efforts that go beyond engineering improvements alone will be necessary. Bangladesh is one of many countries in which fundamental road-safety education and enforcement (seatbelts, helmets, drink-driving and general adherence to traffic law) are not in place. As a result, the benefit of some infrastructure improvements may be compromised because they are not used as they are intended. For example, pedestrian overpasses are only effective if pedestrians use them. Nonetheless, basic infrastructure, such as clear signs and road markings, will be essential if road users are to know what they are expected to do and if traffic law is to be effectively enforced.

Near the completion of the N2 upgrades in 2005, BRAC reported on a survey of people living along and using the road, which emphasises this point. BRAC concluded that local communities need to have the opportunity both to contribute to road designs and to understand the intended use of various road design features, if roads are to be used safety [15]. The implementation of any countermeasures proposed by iRAP needs to take this into account.

Given Bangladesh's situation, significant benefits could also be realised through coordinated targeting of risk factors for road users (such as speed, seatbelt wearing and alcohol) and vehicles. This would be consistent with taking a Safe System approach to the program. The Road Safety Toolkit and United Nations Road Safety Collaboration Good Practice Manuals provide further information on this issue [16].

Conclusion

The iRAP Bangladesh Pilot Project provided the first comprehensive infrastructure risk assessment of the N2 and N3 Highways. The assessment showed that despite recent large-scale upgrades to the N2, road users still face a high level of risk. The N3 is also categorised as high risk for all road users.

The project identified a range of economically viable countermeasures that have the potential to prevent thousands of deaths and serious injuries. These include wider shoulders and safety barriers to reduce 'run off road' and head-on crash risk, footpaths and pedestrian crossings to reduce risk of severe pedestrian crashes, and roundabout and traffic signals to reduce the incidence of serious intersection crashes. The most comprehensive of the plans identified the potential to reduce deaths and serious injuries by 36% on the N2 and by 44% on the N3.

The results of the project provide the Government of Bangladesh with a means of planning infrastructure safety improvements and negotiating support from the development banks. The plans also provide a basis for setting infrastructure safety performance indicators and associated targets for the roads. For example, it is now possible to monitor and aim to decrease the percentage of travel on roads that have high risk of death or serious injury due to head-on crashes (car occupants and motorcycles).

Overall, the pilot project demonstrated that the iRAP approach to risk assessment is able to be applied in Bangladesh, as it has been in numerous countries around the world. With the Government's demonstrated commitment to road safety, and with the support of local road safety organisations and the regional development banks, it is hoped that significant gains can be made during the Decade of Action for Road Safety.

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Literature Review

Emergency lane deaths

Twenty-nine people died in emergency lane collisions over the last 10 years, and 12 more cases are being investigated by a coroner, according to data released by the National Coroners Information System (NCIS) located at the Victorian Institute of Forensic Medicine. Almost 80% of the emergency lane deaths involved males and 70% were aged between 20-49 years. Heavy trucks were the most common counterpart vehicle.

Based on these data the Director of NCIS, Professor Joan Ozanne-Smith, is encouraging motorists to stay well clear of their vehicle following a breakdown, if it is safe to do so. 'The most common scenario is people being killed while parked in the emergency lane or being too close to the car,' Professor Ozanne-Smith said. She recommended that if motorists had to stay inside their stationary vehicle, it was imperative to keep their seatbelts firmly fastened.

This advice is confirmed by public motoring authorities, which recommend that motorists leave a stationary vehicle through the passenger-side door and wait for assistance as far away from traffic as possible. They also discourage motorists from working on their vehicle in the emergency lane, particularly on the traffic side.

The NCIS Fact Sheet, *Deaths in emergency lanes,* is available at http://www.ncis.org.au/web_pages/FACT-SHEET%20-%20Deaths%20in%20emergency%20lanes%20-%20final.pdf

Recent CASR reports

reviewed by Jaime Royals, Information Manager, Centre for Automotive Safety Research, University of Adelaide, South Australia 5005
For hard copies of reports, contact Jaime at jaime@casr.adelaide.edu.au, phone 08 8303 5890.

Raftery SJ, Wundersitz LN. *The efficacy of road safety education in schools: A review of current approaches.* CASR077. March 2011

This report provides an overview of current road safety education (RSE) programs for school students that are currently in use in Australia and overseas, with the primary aims of commenting on the effectiveness of current approaches and identifying any gaps in the provision of RSE. The report includes only RSE programs that have been evaluated or that are comparable with similar evaluated programs. RSE programs were categorised according to the five primary strategies adopted: indirect or holistic approaches, one-time interventions, driver training, curriculum-based, and multi-modal approaches. The lack of well-designed evaluations makes commenting on the short- and long-term efficacy of RSE programs problematic; however, the report makes use of evidence from a variety of sources to facilitate an informed discussion.

The effectiveness of current road safety educational programs remains largely undetermined as there is little evidence showing that RSE either does or does not work, although programs addressing the general causes of risk-taking behaviour are showing some promise. In general, current approaches do not appear to cause harm, unless they promote early licensing, and an inherent value would be expected in passing on road safety knowledge. Suggestions for improvements and future directions for RSE are also offered. The report is available at http://casr.adelaide.edu.au/publications/list/?id=1212.

Baldock MRJ, Grigo JAL, *Raftery SJ. Protective clothing and motorcyclists in South Australia.* CASR088. March 2011

In November 2010 the South Australian Motor Accident Commission launched its 'Gear Up' campaign to promote greater use of protective clothing by motorcyclists. Such clothing may include impact protectors and abrasion-resistant materials. This study was conducted to ascertain the extent to which abrasion-resistant materials could be expected to be of benefit in motorcycle crashes in urban and rural areas. A literature review and analysis of in-depth crash data revealed that riders involved in motorcycle crashes are likely to slide or tumble on the road surface, regardless of crash type or crash location (urban or rural). It was concluded that protective clothing would be beneficial for all motorcyclists, whether they were urban commuters or weekend recreational riders. The report is available at
http://casr.adelaide.edu.au/publications/list/?id=1213.

Raftery SJ, Wundersitz LN. *No restraint? Understanding differences in seat belt use between fatal crashes and observational surveys.* CASR090. March 2011

Observational surveys of restraint use in South Australia have reported vehicle occupant wearing rates somewhere in the order of 97%; these rates drop below 70%, however, for crashes where vehicle occupants are killed or seriously injured. In order to seek some understanding of why the prevalence of seat belt use varies between observational surveys and crash statistics, a review of published international research and an analysis of a sample of fatal crashes in South Australia were undertaken.

The literature review indicated that individuals less likely to wear seat belts were also most likely to be involved in crashes resulting in death or serious injury. A review of South Australian coroner's data for fatal crashes in 2008 revealed that 37% of vehicle occupants killed in a crash were unrestrained. Further analysis indicated that those least likely to be restrained were younger, more likely to have tested positive to drugs and more likely to have engaged in extreme behaviour than those who were restrained. Restraint use was also less common amongst fatalities in rollover crashes and amongst those ejected from the vehicle. Restraint use was identified as an important issue for Indigenous Australians and people in regional and remote areas.

Examination of the characteristics of fatal crashes revealed that observational survey methodologies have a limited capacity to detect those least likely to wear seat belts. Evidence of a selective recruitment effect was also observed. The findings are discussed in relation to potential countermeasures to increase restraint use. The report is available at
http://casr.adelaide.edu.au/publications/list/?id=1214

Anderson RWG, Hutchinson TP, Linke B, Ponte G. *Analysis of crash data to estimate the benefits of emerging vehicle technology.* CASR094. April 2011

The purpose of this report is to estimate the potential benefits of some of the safety technologies emerging for passenger vehicles, trucks and motorcycles. The focus is overwhelmingly on systems that actively prevent crashes, but a few passive safety features are also included.

The largest potential for reducing the number of serious and fatal crashes is likely to come from forward collision detection and avoidance technologies. These technologies currently include emergency brake assist, 'city-safe' low speed obstacle detection with automatic braking, and adaptive cruise control with automatic braking (for example, operating sometimes only above 60km/h). In the next five years, it is expected that the technologies will continue to develop such that there will be complete convergence in the operable range of systems, and a complete integration of the sensing and intervention technologies.

It is from such future systems that the largest road safety gains are likely to be made. However, BCR values for forward collision detection and avoidance in passenger vehicles appear marginal given the present stage of development of the relevant technologies (where such systems might only be used to effect in higher speed limit areas); better estimates of future costs of the relevant technology will be critical to any justification for wide-scale installation. Nevertheless, BCR values support wide-scale installation of forward collision avoidance technologies in trucks. Mechanisms are suggested for accelerating the deployment of cost-effective safety technology into the Australian passenger fleet. The report is available at
http://casr.adelaide.edu.au/publications/list/?id=1217.

Monitoring drink driving in Europe

The 13th *Drink Driving Monitor* brings news from across the EU on steps to further improve drink driving legislation and enforcement. Updates on the Cross-Border Enforcement Directive and the decision by the UK to delay its opt-in are presented, together with the Draft Report on Road Safety proposed by MEP Koch and the latest on the TISPOL European Traffic Police Network alcohol and drug campaign. An interview with Desiree Schaap from the Netherlands Ministry of Transport bout the Dutch Alcolock Programme and the ETSC alcolock legislation barometer are also featured. This publication can be downloaded at http://www.etsc.eu/documents/Drink_Driving_Monitor_April_2011.pdf .

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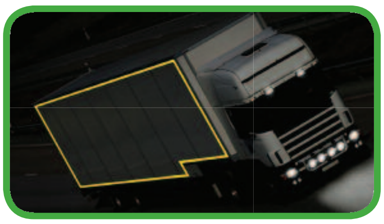

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