TRIPP BULLETIN
VOL. 18 NO.1 SUMMER 2021
TRANSPORTATION RESEARCH & INJURY PREVENTION PROGRAMME
INDIAN INSTITUTE OF TECHNOLOGY DELHI

Publications

Behal, D., Kumar, S. and Tiwari, G., 2020. Determination and analysis of informal public transport stops. IATSS research, 44(1), pp.36-54.

Bisht, L.S. and Tiwari, G., 2020. Assessing the black spots focused policies for Indian national highways. Transportation research procedia, 48, pp.2537-2549.

Chanda, S., Mukherjee, K., Gupta, S. and Pratihar, D.K., 2020. A comparative assessment of two designs of hip stem using rule-based simulation of combined osseointegration and remodelling. Proceedings of the Institution of Mechanical Engineers, Part H: Journal of Engineering in Medicine, 234(1), pp.118-128.

De Bakshi, N., Tiwari, G. and Bolia, N.B., 2020. Influence of urban form on urban freight trip generation. Case Studies on Transport Policy, 8(1), pp.229-235.

Dixit, A., Vishnoi, S. and Paul, S.B., 2020. Adding Structure to Statistics: A Study on COVID-19 Dynamics in India. medRxiv.

Gaur, P., Sharma, S., Kumar, D., Chawla, A., Mukherjee, S., Jain, M., Mayer, C., Chitteti, R.K., Ghosh, P., Malhotra, R. and Lalwani, S., 2020. Inverse material characterisation of human aortic tissue for traumatic injury in motor vehicle crashes. International Journal of Crashworthiness, pp.1-20.

Gupta, D., Zubair, M., Lalwani, S., Gamanagatti, S., Roy, T.S., Mukherjee, S. and Kale, S.S., 2020. Development and Validation of Finite Element Analysis Model (FEM) of Craniovertebral Junction: Experimental Biomechanical Cadaveric Study. Spine, 45(16), pp.E978-E988.

Jain, D. and Tiwari, G., 2020. Gender and income based variability in travel choices in Vishakhapatnam, India. Transportation Research Procedia, 48, pp.2870-2890.

Janwari, M., Tiwari, G. and Mir, M.S., 2020. Estimating Congestion Cost for Ring Road of Delhi. Transportation Research Procedia, 48, pp.2638-2655.

Jha, A.N., Tiwari, G. and Chatterjee, N., 2020. Road accidents in EU, USA and India: a critical analysis of data collection framework. In Strategic System Assurance and Business Analytics (pp. 419-443). Springer, Singapore.

Koushik, A.N., Manoj, M. and Nezamuddin, N., 2020. Machine learning applications in activity-travel behaviour research: a review. Transport reviews, 40(3), pp.288-311.

Kumar, R., Zubair, M., Mukherjee, S. and Makoshi, J.A., 2020. A method to predict location of non-coup brain injuries. arXiv preprint arXiv:2011.13111.

Lakhotia, S., Lassarre, S., Rao, K.R. and Tiwari, G., 2020. Pedestrian accessibility and safety around bus stops in Delhi. IATSS research, 44(1), pp.55-66.

Mishra, V., Ahuja, R., Nezamuddin, N., Tiwari, G. and Bhalla, K., 2020. Strengthening the capacity of emergency medical services in low and middle income countries using dispatcher-coordinated taxis. Transportation Research Record, 2674(9), pp.338-345.

Mohan, D. and O'Neil, B., 2020. Dealing with existing theory: national fatality rates, vehicle standards and personal safety. International journal of injury control and safety promotion, 27(1), pp.12-19.

Mohan, D., Tiwari, G., Varghese, M., Bhalla, K., John, D., Saran, A. and White, H., 2020. Protocol: Effectiveness of road safety interventions: An evidence and gap map. Campbell Systematic Reviews, 16(1), p.e1077.

Naqvi, H.M. and Tiwari, G., 2020. Safety performance functions for fatal crashes on national highways in India. Transportation research procedia, 48, pp.1185-1199.

Ramanathan, A. and Paul, S., 2020, June. The effect of urban infrastructure development on female labour force participation among the poor and middle class in India. In Proceedings of the 3rd ACM SIGCAS Conference on Computing and Sustainable Societies (pp. 314-316).

Rankavat, S. and Tiwari, G., 2020. Influence of actual and perceived risks in selecting crossing facilities by pedestrians. Travel Behaviour and Society, 21, pp.1-9.

Sarangi, P. and Manoj, M., 2020. Escorting and mode choice decisions of members of an urban university in New Delhi, India. Case Studies on Transport Policy, 8(4), pp.1440-1450.

Sharma, A., Tiwari, G. and Rao, K.R., 2020. Identifying mixed use indicators for including informal settlements as a distinct land use: Case study of Delhi. Transportation Research Procedia, 48, pp.1918-1930.

Singh, M.K. and Rao, K.R., 2020. Cellular automata models for signalised and unsignalised intersections with special attention to mixed traffic flow: a review. IET Intelligent Transport Systems, 14(12), pp.1507-1516.

Sinha, A.K. and Jha, K.N., 2020. Critical Analysis of Contract Clauses in Road Sector: Case Study. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 12(3), p.05020005.

Sinha, A.K. and Jha, K.N., 2020. Dispute resolution and litigation in PPP road projects: evidence from select cases. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 12(1), p.05019007.

Tiwari, G., 2020. Progress in pedestrian safety research. International journal of injury control and safety promotion, 27(1), pp.35-43.

Tiwari, G., 2020. Research challenges in uncertain times. International Journal of Injury Control and Safety Promotion, Volume 27, 2020 - Issue 3, Pages 263-265

Tiwari, G., 2020. Safety research: learnings from new methods and large data sets. International Journal of Injury Control and Safety Promotion, Volume 27, 2020 - Issue 4, Pages 401-402.

Tiwari, G., Khayesi, M., Mitullah., Kobusingye, O., Mohan, D., Zuidgeest M. (2020). . Road traffic injury and transportrelated air quality in Sub-Saharan Africa. Position paper The extent of the challenge in Mobility and Access in African Cities, VREF.

Valverde-Marcos, B., Rubio, I., Antona-Makoshi, J., Chawla, A., Loya, J.A. and Rodríguez-Millán, M., 2020. Numerical Analysis of EOD Helmet under Blast Load Events Using Human Head Model. Applied Sciences, 10(22), p.8227.

Verma, M., Rodeja, N., Manoj, M. and Verma, A., 2020. Young Women's Perception of Safety in Public Buses: A Study of Two Indian Cities (Ahmedabad and Bangalore). Transportation research procedia, 48, pp.3254-3263.

Yugendar, P., Rao, K.R. and Tiwari, G., 2020. Driving cycle estimation and validation for Ludhiana city, India. International Journal for Traffic & Transport Engineering, 10(2).

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

TRIPP BULLETIN
TRANSPORTATION RESEARCH & INJURY PREVENTION PROGRAMME
VOL 18 NO.1 SUMMER 2021

ROAD SAFETY DEVELOPMENT – A CONTINUOUS LEARNING ABOUT THE IMPORTANCE OF KNOWING WHAT YOU DO, AND WHY

Ingrid Skogsmo,
Swedish National Road and Transport Research Institute (VTI), Sweden.

The time to discuss road safety is "now" for several reasons, among which we can find:

- The 3rd ministerial global conference on road safety, in February 2020, closed by the "Stockholm Declaration" and a renewed 10-year road safety goal;
- The high pace of technology development and innovations, e.g. regarding connectivity and automation, and in the IT sector;
- A lot of data is available and can be created – and is asked for by "all".

Irrespective if "now" is today, or was a couple of years ago, road safety is and has been a concern, and there have been several calls to "act now". Ambitious targets have been set - and missed. Actions and improvements have been introduced, but so have also new areas of risk. While this is the time to discuss road safety, it is also the right time to reflect on experiences gained so far and bring in gained insights as we look ahead.

This paper will discuss the importance of a real world understanding when addressing road safety from different angles. Examples from how this understanding has led to concrete actions are given and they mirror the expansion of the context of "road safety". The future role of safety research will also be reflected by looking at automated vehicles.

Road safety can be discussed in terms of statistics, economic burden of road accidents, cause of death, number of severe injuries, vulnerable road user (VRU) exposure, truck driver fatigue, distraction,… The perspective can be global, national, regional, local, societal, public, corporate, individual,….

Without claiming that this is the exhaustive list, the multitude of aspects point out the importance of understanding the CONTEXT in which road safety is addressed. This is particularly important when transferring results from one study or place to another, when trying to learn from existing and past knowledge and experience.

The context that forms the background to this paper is my 30+ year career in road safety. It encompasses all parts of the "triple-helix" – government, research and over two decades working with safety at Volvo Cars, which explains the selection of learnings.

Sweden, the country that invented "Vision Zero" has been my main basis. This high-income country is half as long as India, with over 10 million persons living on a surface 1/8 of India's. The Swedish context is very different from many other places - still many of the learnings can be generalized.

Volvo was then one of the few car makers actively talking about road safety, which was a part of its brand promise. "Vehicle" and "During" in the matrix received major attention. Already in 1972 an accident research team had been established. The team investigated in-depth accidents involving Volvo cars in the vicinity. The documentation (photos, measurements, verbatims) taken would then be entered into a database, and accompanied by medical records or autopsy protocols for the occupants. Accidents that took place further away were documented when undergoing inspection for insurance and repair, according to a less detailed protocol. The database thus included both in-depth studies and material allowing statistical analysis – an excellent foundation for KNOWLEDGE, for defining priorities and undertaking research.

Despite meeting legal requirements, crashes and fatalities were however still happening. To know what to do be "leading in safety" it was essential to understand why and how accidents happen, what the outcome was and how to influence this by vehicle design. A structured method was developed to make use of world knowledge by transferring it into cars. Examples of the practical application of the knowledge, method and use of data are given in the following sections.

Based on the extensive collection of real-world data for existing vehicles Volvo researchers developed a method for predicting real-world performance for a new or modified car design over the whole range of crash severities where injuries occur.

The procedure can be used for predicting the overall effect of a safety design. By correlating accident data with lab test data in equivalent crash modes, it was possible to develop an injury probability function associated with dummy responses.

To cover the wider spectrum than the basic performance prescribed by regulation, Volvo's crash safety in house requirements encompassed already since the late 1970's a variety of crash types, crash speeds and directions. Dummies of various sizes were used. The method described above was elaborated to select solutions that would give real world improvements. One application was in the development of a new vehicle family and that resulted in launching SIPS, Side Impact Protection System, in 1991.

Initially regulators' interest in crash tests focused frontal impact. However, in the 1990's side impacts in highly motorized countries made up over 25% of the vehicle crash fatalities. This had been noted by Volvo who developed its own requirements aiming for a 25% reduction in occurrence of severe to fatal chest injuries. Using the real-world prediction model, an ambitious side impact program was launched. Tests were run at 25, 30 and 35 mph in the US method. In 1991 the new Volvo 850 was launched with the SIPS system as one of several safety features. Two "world firsts" followed: the side impact airbag, the SIPS-bag, in 1994, and an inflatable curtain for head protection in 1998.

Real world data has since shown an over 55% reduction of severe chest injuries for SIPS together with SIPS bag.

What was going on regarding regulations? It took until the mid-nineties until regulators introduced side impact tests with moving barriers and dummies:

- EU 1996: barrier test at 50 km/h, perpendicular impact.
- USA 1997 barrier test at 30 mph (48 km/h) ("Crabbed configuration")

Already in 1993 NHTSA (National Highway Traffic Administration, part of the US Department of Transport) had tried to increase the public attention to road safety by introducing the New Car Assessment Program, NCAP. It was initially based on dummy values from the frontal barrier regulatory test, run at an impact speed 5mph higher than the regulated 30 mph in FMVSS 208. A 5-star rating system was introduced in 1993 aiming to make this consumer information more user-friendly. Various other actors, including US institutes and German press, also developed their own ratings and tests with the purpose to demonstrate differences between vehicles. In Europe the EuroNCAP was introduced in 1996. Occasionally media headlines, some quite dramatic, could announce the failure (more often) or success (rarely announced) of a certain make. Safety performance had become a marketing element!

When compared to real world accident data, which had been gathered by e.g. insurance organisations, it could however be observed that a high score in a rating test didn't necessarily translate into good real-world performance. The risk of focusing one single test in one single situation, with one single size of occupant type – leading to a top score could be shown by use of the prediction model above.

Ratings are typically run at a very high speed compared to the speeds where most crashes occur. Human tolerances vary across the occupant population, and injuries will occur also at lower speeds. To secure a good overall occupant

protection it may be equally important to perform well at lower crash severities, since a small deterioration at the more frequent crash severities can easily outbalance an improved performance at high speed. For example characteristics of impact areas or triggering of airbags may incur a suboptimization effect if not designed for the real world speed spectrum.

Repeatedly real-world studies confirm the importance of having knowledge, of using it wisely and to apply it not only for a single top mark, but for the purpose of making a true positive impact. Today structures similar to SIPS and side-bags and are widely present in cars. Doing the right thing for the real world pays off!

"Data" is often asked for. More data, even more data, big data, different data, access to data… Still a lot is available, and there may be creative ways of making use of what is already there. Requesting more data before acting based on the obvious should never be an excuse for indecisiveness.

Whiplash injuries in rear end crashes is one example of a real-world problem that had to be tackled in a step-by-step fashion. Early work at Volvo had resulted in a sturdy head restraint positioned high up against the head.

Taking stock of the database, several accident studies were undertaken with medical experts during the 1980s and '90 to try to determine why some persons who had been in low speed rear end crashes sustained a whiplash injury, while others didn't, and to understand how the car could provide better protection for the neck in rear-end impacts. At the time, there were neither agreed definitions nor diagnosis methods for whiplash, and injury mechanisms and criteria were missing. Existing dummies, Hybrid II and Hybrid III, were designed to be reasonably biofidelic in frontal crashes at 50 km/h, and were far too stiff in lower speed rear-end impacts.

Based on the knowledge of real-life accidents a computerised model of the human body was developed. With the help of the model, unique at the time, effects of different seat parameters on the spine's movement patterns could be studied. Successively guidelines for a seat design could be developed, resulting in a complete seat design – the WHIPS (WHIplash Protection System).

The main principle is to keep the spine curvature intact throughout the crash sequence. By the help of a specially designed hinge the seat absorbs energy by translating rearwards instead of "whipping" the occupant forward. Finally, the seat back tilts slightly backward while absorbing the remaining crash energy. Real world injury reduction between 30-50% has been reported.

Whiplash injuries have since these pioneering research steps been included in EuroNCAP . These tests use the BioRID dummy, the first crash test dummy built for rear-end collisions. It was developed by Swedish industry and academia, and launched in the end of the 1990's. BioRID is designed to move just like a human body does when subjected to a rear-end crash. The resulting forces on the dummy's neck are measured and the probable injury risk estimated. BioRID has since become a standard equipment of the industry.

It should be noted that additionally to reducing suffering and pain, the Swedish innovation agency, Vinnova, in 2004 reported that the Swedish society has gained about 5,5 bn SEK (approx. 45 bn INR) from the whiplash research, as well as export opportunities for Swedish businesses.

Sweden's Vision Zero was adopted by the parliament in 1997. The basic starting point is that no-one should be killed or suffer lifelong injury in road traffic, thus switching focus from the prevention of crashes to mitigating serious injury and death. An intermediate objective to halve the number of killed people of Swedish roads until 2008 was established. Although revised and updated several times, it has initiated numerous research studies and several measures. Vision Zero takes a systems- oriented approach, in which it is recognized that to achieve effects it will not be sufficient to address single elements in isolation.

Today Vision Zero is adopted on the global level. It was a theme of the 3rd global ministerial conference on road safety taking place in Stockholm, February 2020, which can be interpreted as a societal readiness to take on road safety, not least because of the increasing cost for road accidents.

Technology development is one important enabler for a systems approach to address road safety in a holistic Vision Zero manner. Already in the early 2000's several vehicle technologies that aimed for mitigation and prevention of crashes were launched. Advancements in sensor, camera and materials technology were essential in enlarging the action sphere of vehicle measures as shown by the example from 2007.

Most examples in this paper have so far looked at vehicle aspects. To effectively contribute to a sustainable development, e.g. the Sustainable Development Goals (SDG) in Agenda 2030 , a global perspective is essential when looking at scenarios, trends and measures. Data is, as always, important but when looking ahead it is also evident that data will not always be available. It is therefore even more important that measures are developed with a systems mindset, and that they are based on an understanding of the real-world conditions and contexts.

While real world situations are sometimes unclear, this is even more true when looking ahead. There is generally no shortage of scenarios and trends projections, analyses and speculations. In the project "PROS" (Priorities in Road Safety) a compilation of reports with potential relevance for transport was made. By looking at the background data it became clear that some of the identified global trends have a high certainty, whereas others can be said to be wishes or even hopes, dreams.

A renewed look at the trends in 2020 shows that trends entirely built on data are still valid (in particular Population Growth, Demographic Changes). Others may depend more on politics and market forces, such as Economic growth, Globalization and Energy & resource, and therefore are less stable. The oil price has e.g. dropped significantly since 2013, whereas connectivity has increased. Today the worries about Climate change and the CO2 concerns are more pronounced.

The belief in the necessity of real world understanding, of data and of collaboration to get ahead in road safety is also illustrated in development work of a Swedish strategic research and innovation agenda for road safety in 2014, "Safe Future in business and society". Safety was here considered to be a matter of public health both globally and nationally, and also a trigger for business opportunities and innovation. A systems thinking was applied, and four of the global trends mentioned above with impact of road safety were used as input.

The agenda expressed 18 ambitions for accident free traffic. "Accident free" goes beyond Vision Zero's focus on avoiding severe injuries and fatalities, since a crash also can be a disturbance in the transportation system, affecting e.g. emissions and congestions.

Road users, vehicles, traffic environment and the overall transport system are addressed. Vulnerable road users and public transportation play an important role. Some of the ambitions are "more mature", supported by a lot of available data and knowledge compared to ambitions with lower maturity for which societal readiness to handle the topic may also be low.

Examples of maturity grading (12 maximum maturity points):
- crash safety of car and truck: 10-11
- VRU's and public transportation safety: 5-6 points
- Connected and automated transport alternatives:

*3 in 2014

*6-8 in 2020 – despite frequently labelled as "safe and secure" and despite research efforts, experience, evidence and data is still not highly mature

Activities need to be tailored to the individual ambition and its maturity. The context plays an important role. Examples of possible activities can be:

- Feasibility analyses, methods development.
- Concepts, use of new approaches.
- Real world applications of solutions, pilot studies, business cases.
- Stakeholder involvement, changes in behaviours and laws.

Excerpts from: *12th TRIPP Annual Lecture (4th December 2020) online.*

TRIPP BULLETIN
TRANSPORTATION RESEARCH & INJURY PREVENTION PROGRAMME
VOL 18 NO.1 SUMMER 2021

News

Assessment pedestrian crossing safety using vehicle-pedestrian interactiondata through two different approaches: Fixed videography (FV) vs In-MotionVideography (IMV)

Despite numerous studies on pedestrian safety based on various roads, outskirt areas have not been con-sidered. Hence, the present study focuses on evaluating the safety of pedestrian crossing in urban and outskirtareas and to determine the differences of drivers and pedestrians'behaviors between these areas through databased onfixed videography (FV) and in-motion videography (IMV). These approaches may lead to an exactanalysis of the behavioral differences of road users behaviors from the perspective of pedestrians (FV data) anddrivers (IMV data) in urban and outskirts roads. Accordingly, behavioral studies were conducted at urban andoutskirts sites through FV as well as IMV using the behavior of 29 participants in the same roads in Babol city,Iran. The gap acceptance model using linear regression and pedestrian crossing probability model using logisticregression for both approaches showed similarity on results in both urban and outskirts roads. Furthermore,behaviors of pedestrians crossing and drivers'yielding on urban and outskirts roads were very similar. Vehiclespeed, the distance of vehicle to pedestrian at the possible collision point, size of pedestrian groups, and waitingtime before crossing were the most important behavioral differences of pedestrian for choosing a gap acceptanceand probability of crossing on various sites through two different approaches. The inference of the modelsobtained in this study will lead to a better understanding of the behavior of road users for studies on advanceddriving assistance systems (ADAS).

New approaches such as FV and IMV data for better detailed ana-lysing road user behavior have compensated some of the limitations ofusing previous methods. Considering remarkable portion of pedestrianaccident occur on the outskirts areas connecting to the urban areas, thecurrent study attempts to evaluate the safety of pedestrians crossing onboth urban and outskirts areas through two different approaches. Data collection based on FV and IMV on the roads provided valuable in-formation on the behavior of road users at different times and distanceon roads. In thefirst step, data were analyzed to determine the pe-destrian acceptance gap behavior model through the linear regressionmodel. FV and IMV data were analyzed for each of the urban andoutskirts roads.Thefindings showed the similarity of results using thesetwo different approaches. Based on result of linear regression modelsthe drivers and pedestrians exhibited relatively similar behavior onboth outskirts and urban routes. Also, the results showed that thevariables of pedestrian gender, pedestrian willingness to cross withoutwaiting on the side of the roads, inclination of pedestrians to move ingroups, and time required to cross the road can be described as pe-destrian behaviors that lead to different decisions when crossing theroad. On the other hand, the distance between the vehicle and thepedestrian as well as the speed of the approaching vehicle are otherinfluential factors in choosing an accepted gap by pedestrian. In secondstep, the pedestrian crossing behavior model on both types of studiedareas showed similar affects on variables such as vehicle speed, distanceof vehicle and pedestrian, pedestrian group size, and waiting time onthe both case study area. A similar behavior pattern was observed forpedestrians crossing in the outskirts and urban roads. However, pe-destrians on the outskirts roads perform more cautious behavior tocross than in the urban ones. The modeling results also showed that theIMV and FV data are mostly similar to one another and can be deducedthat drivers' behavior in NDS studies was not different from theirnormal behavior. In general, thefindings of the present study are veryimportant in two forms. First, using FV and IMV approaches evaluatedthe issue of pedestrian safety from the perspectives of drivers and pe-destrians. Meanwhile, previous studies on road user behavior have al-ways been addressed from a separate perspective. Accordingly, theresults of the present study expose a better understanding of the natureof the interaction between the driver and pedestrians. Second, in thisstudy the pedestrian safety was examined on the outskirts areas,meanwhile, this subject had not been addressed through driver or pe-destrian behaviors on previous studies up to now. Based on the result,the behavior of road users in both urban and outskirt areas indicates thesame behavior in different situations, although slight changes wereperformed in some of road users' decisions regarding different conditions.

Abbas Sheykhfard, Farshidreza Haghighi. Accident Analysis and Preventio n, 144(2020) 105661.

Impacts of COVID-19 on access to transportation for people with disabilities

Findings from this study suggest that the pandemic is exacerbating many difficulties accessing transportation, as well as other essential goods and services that people with disabilities always face. These include challenges accessing reliable and safe transportation as well as up-to-date communications about transportation and public health, and difficulties getting needed assistance using transportation and completing activities of daily living. The pandemic response has made individuals with disabilities, particularly those without access to a household vehicle, worry that they have few options to get around and obtain what they need. Safety and health concerns kept many individuals from using transportation—even services that they believed were still operating, and even to perform essential activities like going to the doctor. Limiting travel poses a health risk to people with disabilities who are already more prone to transportation-related social exclusion and associated health risks, like feelings of perceived social isolation and delaying health care.

While more travel should not necessary be encouraged during the pandemic, transportation professionals should consider how they could mitigate wider health consequences of COVID-19 among people with disabilities. One way might be to provide members of this group with new, safe, accessible service options to make essential trips on demand. Transit agencies could accomplish this by partnering with on-demand service providers, like taxi and ridehailing companies. The San Francisco Municipal Transportation Agency leveraged such a partnership with Flywheel Taxi to develop the Essential Trip Card (ETC) program for San Francisco residents who have a disability and residents age 65 and older. The ETC program launched in April, and as of mid-July, over 15 hundred individuals had been approved for an ETC card and more than 5 thousand subsidized trips had been taken through the program (Graf, 2020). Other cities should explore developing and implementing similar initiatives.

Abigail L. Cochran. Transportation Research Interdisciplinary Perspectives, Volume 8, November 2020, 100263

Establishment funds have been received from
Ministry of Industry, Government of India
Asian Institute of Transport Development, India
Tata Motors Limited, India
Volvo Research and Educational Foundations (VREF), Sweden

Endowments for perpetual Chairs
CONFER, India: TRIPP Chair for Transportation Planning
Ford Motor Co., USA: Ford Chair for Biomechanics and Transportation Safety
Ministry of Urban Development India: MoUD Chair for Urban Transport & Traffic Planning
MoUD Chair for Urban Transport and Environment
MoUD Chair for Urban Traffic Safety
VREF: Volvo Chair for Transportation Planning for Control of Accident and Pollution

Transportation Research and Injury Prevention Programme
Room MS 815 (Main Building)
Indian Institute of Technology Delhi
Hauz Khas,
New Delhi 110016, India

Phone: 91-11-26596361, 26596557
Fax : 91-11-26858703, 26851169
Email : ird11830@civil.iitd.ernet.in
http://tripp.iitd.ernet.in

TRIPP BULLETIN
VOL 18 NO.1 SUMMER 2021
TRANSPORTATION RESEARCH & INJURY PREVENTION PROGRAMME
INDIAN INSTITUTE OF TECHNOLOGY DELHI

Excerpts from three publications: A TRIPP BULLETIN INSERT

Dealing with existing theory: national fatality rates, vehicle standards and personal safety

The World Health Organization (WHO) released its World Report on Road traffic Injury Prevention in 2004 (Peden et al., 2004). It pointed out that 'Without new or improved interventions, road traffic injuries will be the third leading cause of death by the year 2020'. The publication of this report spurred some national and international agencies and civil society groups to give a little more attention to the problem of road safety and a number of resolutions have been passed by the United Nations General Assembly, World Health Assembly and the Executive Board of the WHO (United Nations, 2014, 2016; WHO, 2004, 2016). The WHO has released four Global Status Reports on Road Safety in 2009, 2013, 2015 and 2018 (WHO, 2009, 2013, 2015, 2018).

The 2018 WHO Global Status Report shows that lowincome and middle-income countries (LMIC) on an average have higher road traffic fatality rates (27.5 and 18.4 per 100,000 population, respectively) than high-income countries (HIC) (8.3 per 100,000 population). These estimates are based on regression models that rely on national death registration data and seek to correct for substantial underreporting in official government statistics that are usually based on traffic police reports. WHO's modelled estimates exceeded official statistics by more than 20% in 57% of the countries.

This leads many policy makers to believe that significant road safety advances can only be made as the countries increase their per capita income levels (Koornstra, 2007; Kopits & Cropper, 2005). However, the data also show that there is significant variation in rates even among countries at similar income levels and that some HIC have relatively high rates and some LMIC relatively low rates. At present there is very little scientific understanding to explain these phenomena. In this paper we discuss some of the weaknesses in exiting theories and understandings behind road safety interventions and policy making. The paper deals with four main issues: road traffic fatality rates and per capita income of countries, vehicle crashworthiness standards, role of pedestrian and powered two-wheeler share in traffic on fatalities, and safety standards for vehicles other than cars.

We assumed the following daily travel distance values for the different vehicle types: Bus-150 km, Car-50 km, TWT-150 km, MTW-25 km. The data include fatalities of occupants and road users other than vehicle occupants. For example, if a motorcycle hits a pedestrian and the pedestrian dies, the pedestrian death is also associated with the motorcycle. This index gives a rough idea of the total number of fatalities one might associate for each vehicle type given the present traffic conditions and mode shares. Essentially, the figures indicate that the low rate for TWT relative to cars is due to the higher number of passengers carried TWT per day. These indices appear to suggest that, on a travel distance basis, TWT, MTW, and cars may pose roughly similar level of danger to society under the present conditions. Safer design is a pressing concern for TWT, which are threats to both their occupants and the VRU that they impact.

No previous studies are available on safety records of motor vehicles that are not capable of high speeds operating in mixed traffic in urban areas. TWT operating in Indian cities have engines smaller in size than 175 cc and generally cannot exceed velocities greater than 50 km/h. The experience of TWT in Indian cities suggests that small lightweight vehicles with limited speed capabilities operating in the urban environment can result in low occupant fatality rates.

The lower operating speed of TWT also implies that they pose a much lower risk to pedestrians, bicyclists, and other road-users. This issue needs to be studied in greater detail, and if found true, it may suggest that very different crashworthiness standards or NCAP tests need to be developed for low mass vehicles incapable of operating at speeds greater than 50 km/h. Such vehicles may be optimal for urban use and could be prohibited on roads with speed limits greater than 50 km/h.

RTI fatality estimates from the WHO suggest that the earlier understanding of the relationship between national income and RTI fatality rates (initial increase in deaths with increasing incomes and a subsequent decrease) may not be entirely correct. There is a large variation in road safety performance of countries at the same income level. This is true for countries at all income levels. The reasons for such variation are poorly understood but are likely due to a wide range of structural factors that affect road safety outcomes. Different patterns of built environment, settlement patterns and commuting modes and distances play a very significant role in RTI fatality rates in addition to vehicle and road design issues. When vehicle occupant deaths contributed only 20% in a country instead of >50% of the total count, then it is possible that reduction in deaths due to improved automobile safety performance would be less than 15%. It is possible that significant gains in traffic safety in HIC are partly due to reducing exposure of VRU and not only due to effect of safety policies.

Small lightweight vehicles with limited speed capabilities operating in the urban environment (like tuk-tuks, therewheeled scooter taxis) operating in many LMIC appear to have low fatality rates though they do not follow any crashworthiness standards. Very different crashworthiness standards (than current NCAP) need to be developed for low mass vehicles incapable of operating speeds greater than 50 km/h.

Such vehicles may be optimal for urban use and could be prohibited for roads with speed limits greater than 50 km/h. It may not be possible for LMIC to reduce fatality rates below about 7 per 100,000 population along with high exposure of VRUs unless there are innovative developments in road design and vehicle safety standards including all indigenous intermediate transport vehicles with special emphasis on VRU protection.

Dinesh Mohan and Brian O'Neill (2020), International Journal of Injury Control and Safety Promotion, vol 27(1), 12-19.

A comparative assessment of two designs of hip stem using rule-based simulation of combined osseointegration and remodelling

The survival of a cementless total hip arthroplasty (THA) depends on the biologic fixation between bone and implant. After implantation, the implant–bone interface undergoes an adaptive process of bone ingrowth that facilitates osseointegration.The stability of a cementless hip implant is indicated by the amount of implant–bone fixation, which is dependent on the combination of primary stability (mechanical stability) and secondary stability (biologic stability). The resistance to implant–bone relative displacement (micromotion), during early post-operative period and prior to bone ingrowth, is usually known as primary stability. Once the bone ingrowth process is completed, the resistance to micromotion due to physiological loading is defined as secondary stability. It is known that the initial post-operative implant–bone micromotion (primary stability) has predominant influence on the bone ingrowth. Lack of primary stability of cementless implants inhibits bone ingrowth, but promotes fibrous tissue formation. On exceeding certain threshold value, micromotion may lead to the formation of fibrous layer at the interface.9 This may impair the implant–bone interface stiffness, resulting in poor secondary stability of the prosthesis.

Appropriate description of implant–bone interface condition, however, is essential for any preclinical analysis to assess the effects of peri-prosthetic bone ingrowth and remodelling. Although commonly finite element (FE) analyses prescribe either contact or bonded interfacial conditions, such models fail to represent the progressive interfacial behaviour. While bonded contact does not allow debonding for assessment of micromotion, contact interfacial conditions modelled on idealized Coulomb friction are insufficient to represent non-linear interface behaviour, even before osseointegration.

Primary stability of hip stem, nonetheless, depends mainly on the mechanical factors. Some existing literatures based on contact FE models predicted primary stability with reasonable accuracy. Various experimental techniques had also been proposed to measure stem subsidence and initial micromotion after THA. However, the secondary stability still confounds researchers, since no known relationship exists between the primary stability and the osseointegration process. Investigations on this aspect were primarily based on numerical simulations, due to

Continued overleaf

TRIPP BULLETIN
VOL 18 NO.1 SUMMER 2021
TRANSPORTATION RESEARCH & INJURY PREVENTION PROGRAMME
INDIAN INSTITUTE OF TECHNOLOGY DELHI

Excerpts from three publications: A TRIPP BULLETIN INSERT

the lack of availability of suitable in vivo experimental techniques.

Preclinical analysis based on evolutionary interface calculations appeared to have addressed the aforementioned design problems to a certain extent. However, early investigations on evolutionary bone ingrowth were too simplistic in approach for appropriate representation of the phenomenon.

The objective of this study was to preclinically assess the relative performances of two distinct designs of hip stems by addressing the combined effect of bone remodelling and osseointegration, which was based on certain rule-based criteria obtained from the literature. Premised upon non-linear FE analyses of patient-specific implanted femur models, the study attempts to ascertain the in silico outcome of the hip stem designs based on an evolutionary interfacial condition, and to further comment on the efficacy of the rule-based technique on the prediction of peri-prosthetic osseointegration.

This study attempts to assess two designs of fully coated cementless hip implants based on evolutionary interfacial conditions, arising due to the combined effect of osseointegration and remodelling. With regard to remodelling, the trade-off design predicted improved results as compared to the TriLock stem. The final osseointegration predictions were found to be similar for both designs, although the trade-off stem predicted improved post-surgery osseointegration characteristics. The rule-based technique was found to predict clinically coherent osseointegration around both the hip stems and hence appears to be an alternative to more expensive echanobiology-based multiscale modelling frameworks. The present strategy seems to provide a realistic and fast interpretation of the two postimplantation phenomena for implant surfaces having an extreme irregular porous texture (e.g. trabecular metal material or Regenerex); whereas, performing a mechanoregulatory-based multiscale study would be comprehensive, albeit computationally prohibitive. Nevertheless, a thorough clinical and experimental investigation is warranted to validate the scheme.

Souptick Chanda , Kaushik Mukherjee, Sanjay Gupta and Dilip Kumar Pratihar , Proc IMechE Part H:J Engineering in Medicine 2020, Vol. 234(1) 118–128

The effect of urban infrastructure development on female labour force participation among the poor and middle class in India.

Labour force participation in India is driven by diverse factors. It is known that female labour force participation is affected by social factors such as religion, caste, marital status and household size, apart from labour market conditions and education. It has also been found that infrastructure development programs may have a positive effect on female labour force participation in developing countries. Since the factors influencing female labour force participation are different for the poor, the lower class, and the middle class, we consider the effect of infrastructure development on female labour participation for these classes separately. In the Indian context, we look at the effect of the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) for urban infrastructure development on labour force participation. We use a probit regression model over a pooled cross sectional dataset at the district level for our analysis.

In this paper, we argue that the JNNURM has been instrumental in creating a better environment for female labour force participation and these effects would vary for the poor, lower class, and middle class based on the previous observations about the scheme and the established effect of infrastructure programs on female employment generation. We study these effects at the disaggregated level for the three crucial components of the scheme, namely, provision of water supply and sanitation facilities, deployment of buses, and the provision of dwelling units and basic services to the urban poor.

India has one of the lowest female labour force participation rates in the world and,surprisingly, the urban female labour force participation rates have been declining over time. Various explanations have been attributed to this decline including the rising enrolment of women in education; the income effects of households; enumeration or measurement errors; and/or the lack of job opportunities (Rustagi, 2013). It has been noted that at very low levels of income, survival instincts force women to work, but as income increases, women withdraw from the labour force in order to maintain the family status (Bhalla and Kaur, 2011). This is especially the case in India where upper caste and class women are secluded from the labour force as an upward mobility strategy so as to maintain the family status (Srinivas, 1977). Since the manufacturing sector is not creating many jobs, most of the urban women look forward to working in the service sector jobs. While the poor and lower class women may be absorbed into services such as construction services, middle class women are usually unwilling to take up manual labour. In order to maintain the social status of their family, they are more willing to take up jobs in the sectors of education, healthcare and social work, and public administration in the formal sector.

It has been noted that a number of policy initiatives could be used to address this gender gap in Indian labor force participation including supply side reforms to improve infrastructure and address other constraints to job creation to enable more women to enter the labor force (Rustagi, 2013). Das et.al. (2015) note that increased public spending helps in improving female labour force participation. There have also been various studies on the impact of housing infrastructure development on creating employment in South Africa.

The basic motivation of this paper has been to establish the effect of investment in urban infrastructure development on female labour force participation and to study the variation in this effect among different income groups. We have looked at this effect due to Central Government expenditure on the three components of the JNNURM, namely, water supply and sanitation, provision of buses, and creation of dwellings for the urban poor. While the effects of infrastructure investment on economic development and job creation have been explored before, its effect on female labour force participation has been little explored. However, infrastructure development also creates job opportunities, and better accessibility to jobs, creating both demand and supply side effects inducing an increase in female labour force participation. On the other hand, infrastructure development by providing dwellings for the poor may also give a higher status to households, which will create status effects among women who will no longer prefer to stay in the labour force looking for lower status jobs.

The results of this paper show that while there is positive effect of investment in water supply, and buses on female labour force participation for all classes, the effect is higher for the middle class, indicating that the program has benefitted the middle class women more than the poor. The negative effect of dwellings investment may be indicative of a status effect among women. However, we must be careful while interpreting these results since causality is difficult to establish due the inherent bias in the government investment decisions in the different components of the scheme, despite the assumptions and controls used as has already been discussed. All we can claim from our analysis is that the results indicate the direction and extent of the correlation between the expenditure on the scheme and female labour force participation for the poor, lower class, and middle class.

The varied effect of religion and caste on different classes of women also indicates the interaction of class, religion, and caste on female labour force participation. The lack of effect of marital status and an additional year of education on female labour force participation among middle class women also indicates the presence of a class privilege that allows them to make a choice regarding these decisions. The effect of all the other factors included is consistent with previous literature.

This paper has tried to throw some light on how infrastructure development alters the behaviour of women towards the labour market. This may guide us on how the government can design its urban infrastructure projects to place a greater focus on promoting female labour force participation. This is specifically necessary in the Indian scenario since many women withdraw from the labour force due to poor facilities, lack of safety, and difficulties in accessing the job location. Since the scope of this paper is limited to studying the effect of the three main components of the urban infrastructure scheme, a more detailed study on a wider range of infrastructure projects in urban areas may provide scope for further research.

R. Ahalya and Sourabh Bikas Paul. Proceedings of the 3rd ACM SIGCAS Conference on Computing and Sustainable Societies June 2020 Pages 314–316 https://doi.org/10.1145/3378393.3402234