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TRIP- CENTRE BULLETIN

TRANSPORTATION RESEARCH & INJURY PREVENTION
CENTRE
VOL 3 NO. 1

PUBLICATIONS

Research Papers

Amrutsamanvar, R., Chand, S., Qurashi, M. and Waller, S.T., 2023.

Rapid Planning: Opportunities with Pervasive Data for Sustainable Mobility. In 2023 Smart City Symposium Prague (SCSP) May, (pp. 1-6). IEEE.

Banerjee, A., Jha, A., Farooq, B., Mohan, D., Tiwari, G., Bhalla, K. and Goel, R., 2023.

Developing a national database of police-reported fatal road traffic crashes for road safety research and management in India. International journal of injury control and safety promotion, 30(3), pp.439-446.

Bhagat, G. and Jha, K.N., 2023.

Corruption Risks in Public Construction. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 15(2), p.04522062.

Bhagat, G. and Jha, K.N., 2023.

Determinants of the integrity climate of public organizations–a procurement perspective. International Journal of Construction Management, pp.1-9.

Bhagat, G. and Jha, K.N., 2023.

Stage-wise evaluation of integrity risks in public works procurement in India. International Journal of Construction Management, 23(16), pp.2818-2829.

Bisht, L.S. and Tiwari, G., 2023.

A matched case–control approach to identify the risk factors of fatal pedestrian crashes on a six-lane rural highway in India. International journal of injury control and safety promotion, 30(4), pp.612-628.

Bisht, L.S. and Tiwari, G., 2023.

Assessment of fatal rear-end crash risk factors of an expressway in India: A random parameter NB modelling approach. Journal of transportation engineering, Part A: Systems, 149(1), p.04022111.

Biswal, A., Singh, V., Malik, L., Tiwari, G., Ravindra, K. and Mor, S., 2023.

Spatially resolved hourly traffic emission over megacity Delhi using advanced traffic flow data. Earth System Science Data, 15(2), pp.661-680.

Biswal, A., Singh, V., Malik, L., Tiwari, G., Ravindra, K. and Mor, S., 2023.

An emission model to predict hourly street level traffic emission for air quality management in megacity Delhi (No. EGU23-3027). Copernicus Meetings.

Castrellon JP, Sanchez-Diaz I, Roso V, Altuntas-Vural C, Rogerson S, Santén V, Kalahasthi L., 2023.

Assessing the eco-efficiency benefits of empty container repositioning strategies via dry ports. Transportation Research Part D: Transport and Environment. Jul 1; 120:103778.

Castrellon, J.P., Sanchez-Diaz, I. and Kalahasthi, L.K., 2023.

Enabling Factors and Durations Data Analytics for Dynamic Freight Parking Limits. Transportation Research Record, 2677(2), pp.219-234.

Das, A., Baig, N.A., Yawar, M., Kumar, A., Habib, G. and Perumal, V., 2023.

Size fraction of hazardous particulate matter governing the respiratory deposition and inhalation risk in the highly polluted city Delhi. Environmental Science and Pollution Research, 30(5), pp.11600-11616.

Goel, R., 2023.

Population-level estimate of bicycle use and fatality risk in a data-poor setting. International journal of injury control and safety promotion, pp.1-5.

Goel, R., Agrawal, S., Bilam, S. and Tiwari, G., 2023.

Cycle fatalities in Delhi and their risk factors. Available at SSRN 4377975.

Goel, R., Oyebode, O., Foley, L., Tatah, L., Millett, C. and Woodcock, J., 2023.

Gender differences in active travel in major cities across the world. Transportation, 50(2), pp.733-749.

Gupta, P. and Jha, K.N., 2023.

A decentralized contracting system in digital construction. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 15(1), p.02522002.

Gupta, P. and Jha, K.N., 2023.

Integration of blockchain in contract management for prevention of construction disputes: a systematic literature review and conceptual framework. International Journal of Construction Management, pp.1-12.

Habib, G., Sharma, A., Chahal, D., Roy, S., Sinha, B., Chaudhary, P., Jahangir, A. and Raman, R.S., 2023.

Public health risk assessment of ambient PM2. 5-bound toxic heavy metals (No. EGU23-17127). Copernicus Meetings.

Kalahasthi, L.K., Sutar, P., Yushimito, W.F. and Holguín-Veras, J., 2023.

Optimal Sampling Plan for Freight Demand Synthesis with Mode Choice: A Case study of Bangladesh. Transportation Research Record, p.03611981231169527.

Krishna, C.M., Singh, A. and Jha, K.N., 2023.

Safety Improvement on Indian Highways. Journal of Safety Engineering, 12(1), pp.1-12.

Jain, D. and Bhatnagar, S., Travel Choice Adaptation During Degraded Air Quality Levels in Delhi. Available at SSRN 4368083.

Kwatra, D., Rao, K.R. and Bhatnagar, V., 2023.

Novel Accessibility Metrics Based on Hierarchical Decomposition of Transport Networks. Scientific journal of Silesian University of Technology. Series Transport, 118.

Ludowieg AR, Sanchez-Diaz I, Kalahasthi L., 2023.

Using Machine Learning to Predict Freight Vehicles' Demand for Loading Zones in Urban Environments. Transportation Research Record. Jan;2677(1):829-42.

Mukherjee, D., Rao, K.R. and Tiwari, G., 2023.

Built-environment risk assessment for pedestrians near bus-stops: a case study in Delhi. International journal of injury control and safety promotion, 30(2), pp.185-194.

Pydi, Y.S., Nath, A., Chawla, A., Mukherjee, S., Lalwani, S., Malhotra, R. and Datla, N.V., 2023.

Strain-rate-dependent material properties of human lung parenchymal tissue using inverse finite element approach. Biomechanics and Modeling in Mechanobiology, 22(6), pp.2083-2096.

Ramirez-Rios DG, Kalahasthi L, Holguín-Veras J., 2023.

On-street parking for freight, services, and e-commerce traffic in US cities: A simulation model incorporating demand and duration. Transportation Research Part A: Policy and Practice. Mar 1; 169:103590.

Roy, S., Habib, G., Dev, R., Joshi, S., Qadri, A.M., Gupta, T. and Raman, R.S., 2023.

Wintertime aerosol properties of urban desert region of western India: Implications in regional climate assessment. Science of The Total Environment, 868, p.161473.

Singh Bisht, L. and Tiwari, G., 2023.

Assessing the Effect of Paved Shoulder Width on Road Traffic Crash Risk on a Six-Lane Rural Highway in India. Journal of Transportation Engineering, Part A: Systems, 149(7), p.04023059.

Suthar, B., Zubair, M., Kansal, S. and Mukherjee, S., 2023.

Design of Adaptive Sensor Coupling-based Upper Limb 7-DOF Exoskeleton for Smooth Human Motion Tracking: ASC-EXO. IEEE Sensors Journal.

Tiwari, G. and Mohan, D., 2023.

Traffic Safety in India and Vision Zero 19. The Vision Zero Handbook, p.597.

Tiwari, G., 2023.

Safety research guided by systems theory? International Journal of Injury Control and Safety Promotion, 30(2), pp.153-154.

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POPULATION LEVEL ESTIMATE OF BICYCLE USE AND FATALITY RISK IN A DATA-POOR SETTING

Rahul Goel

Lack of data on exposure for walking and cycling poses a significant barrier to understanding the injury risk of these road users. Though this data paucity is most prevalent across low-and-middle-income countries, it remains a challenge in many high-income countries as well. A new and simple method has been proposed to estimate population-level cycling distance travelled, with New Delhi, India as a case study. I used two independent estimates to calculate this distance. First, a ratio of motorcycle volume counts to that of cycle volume counts across major roads, and second, the total annual distance travelled by motorcycles. I validate this method using data from London, where cycling distance estimates are available from city-wide traffic volume counts as well as household travel survey. Combining the distance estimates with annual fatalities of corresponding road users, I found that cyclists have about 2 times greater fatality risk per kilometre than motorcycle occupants and about 40 times greater risk than car occupants. To encourage greater use of cycling, there is an urgent need to narrow this gap between the safety of cyclists and that of car occupants. The proposed method can be used to monitor cycling usage and its risk for many settings where traffic surveillance systems do not exisT.

I aim to estimate city-wide annual bicycle kilometres travelled for New Delhi, India. For this, I assume that the ratio of city-wide cumulative traffic volume of motorcycles to that of the volume of bicycles is the same as the ratio of city-wide annual vehicle-kilometres travelled (VKT) of motorcycles to that of cycles. Using this ratio from traffic volume with the annual VKT estimate of motorcycles, we estimate annual VKT for cycles. Similarly, using the ratio of volume counts of motorcycles to that of cars, I calculate the VKT for cars

$$VKT_m = VKT_{MC}/R_{(MC,m)}$$

where, VKT_m is the annual vehicle kilometres travelled by the mode m and VKT_{MC} is the vehicle kilometres travelled by motorcycles, and $R_{(MC,m)}$ is the ratio of cumulative traffic counts of motorcycles to the cumulative counts of mode m.

Note that the reason that I use motorcycle distance as a reference is that motorcycles registered in the city have a greater likelihood to be used within the city boundary. Cars, on the other hand, are also used for inter-city travel as taxis or otherwise. I validate this method using data from London where city-wide kilometre estimates of cars and cycles are available from traffic volume counts as well as household travel survey.

I used classified traffic counts for the 72 locations spread across the city (Malik et al., 2018). None of these locations was on minor or residential roads, and traffic counts were conducted for one direction. The data for each location includes hourly volume from 8 AM to 2 PM—a period that includes both the morning peak and part of day-time off-peak. For all locations, I listed total traffic volumes over the 6-hour period for cycles, motorcycles, and cars. Next, I calculated the series of cumulative sum of traffic counts for the three modes of transport. For each location, the sum was the addition of its volume count and the values of all locations listed before it. Next, for each location, I calculated the ratio of cumulative motorcycle counts to the cumulative cycle counts. Next, I calculated the percentage change in the values of two consecutive ratios. I consider value to achieve convergence when the running average of five subsequent percentage change is less than 1 percent. When the value converges, I take the average, minimum and maximum of the ratios for all the subsequent points as the estimate for the ratio. At the 33rd location, convergence is reached for the ratio of motorcycle to cycle counts. The average and 95% CI for the 40 locations (33 to 72) is 16.6 (15.9 – 17.2). Similarly, the ratio of motorcycle counts to that of cars stabilised at the 36th location with the average value of 0.85 (0.81 – 0.89) for the subsequent locations.

For Delhi, total motorcycle VKT is 41.39 billion km (bkm) and person kilometre travelled (PKT) is 57.11 billion km. Dividing motorcycle VKT by the average ratio of motorcycle counts to bicycle counts, annual VKT for cycle is 2.5 (2.4 – 2.6) bkm. Similarly, using ratio of motorcycle counts to car counts, annual VKT for car is 48.8 bkm, and annual PKT is 99.5 bkm.

To corroborate the distance estimate for bicycles, I used an approach reported by (Lovelace et al., 2016). I used Census commuting data reported for Delhi in 2011 (seven years prior to the year considered above). Census reported the total number of workers who cycled to work. Using the number of work trips in various distance bands, (Goel, 2018) reported the average distance of all modes of transport. Using this information, the annual distance travelled for round trips to work is 2.06 bkm (see equation 2).

$$VKT_{cycle} = (365 \times 2 \times n_{cycle} \times d_{cycle})/p_{(work,cycle)}$$

where, VKT_{cycle} is the annual vehicle kilometres travelled by cycles, n_{cycle} is the number of workers who reported cycling to work, d_{cycle} is the average distance travelled for cycling to work and $p_{(work,cycle)}$ is the percentage of all cycle trips that are work trips.

This is less than 2.5 billion kilometres estimated using the above-reported method. This is expected since Census only reports commuting to work, while the estimate using ratio is for all cycling (e.g. school or recreation). According to (Goel et al., 2022), of the total cycling trips in Delhi, 83% are work trips. Dividing commuting distance calculated above by 0.83, the approximate total distance travelled for all trips is 2.48 bkm. Note that this is very close to the estimate from the traffic volume ratio we estimated above (i.e. 2.5 bkm).

To validate the method reported above, I used the data reported for London, UK for 2019. Department for Transport (DfT) in the UK reports raw hourly traffic counts across multiple locations on minor and major roads across London. DfT uses these counts to estimate city-wide annual distance travelled for different modes of transport. To make this count data comparable to that of Delhi, I used data only from major roads, restricted counts to 8 AM through 2 PM, and selected traffic counts of only one direction at each location. There are 327 count locations that satisfy these conditions. For London, I calculated the ratio of cars to that of cycles, as motorcycle is only a marginal mode in this setting. Using similar approach as describe above, I found that the value of ratio stabilises at 100th location, and the mean value of subsequent 227 locations is 46 (42.5 – 49). Using this ratio with the DfT estimated VKT for cars, the average VKT for bicycles is 0.61 (0.57 – 0.66) bkm. This is comparable to 0.65 billion kilometres reported by DfT using their own method using volume counts, and with 0.67 bkm estimated from the per capita cycle kilometres reported using household travel survey.

In Delhi, cycling distance per capita is 130 km per year. Three-year (2017–2019) average number of annual road deaths are 52 for bicyclists, 541 for motorcyclists, and 52.6 for car occupants. Dividing these by their corresponding annual PKT, average fatality risk is 20.8 (20.0 – 21.6) per bkm for cyclists, 9.5 per bkm for motorcyclists, and 0.53 (0.50–0.56) per bkm for car occupants. To put these numbers in perspective, I present risk estimates for London. Here, three-year (2017–2019) average number of deaths is 9 for bicyclists, 12.3 for car occupants, and 28.7 for motorcyclists. The bicycle fatality risk is 14.8 (13.7–15.8) deaths per bkm and that of car occupant is 0.33 deaths per bkm, using average car occupancy of 1.35 to calculate car PKT, and of motorcycle occupant is 32.1 deaths per bkm.

I proposed a method to estimate population-level annual distance travelled for cyclists. The method uses annual city-wide motorcycle distance and the ratio of city-wide motorcycle volume to cycle volume counts. The proposed method can be useful to fill a major data gap that poses a huge challenge towards understanding risk to active travel users.

I found that fatality risk per kilometre for cyclists in Delhi is more than twice as high as motorcyclists, and about 40 times as high as car occupants. In London, cyclists have 57% lower fatality risk than motorcyclists, while they have 42 times greater risk than car occupants. To encourage cycling use, it is imperative that cities make efforts to narrow this wide gap between the safety of cyclists and that of car occupants.

In all the cities reported by (Santacreu & de Gouveia, 2018), fatality risk among cyclists is lower than that of motorcycle occupants. This contrasts with Delhi, where it is the reverse. It is important to notice that the distances travelled by motorcycle in Delhi are far greater than many of the high-income countries where motorcycle usage is much lower. For example, in London, per capita annual distance travelled by motorcycle is 100 km, while in Delhi, it is 2155 km. However, the same distance for cycles is much more comparable in the two cities—72 km in London and 130 km in Delhi. In case of motorcycles, therefore, safety-in-numbers may be in play resulting in lower fatality risk for motorcyclists (Elvik & Goel, 2019).

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VISUALIZING SPATIO-TEMPORAL VARIATION OF AMBIENT AIR POLLUTION IN FOUR SMALL TOWNS IN INDIA

Girish Agrawal, Hifzur Rahman, Anirban Mondal, and P. Krishna Reddy

Exposure to ambient air pollution is a major threat to human health. Air pollution is caused by many factors such as increasing urbanization, industrial pollution, traffic emissions, agriculture, and energy usage [1]. Lim et al. [2] reported the significant effect of air pollution on global mortality. The 2017 data from the Global Burden of Disease study [3] provide new evidence regarding the significant effects of air pollution globally, placing it among the top ten risks confronted by human beings. Most cities worldwide cannot comply with the pollutant standards and have reported measurements that far exceed them, resulting in millions of premature deaths [1]. At the forefront of pollutants which exceed concentration limits are coarse and fine particulate matter (PM), defined as particles with a nominal average diameter less than 10 μm (PM10) and 2.5 μm (PM2.5), respectively. The World Health Organization (WHO) report regarding ambient air pollution suggests that the annual mean concentration of PM2.5 or PM10 increased by more than 10% between 2010 and 2016 in at least 280 cities worldwide [4].

India has one of the highest annual average ambient particulate matter exposure levels in the world. Almost the entire country's population resides in areas that exceed the WHO Air Quality Guidelines, and the majority of the population resides in areas where even the less stringent limits set by the Indian National Ambient Air Quality Standard (NAAQS) [5] for PM are exceeded [6]. Air quality modeling by WHO indicates that the median exposure to PM2.5 in India is 66 μg/m3 with lower and upper bounds of 45 μg/m3 and 97 μg/m3 [7].

Despite the poor air quality, the monitoring of air pollution levels is limited even in large urban areas in India and virtually absent in small towns and rural areas. The Central Pollution Control Board of the Government of India and its companion state-level boards currently maintain just under 350 ambient air quality monitoring stations (AAQMS). These numbers are insignificant for a country with a land area of 3.3 million km2 and a population of over 1.3 billion, 34% of whom live in urban areas. Even on this sparse network, the availability of PM2.5 data is extremely limited as the National Air Quality Monitoring Program monitored only sulfur dioxide, nitrogen dioxide, and PM10 data before 2015. Real-time high-resolution pollutant concentration maps do not exist currently because they require a large amount of data, computing facilities, and high costs. This lack of data leads to a minimal understanding of spatial patterns of air pollutants at the local as well as regional levels, and hampers the ability of planners and administrators to assess the impact of interventions on air quality designed to meet SDG 11 requirements to "reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality …."

Most of the air pollution data in India are from cities with populations greater than one million. According to the 2011 census of India [8], about 230 million of India's urban population lives in towns and cities with populations less than one million. The four cities selected for the present study, Darbhanga in Bihar, located in the Eastern Plains physiographic division of India, and Bhilai, Rajnandgaon, and Kanker in Chhattisgarh, located in the Eastern Plateau physiographic division of India. Darbhanga, Bhilai, Rajnandgaon, and Kanker have populations of about 400,000, 600,000, < 200,000, and < 50,000, respectively, per the 2011 census of India [8]. Ambient air pollution data for these cities are extremely sparse and limited. In recent years, relatively low-cost monitors have become available for measuring ambient particulate concentrations. For a duration of approximately 6 months, i.e., from early September 2021 through late February 2022 (the months with the worst pollution in north and central India), we used these low-cost monitors to measure particulate levels in the above mentioned four cities.

The work reported here is an early step of a larger project with two linked goals: to provide the general public hyper-local air quality information, and to provide local administrators and planners the capability to evaluate the impact of interventions designed to improve air quality, and attain sustainable development goals in line with India's Smart City program goals. The cost for individual cities and towns to install and maintain a conventional air quality monitoring and assessment program runs into tens of millions of rupees, and requires having staff with specialized training. One of the goals of this project is to demonstrate that air quality assessment in small cities can be done with low-cost sensors, and so serve as the first step in developing and providing relatively inexpensive solutions for cities in LMICs to achieve SDG goals to substantially reduce the number of deaths and illnesses from air pollution (SDG 3.9), reduce the adverse per capita environmental impact of cities (SDG 11.6), and improve their ability to mitigate and adapt to climate change (SDG 11.b).

We report here on an initial step in generating pollutant concentrations maps – limited here to particulate matter concentrations – based on sparse, spatio-temporally varying data generated using a combination of mobile and static air quality monitors. Our solution to overcome the lack of high-precision measurements of air quality is to adopt low-cost methods for robust pollution monitoring. Although these methods tend to yield lower quality data, they can be used in a significant number of locations simultaneously, thereby enabling the high-resolution assessment mapping of city pollution. Recent work by Genikomsakis and colleagues [17] has demonstrated that low-cost sensors work very well for collecting fine-grained spatio-temporal [particulate matter concentration] profiles in urban areas.

Compared with analytical instruments for measuring air pollutants, the sensors used in this study are less expensive and easier to deploy, operate, and manage. Retrieving data from the sensors is straightforward, and their automatic operation enables a widespread deployment. Data collected from the sensors can be managed, processed, and analyzed centrally, as well as shared with all the stakeholders. As another step in assessing the temporal variation of particulate matter concentrations in ambient air in small cities, the air quality data for the study period was averaged for each month and plotted.

That the PM2.5 and PM10 levels were high in the first half of the day and lower in the second half suggests that the particulate pollutants descended at night when the temperature was lower and rose as the temperature increased during the day, reaching a peak at mid-afternoon. This may be because a large proportion of the PM2.5 particles are volatile substances that tend to break down and rise as the ambient air temperatures increases. However, our current information regarding the constituents of the PM is insufficient to confirm this conjecture.

To understand the air pollution for a region—even for a small region—we need to be able to visualize the spatial distribution of pollutants. Air quality varies both spatially and temporally, and generating dynamic distribution plots is a complex problem. As a first step, we have averaged the six months of data collected at each location and generated isopleths—contours of a specified meteorological or pollutant parameter—for PM2.5 and PM10 concentrations. The locations of the static monitors were fixed, and so the data from these monitors was simply averaged for the entire monitoring period of six months. Although the portable monitors were carried along each fixed routes at least 25 times, the specific locations of data collection varied from one traverse to the next. To overcome this, the routes were divided into 50-m long segments, and data from each segment was considered as having been collected at the mid-point of the segment. The data was then interpolated using an inverse distance weighting (IDW) method to generate isopleths. At this point we have not tested the validity of the core assumption underlying the IDW method, that the parameter value being estimated is more influenced by the nearest measurements than the distant ones. It is to be noted that an IDW interpolation method should not be considered as providing a model for pollutant distribution because it does not describe the data, and there is no underlying statistic to estimate the uncertainty associated with the prediction of particulate matter concentration at the physical locations where concentrations were not measured.

Among the four cities, Darbhanga and Bhilai exhibited the highest level of PM pollution, followed by nandgaon. Kanker exhibited low levels of PM pollution. Ths is in accord with what we know about the regions. Both Darbhanga and Bholai are heavily industrialized, while Rajnandgaon is in the vicinity of Bhilai. Kanker, on the other hand, is situated within an area with dense forest cover and very little industrialization in the immediate vicinity.
All four areas of study exhibited very similar monthly and diurnal patterns of the increment and decrement of PM2.5 and PM10 levels. The isopleths for all four study areas show that pollution levels are concentrated in specific locations, mostly adjacent to industries and/or heavily travelled arterial roads.

International Workshops on BDMS, BDQM, GDMA, IWBT, MAQTDS, and PMBD 2022,, 11 April 2022 through 14 April 2022, Virtual, Online.

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Tiwari, G., 2023.

Systems-thinking-based road safety research: the way forward. International journal of injury control and safety promotion, 30(4), pp.471-472.

Tripathi, O.P., Hasan, A., Jha, K.N. and Jain, A.K., 2023.

Evaluating Government Contracts for Delays, Delay Damages, and Levy of Compensation Provisions. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 15(1), p.04522032.

Tripathi, O.P., Jain, A.K. and Jha, K.N., 2023.

Evaluation of the Infrastructure Project Management System of Government Organizations and Suggestions for Their Improvement. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 15(1), p.05022004.

Tripathi, O.P., Jha, K.N. and Jain, A.K., 2023.

Identification and Evaluation of Success Factors for the Sustainability Performance of Mega construction Projects. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 15(2), p.02523001.

Tripathi, O.P., Jha, K.N. and Jain, A.K., 2023.

Improving the Safety of Mega construction Projects. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 15(3), p.04523027.

Verma, P.K., Sankrityayan, R., Chawla, A., Mukherjee, S. and Dubey, D.K., 2023.

Equivalent Modeling Scheme of Cellular Structure Under Extreme Loading Using Finite Element Method. In ASME Aerospace Structures, Structural Dynamics, and Materials Conference, June (Vol. 87141, p. V001T03A015). American Society of Mechanical Engineers.

Vikram, A., Chawla, A. and Mukherjee, S., 2023.

Computational assessment of leg response to extreme loadings using a detailed finite element model. International Journal for Numerical Methods in Biomedical Engineering, 39(12), p.e3768.

Vikram, A., Chawla, A. and Mukherjee, S., 2023.

Lower extremity response to blast loading: a computational study. Journal of biomechanical engineering, 145(6), p.061003.

Waller, S.T., Qurashi, M., Sotnikova, A., Karva, L. and Chand, S., 2023.

Analysing and modelling network travel patterns during the Ukraine invasion using crowd-sourced pervasive traffic data. Transportation Research Record, p.03611981231161622.

Wide P, Kalahasthi L, Roso V., 2023.

Efficiency effects of information on operational disruption management in port hinterland freight transport: simulation of a Swedish dry port case. International Journal of Logistics Research and Applications. May 4;26(5):524-47.

Zubair, M., Kansal, S. and Mukherjee, S., 2023.

Investigating the vision-based intervertebral motion estimation of the Cadaver's craniovertebral junction. Robotica, pp.1-8.

NEWS

SAFETY 2024 - 15th World Conference on Injury Prevention & Safety Promotion

The 15th World Conference on Injury Prevention and Safety Promotion (Safety 2024) will be held between 2nd-4th September 2024 at Taj Palace, New Delhi (India). Safety 2024 global event will focus worldwide attention on safety and injury prevention. This will gather international experts in the field with a united goal of "Building a safer future for all: Equitable and sustainable strategies for injury and violence prevention".

The conference hopes to:
- Have a lecture/scholarship in the name of Dinesh Mohan.
- Encourage youth participation through inclusion and involvement.
- Focus on the need for civil society engagement and involvement.
- Encourage equity by ensuring balanced gender, country, seniority, etc. profiles in all committees.
- Build capacity in the region.
- Facilitate policy action for injury and violence prevention in India.
- Raise the profile of The George Institute India as a world-renowned research institute and foster strong collaborations between World Health Organization (WHO) Collaborating Centres in India, the region, developing a network for injury prevention and safety promotion.

We have brought together all the current WHO Collaborating Centers in India and academics, multi-laterals, civil societies and government organizations across the sub-continent, and globally to support the conference.

The conference is hosted by The George Institute for Global Health in collaboration with three other WHO Collaborating Centres in the region, viz Transportation Research and Injury Prevention Center at the Indian Institute of Technology (TRIP-C), IIT Delhi, Department of Emergency Medicine, All India Institute for Medical Sciences (AIIMS), and the Department of Epidemiology, National Institute of Mental Health and Neuro Sciences (NIMHANS).

The conference is co-sponsored by the World Health Organization.

The Transportation Research and Injury Prevention Programme has been operational for two decades. On May 21st 2021 it was established as TRIP Centre. It is based at the Indian Institute of Technology (Delhi) and is an interdisciplinary academic unit focusing on the reduction of adverse health effects of road transportation. Researchers at TRIP Centre seek to integrate all issues concerned with transportation to promote safety, active mobility, cleaner air, and energy conservation. They are involved in planning safer urban and inter-city transportation systems and developing designs for vehicles and safety equipment.

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

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

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Excerpts from: LUSTRE: LOWER URBAN SPEED LIMITS IN EUROPE

Lower speed limits in urban areas (typically 20 mph in place of 30 mph in the UK, and 30 km/h in place of 40 or 50 km/h in mainland Europe) have been introduced since the 1990s. These usually covered relatively small areas. Graz, Austria was the first to embrace a whole city. It was seen as a matter for local policy makers, often within constraints set by central government. This has now changed.

There is now high-level support for widespread use of lower speed limits (20 mph / 30 km/h) in urban areas, to improve road safety and to support other policy objectives. Lower urban speed limits were endorsed by the UN General Assembly in 2020 and have been adopted in many countries and major cities, including for example Spain and Brussels. In 2023, 20 mph limits will become the default on minor roads in Wales. Many towns or cities have implemented 20 mph limits, usually in particular areas but sometimes citywide.

Excessive or inappropriate speed is a major contributory factor to road casualties. Setting and enforcing speed limits is a well-established part of road safety policy.

The increasing adoption of Vision Zero and Safe System has brought about a new approach to speed limit setting. In this context, a safe speed is one at which the road user can withstand a collision without suffering death or life-changing injury. This will depend on the safety performance of the vehicle, the infrastructure, the nature of the collision and other factors.

20 mph speed limits are not new in the UK. In the 1990s a number of 20 mph zones were introduced in the UK on streets with 30 mph limits. A condition of introducing the 20 mph limit was that it should be self-enforcing and speed humps and other traffic calming measures were installed where necessary. These schemes were independently assessed and found to substantially reduce vehicle speeds and casualties.

The magnitude of the results of individual studies varies, both within countries and between them. However, there is enough commonality to draw the following findings, based on the UK and six European case studies.

- 20 mph limits without physical measures result in modest speed reductions – typically 1-2 mph where before speeds are approximately 25 mph, and reductions of 3-5 mph where before speeds are approximately 30 mph.
- 20 mph limits without physical measures result in approximately 11% fewer casualties than before in the UK.
- For the European case studies, there were approximately 18% fewer casualties after 30 km/h limits were introduced but this figure was for all schemes, including some with physical measures. There were too few studies of sign only schemes to provide an average.
- Some 20 mph limits would have been accompanied by other measures, such as cycling infrastructure which might have contributed to any casualty reductions.
- Compliance with 20 mph limits without physical measures is poor.
- 20 mph limits with physical measures have substantially greater speed and casualty reduction effects than those without.
- Very few studies have attempted to assess the outcomes in relation to other goals set, such as increasing walking and cycling, air quality, noise etc. If speeds did not reduce by perceptible amounts, it seems unlikely that there would be any significant change in other behaviours. It may be that these goals were achieved as a result of complementary measures, such as cycling infrastructure, to which the lower speed limit contributed.

Lower urban speed limits are being introduced in many countries and covering larger areas, sometimes city-wide. These are backed, to varying degrees, by a range of measures to encourage and enforce driver compliance, including physical changes to the streets, speed cameras, police enforcement and publicity. Vision zero, reducing road casualties, promoting active travel, healthy streets, improved public realm and other sustainability programmes are increasingly high on the agendas for world cities and smaller towns.

Lower urban speed limits (20 mph/ 30 km/h) are often promoted as a key policy element. Indeed, since starting on this project, policy support for widespread application of these speed limits in urban areas has greatly increased. It has been endorsed in the 2020 UN Road Safety Declaration and the Welsh Government will implement 20 mph as the default speed limit for minor roads in Wales from September 2023.

Changing speed limits alone, however, does not necessarily change the speed at which drivers will drive. The objective of this project is to review the evidence of the impacts of 20 mph speed limits (30 km/h) in the UK and in other parts of Europe, particularly where they are not supported by physical measures. It is intended to provide a clear, factual statement of the outcomes from setting lower speed limits, 20 mph in urban areas and villages in the UK and 30 km/h in mainland Europe. This report has sought to bring together as many studies of UK 20 mph speed limits as possible. Appendix 1 provides an analysis of their methodological strengths and weaknesses. The report goes on to describe the history and effects of 30 km/h speed limits in six case studies: the Netherlands, Switzerland, Sweden, Norway, France and Germany. It summarises the European experience, referencing outcomes of studies of 30 km/h speed limits conducted in these countries. The report then highlights the lessons that can be learnt for the UK. Appendix 2 provides an advanced statistical analysis of the effects of 20 mph in the UK, based on the results of 24 previous studies of 20 mph.

The six European countries studied have had different approaches to implementing speed limits. For example, in Germany physical measures are less likely to be constructed while in Switzerland they are widespread. As far as we are able to tell, in the six countries studied, a high proportion of residential areas have 30 km/h limits. Almost all streets that have 30 km/h today are small residential streets. In some of the countries a speed limit of 20 km/h, or lower, has been introduced and is used in central areas of cities, and specific areas such as at schools, retirement homes and some residential streets. Use of 20 km/h limits is not widespread and no studies were found about its impact.
However, main arteries in built-up areas, carrying the majority of motor traffic and the biggest burden in terms of collisions and injuries, retain 40 or even 50 km/h limits. In Sweden, politicians have agreed that 40 km/h was a reasonable speed limit, combining the driver’s desire for shorter journey times with improved safety of vulnerable road users and the well-being of residents. However, it was decided to retain the 50 km/h limits. Introducing 30 km/h on those streets could result in the biggest safety gain, if the compliance rate was high.
There is a distinct difference between the impact of speed limits accompanied by physical measures and those implemented with ’signs only’. The latter represents by far the largest group of studies and although ’signs alone’ produce a reduction in speed, it is, on average, quite small. The effect of accompanying ‘sign-only’ schemes with education and campaigns has little further impact and, in practice, enforcement is too difficult to employ on a large scale. Physical measures led to a greater reduction in mean speeds. The optimal design of any physical measures has not been studied for this report.
It has also been found that the initial average speeds on a road, regardless of the speed limit, impact the average speeds after the new limit has been implemented. Where average speeds before a new limit is introduced are close to the new speed limit, there is no or very small changes to the average speed.

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Different countries have taken different approaches to introducing 30 km/h limits
•France, originally, introduced 30 km/h limits in some cities and backed this with a programme of speed enforcement cameras. However, monitoring data is sparse.
•Germany has taken different approaches in different states. Sometimes physical measures were used to support lower limits but not necessarily.
•Netherlands has tended to establish 30 km/h limits mainly where the infrastructure encourages drivers to comply. 30 km/h speed limits are less likely to be reduced where drivers would naturally adopt higher speeds.
•Norway has lowered speed limits to 30 km/h on many minor roads. Most of these are enforced by speed humps and speeding fines are high.
•Sweden has introduced lower speed limits extensively since 1998. Some of these are supported by physical measures.
•Switzerland has a clearly defined and well accepted model for speed limits, known as the 30/50 model. The proportion of zones without any physical measures is small.

The UK, as noted above, has shifted from introducing self-enforcing 20 mph zones, which generally covered small areas, to area-wide and sometimes citywide 20 mph limits which tend not to have self-enforcing physical measures.
•When a speed limit of 30 km/h (20 mph) is introduced with physical measures, often humps, speed is normally reduced to less than 30 km/h, provided it was less than about 40 km/h before the measures were implemented.
•When the driven speed was above 50 km/h before a limit of 30 km/h is introduced with physical measures, it tends to remain above 40 km/h even with physical measures.
•When a speed limit of 30 km/h is introduced without physical measures, the mean speed of traffic changes very little and in most cases remains above 30 km/h.
•The meta-analysis of UK data by Loughborough University found that the introduction of 20 mph speed limits (sign-only) reduced average speed by 1.76 mph (with the 95% confidence intervals: -2.73 mph; -0.8 mph). Sign-only limits reduced the total casualties (all severities), on average, by 10.9% (with the 95% confidence intervals: -18.3%; -3.5%). Larger changes were found for limits with physical measures.
•The mean speeds given without physical measures (33.6; 36.0; 36.2) are all lower than those with physical measures, but in all these cases mean speed in the before-period was lower (around 40-44 km/h) and the reduction of speed from before to after was smaller than where physical measures were used.
The effects on collisions and casualties given in the Table are based on the same studies as those quoted above for changes in speed. In general, larger reductions are found when physical measures are used than when they are not used. There are also larger percentage reductions in fatal or serious injuries than in slight injuries.

The following conclusions can be drawn:
•20 mph limits without physical measures result in modest speed reductions – typically 1-2 mph where before speeds are approximately 25 mph, and reductions of 3-5 mph where before speeds are approximately 30 mph.
•20 mph limits without physical measures result in approximately 11% fewer casualties than before in the UK.
•For the European case studies, there were approximately 18% fewer casualties after 30 km/h limits were introduced but this figure was for all schemes, including some with physical measures. There were too few studies of sign only schemes to provide an average.
•Some 20 mph limits would have been accompanied by other measures, such as cycling infrastructure which might have contributed to any casualty reductions.
•Compliance with 20 mph limits without physical measures is poor.
•20 mph limits with physical measures have substantially greater speed and casualty reduction effects than those without.
•Very few studies have attempted to assess the outcomes in relation to other goals set, such as increasing walking and cycling, air quality, noise etc. If speeds did not reduce by perceptible amounts, it seems unlikely that there would be any significant change in other behaviours. It may be that these goals were achieved as a result of complementary measures, such as cycling infrastructure, to which the lower speed limit contributed.

Lower urban speeds are important to delivering casualty reductions and associated objectives such as increasing active travel. Lower speed limits (20 mph limits / 30 km/h) help to reduce driven speeds and casualties. The extent to which they deliver actual speed and casualty reductions depends on the extent to which schemes are supported by other measures.

The purpose of this document is twofold:
•to provide guidelines for those undertaking evaluations of the effects of changes in low (urban) speed limits;
•to assess the methodological quality of studies evaluating the effects on road safety of 20 miles per hour (mph) speed zones.

These guidelines serve as the basis for a formal quality scoring system for studies that have evaluated the effects on road safety of 20 mph speed zones.
In addition to the quality of studies, the completeness of reporting is addressed. To be included in formal research synthesis and meta-analysis, a study at least needs to report the best estimate of the change in the number of collisions and the standard error of the estimate, or information permitting the standard error to be computed. These statistics are needed to assign a statistical weight to a study, reflecting the precision of its estimate of effect. A study of otherwise high methodological quality may have to be omitted from a meta-analysis if the results are not reported in sufficient detail to determine its statistical weight.
The methodological quality of a study is the extent to which it controls for potential sources of bias and confounding that may influence its results. The number of collisions, and their severity, is influenced by very many factors. To conclude that a change in the number of collisions was caused by a road safety measure, like a 20 mph zone, it must be ruled out that the change was caused by something else. The only way of ensuring this, is to do a randomised controlled trial (experiment), in which the road safety measure is introduced at random to ensure that there are no systematic differences between the treated group and the control group. Randomised controlled trials are rare in road safety research. A common design for an observational (non-experimental) study is a beforeand-after study with or without a comparison group. No observational study can control for all potentially confounding factors, but the most important confounding factors in before-and-after studies are known.

The three most important potential confounding factors in before-and-after studies evaluating the effects of road safety measures are:
1.Regression-to-the-mean
2.Long-term trends in the number of collisions
3.Exogenous changes in traffic volume
A fourth factor which has been found to be relevant in evaluations of 20 mph zones is:
4. Collision migration