a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA

School of Population and Public Health
2206 East Mall
Vancouver, BC Canada V6T 1Z3

Phone 604 822 2772
Fax 604 822 4994
info@spph.ubc.ca
www.spph.ubc.ca

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Dr. Dan Cass
Regional Supervising Coroner
Toronto West Region
Office of the Chief Coroner
26 Grenville Street
Toronto, ON
M7A 2G7
occo.inquiries@ontario.ca

Dear Dr. Cass

Re: Review of Cycling Deaths in Ontario

We were pleased to hear that you will lead a review of cycling deaths in Ontario. We are a team of researchers in the fields of public health, emergency medicine, neurosurgery, law, engineering and transportation. We have been conducting a study of cycling injuries in Toronto and Vancouver, and believe that we may be able to contribute some useful insights for your review.

Much of the research on cycling injuries in North America has focused on helmets or the specific manoeuvres of cyclists and drivers. We chose to study the impact of transportation infrastructure on injury risk for the following reasons:

- Cycling injury rates in North America are higher than in northern European countries where bicycle-specific infrastructure is common, but use of helmets for commuter cycling is rare.[1] The relative safety of bicycle-specific infrastructure has been the subject of a great deal of debate, but insufficient evidence. As an example of one perspective, a California transportation engineer, John Forester, has advocated cycling on roads in vehicle lanes with cars as the safest mode of travel ("vehicular cycling").[2] North American transportation planning evolved, in part, in parallel with Forester's beliefs and this has resulted in less bicycle-specific infrastructure here than in northern European countries. We wanted to directly test whether routes with bicycle-specific infrastructure were safer or more dangerous than routes without such infrastructure.
- We also hypothesized that the physical environment may mitigate the effect of human error, as suggested in Paul Weiler's[3] eloquent description of the importance of the environment in occupational injuries:

  There are (those) who believe that human error is the prime culprit in the majority of cases; who find . . . that (the individual) was momentarily careless and inattentive and thus injured himself . . . It (is important) to note that even human error when it occurs is harmful only because it is taking place in an environment with some hazards. After all, mining produces some fifty times the injury toll that banks do, not because miners tend to be fifty times as careless as do bank clerks, but simply because the mining environment is much less forgiving to the inevitable human error as and when it occurs.

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1 Pucher J, Dijkstra L. Promoting safe walking and cycling to improve public health: Lessons from the Netherlands and Germany. *Am J Public Health*. 2003;93(9): 1509-16

2 Forester J. *Bicycle transportation: A handbook for cycling transportation engineers*. The MIT Press, Cambridge, MA, 1994

3 Weiler PC. *Protecting the Worker from Disability: Challenges for the Eighties*. Report submitted to Russell H. Ramsay. Toronto: Ontario Minister of Labour, April, 1983, p. 89

Our review of the literature and the results of our study have convinced us that transportation infrastructure design is a very important component of cycling injury risk, one that needs to be taken into account more than it has been in North America.

The following is a brief outline of the results of our work to date:

- We conducted a review of the scientific evidence on cycling injuries and route infrastructure. This was published in 2009[4] and has also been summarized in lay language[5]. The literature available was limited by the incomplete range of facilities studied and difficulties in controlling for exposure to risk. However, the evidence suggested that infrastructure does influence injury and crash risk. The studies suggested that sidewalks and multi-use trails pose the highest risk, major roads are more hazardous than minor roads, and bicycle facilities (e.g., cycle tracks, on-road painted bike lanes, on-road bike routes, and off-road bike paths) were associated with the lowest risk.
- Our own study is just being completed. It used a case-crossover design to carefully control for exposure to risk and to prevent confounding from non-infrastructure characteristics related to the trip (e.g., time of day) and the person (e.g., propensity for risk taking). We included people who were injured while cycling and who attended the emergency department of one of 5 hospitals (3 in Toronto, 2 in Vancouver) within 24 hours of their injury event. We excluded those who died or were so seriously injured that they could not recall their route on the injury trip (this was done to allow reliable data collection, but we expect that our findings should be relevant to more severe and fatal injuries). We were able to study a wide array of infrastructure found in Vancouver and Toronto. The study design has been published[6] and the results of the study are in the process of publication. The following is a short summary:
    - 690 injured cyclists took part in the study; 59% were male. The injury trips were mainly on weekdays (77%), less than 5 km long (68%), and for utilitarian purposes (74%). Of the injury events, 72% were collisions (with motor vehicles, route features, people, or animals) and 28% were falls.
    - The **following infrastructure features had increased risk**:
        - streetcar or train tracks (odds ratio (OR): 3.0, 95% confidence interval (CI): 1.8-5.1)
        - downhill grades (OR: 2.3, 95% CI: 1.7-3.1)
        - construction (OR: 2.0, 95% CI: 1.3-3.0)
    - **We examined 15 route types**, and used the most commonly observed route type as the basis for comparison: major streets with parked cars (and no bike infrastructure). It had the highest risk of all route types. In comparison, **the following route types had 1.7 to 9 times lower risk**:

        - off-street bike paths (OR: 0.60, 95% CI: 0.20-1.8)
        - major streets with bike lanes and no parked cars (OR: 0.55, 95% CI: 0.29-1.0)
        - local streets (OR: 0.51, 95% CI: 0.31-0.84)
        - local street bike routes (OR: 0.49, 95% CI: 0.26-0.91)
        - local street bike routes with traffic diverters (OR: 0.44, 95% CI: 0.16-1.2)
        - cycle tracks (bike lanes physically separated from motor vehicle traffic) alongside major streets (OR: 0.11, 95% CI: 0.02-0.56)

In summary, our study provides more detailed and convincing evidence that bicycle-specific infrastructure is effective at lowering injury risk, especially if it physically separates cyclists from motor vehicle traffic on major streets or diverts traffic on local street bike routes. The evidence about route types and other infrastructure

4 http://www.ehjournal.net/content/pdf/1476-069x-8-47.pdf
5 http://cyclingincities-spph.sites.olt.ubc.ca/files/2011/10/infrastructure_cycling.pdf
6 http://injuryprevention.bmj.com/content/early/2011/06/08/injuryprev-2011-040071.abstract

features that impact risk can be used to design safer routes for cycling and reduce injuries. We believe that these are important findings, and should be useful in your review of cyclist deaths in Ontario.

We would welcome the opportunity to discuss our study results with you or others involved in your review. Several of our investigators reside in Toronto and one or more of them would be available to make a presentation about the study and its findings. In addition, if there are infrastructure aspects of your review that we might help interpret, we would be pleased to assist.

Thank you for this opportunity to send comments.

Yours sincerely

Kay Teschke, MPH PhD
Professor
604 822 2041
kay.teschke@ubc.ca
cyclingincities.spph.ubc.ca

Anne Harris, PhD
Post-Doctoral Fellow
Occupational Cancer Research Centre

Peter Cripton, PhD
Associate Professor, Mechanical Engineering
University of British Columbia

Michael Cusimano, MD MHPE PhD FRCSC FACS
Division of Neurosurgery
St. Michael's Hospital
Professor, University of Toronto

Jack Becker, BASc MBA
President, VeloWorks Cycling Society

Steven Friedman, MD MPH CCFP(EM) FCFP
Assistant Director (Research), Emergency Medicine
University Health Network
Associate Professor, University of Toronto

Garth Hunte, MD PhD FCFP
Trauma Director, St. Paul's Hospital
Department of Emergency Medicine
University of British Columbia

Nancy Smith Lea, MA
Director, Toronto Coalition for Active Transportation

Lee Vernich, MSc
Director, Research Services Unit
Dalla Lana School of Public Health
University of Toronto

Conor Reynolds, PEng PhD
NSERC Post-Doctoral Associate
Civil Engineering, University of Minnesota

Mary Chipman, BSc MA
Professor Emeritus
Dalla Lana School of Public Health
University of Toronto

Shelina Babul, PhD
Associate Director
BC Injury Research & Prevention Unit

Jeff Brubacher, MD MSc FRCFM FRCEM
Departments of Emergency Medicine
Vancouver General Hospital and
University of British Columbia

David Hay, LLB
Partner, Richards Buell Sutton LLP

Hui Shen, MSc, PhD
Statistician, School of Population and Public Health
University of British Columbia

David Tomlinson, BSc MES
Cycling Infrastructure and Programs
City of Toronto

Meghan Winters, MSc PhD
Assistant Professor, Faculty of Health Sciences
Simon Fraser University

Glossary

Major street with parked cars	Paved city street with at least 2 demarcated moving lanes of motor vehicle traffic, with parked cars on the cyclist's side of the street
Major street with bike lane & no parked cars	Paved city street with at least 2 demarcated moving lanes of motor vehicle traffic, with bike-only lane marked with painted solid or dotted lines on street surface, and with no parked cars
Local street	Paved city street with no demarcated lanes of motor vehicle traffic; car parking may be allowed or not; most often in residential areas
• Bike route	• Local street with bike signage on the street surface or on posts, indicating designated bike route; may have bicyclist operated traffic signals at intersections with major streets
• Bike route with traffic diverters	• Local street bike route with traffic diverters, medians or corner bulges permeable only to bikes
Bike path	Paved path designated for cyclist use away from streets, e.g., in parks
Cycle track	Paved bike lane alongside major streets, demarcated and separated from motor vehicle traffic by a physical barrier, e.g., a curb or bollards (in the sections between intersections)
Odds ratio (OR)	Measure of risk relative to a comparison infrastructure type that is assigned an odds ratio of 1
95% Confidence interval (CI)	Statistical measure of the range of values that the odds ratio could include; affected primarily by the number of injuries at that infrastructure type and the number of control sites at that infrastructure type