The Role of Environment in Cyclist Injuries in Toronto

& Some Methodological Questions

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Issues for study

- Bicycles are a growing part of urban road transportation in Canada and elsewhere

- Previous research on injuries has concentrated on human factors
  - driver errors
  - cyclist errors
  - helmet use

- This study concentrated on the **environment** where the injury occurred to look for risk factors

Bicyclists' Injuries & the Cycling Environment
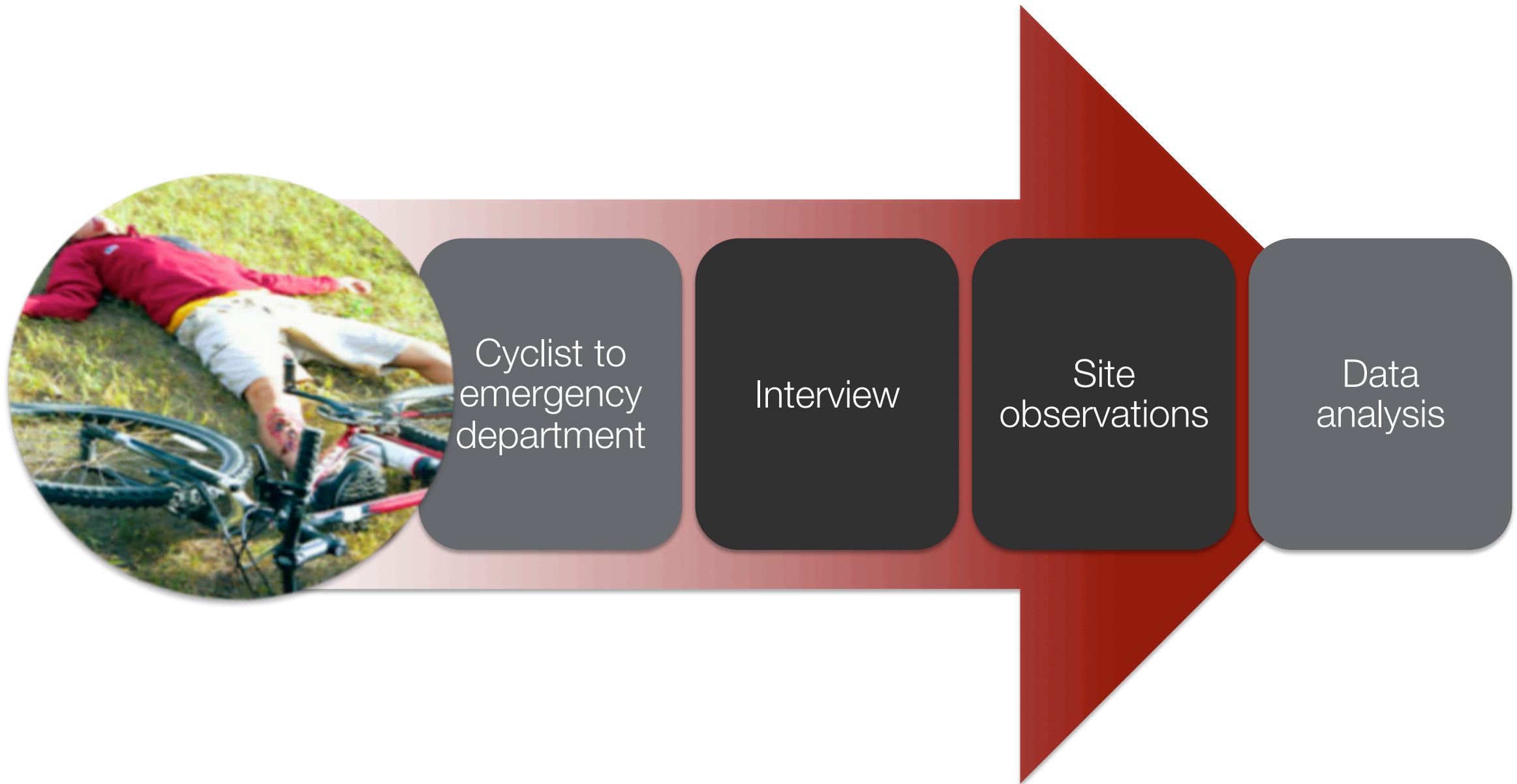
Participating cities

Vancouver

- 2 participating hospitals
- 0.6 million people
- rain in winter, temperate summer
- lots of hills
- 26 km of bike lanes & paths per 100,000 population
- 3.7% of trips by bike

Toronto

- 3 participating hospitals
- 2.5 million people
- snow in winter, heat in summer
- mostly flat
- 11 km of bike lanes & paths per 100,000 population
- 1.7% of trips by bike

Study overview

Cyclist to emergency department → Interview → Site observations → Data analysis

Interview to map route & choose control sites

Observations of injury & control sites

injury
site

control
site 1

control
site 2
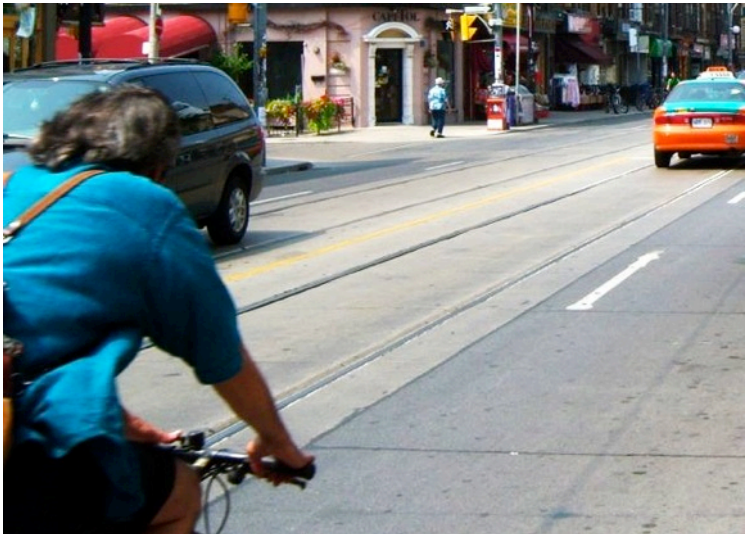
"Case-crossover" design features

Control sites randomly selected from injury trip: controlling for exposure to risk, i.e., distance ridden on each route type

Sites observed by researchers blinded to site status (injury or control): preventing observation bias

Comparisons made within a person-trip: controlling for personal & trip characteristics

Comparisons cumulated over all person-trips, using conditional likelihood method in Proc Logistic

Person-trip 1
Person-trip 2
Person-trip 3
Person-trip . . . n
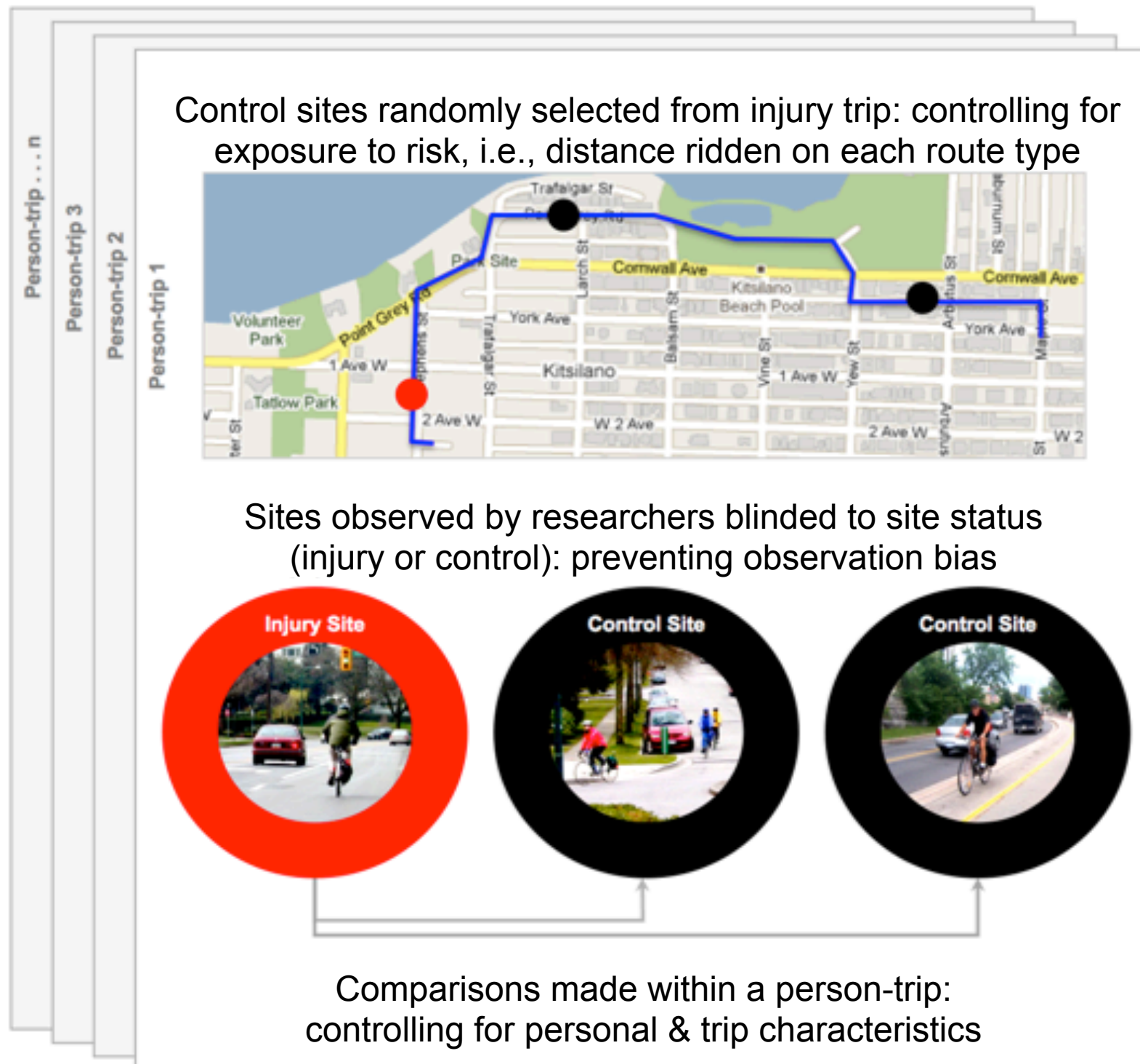
Study results

Participants & Trips

- **Toronto** **273**
- Vancouver 417 } 690

- male 59%
- 19 to 39 years old 62%
- income > $50,000 56%
- cycle > 52 times/year 88%

- wore helmet 69% **59% T**
- wore high viz clothes 33% 76% V

- trip < 5 km 68%
- weekday, daylight 77%

- commute 42%
- other transport 32%

Factors significant only in univariate analyses

Bike signage
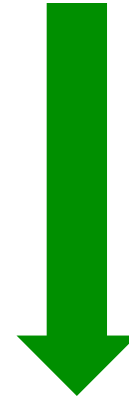
Major city streets

Parked cars

Junctions vs. none, # of junctions

Elevated injury risk, significant in one multiple regression model

Junction yes OR $_{RMM}$ = 3.0 (95% CI: 1.3-7.1)

# of junctions OR $_{RMM}$ = 1.4 (95% CI: 1.03-2.0)

Junctions vs. none, # of junctions

Solving the problem:

Green paint to denote junction crossing to cyclists and drivers

Minimize junctions, "stroads"

Streetcar tracks vs. none

Elevated injury risk, both multiple regression models

OR $_{RMM}$ = 3.7

(95% CI: 2.1-6.4)

OR $_{IMM}$ = 4.0

(95% CI: 2.1-7.5)

Same result in Vancouver

Streetcar tracks vs. none

Solving the problem:

separate streetcar or bike lanes

remember bikes when considering new transit modes

Downhill grades vs. flat

Elevated injury risk, both multiple regression models

OR $_{RMM}$ = 3.1

(95% CI: 1.8-5.3)

OR $_{IMM}$ = 2.0

(95% CI: 1.2-3.2)

Same result in Vancouver

Downhill grades vs. flat

Solving the problem:

Locate bike routes along flat streets

Rail corridors offer opportunities

Limitations

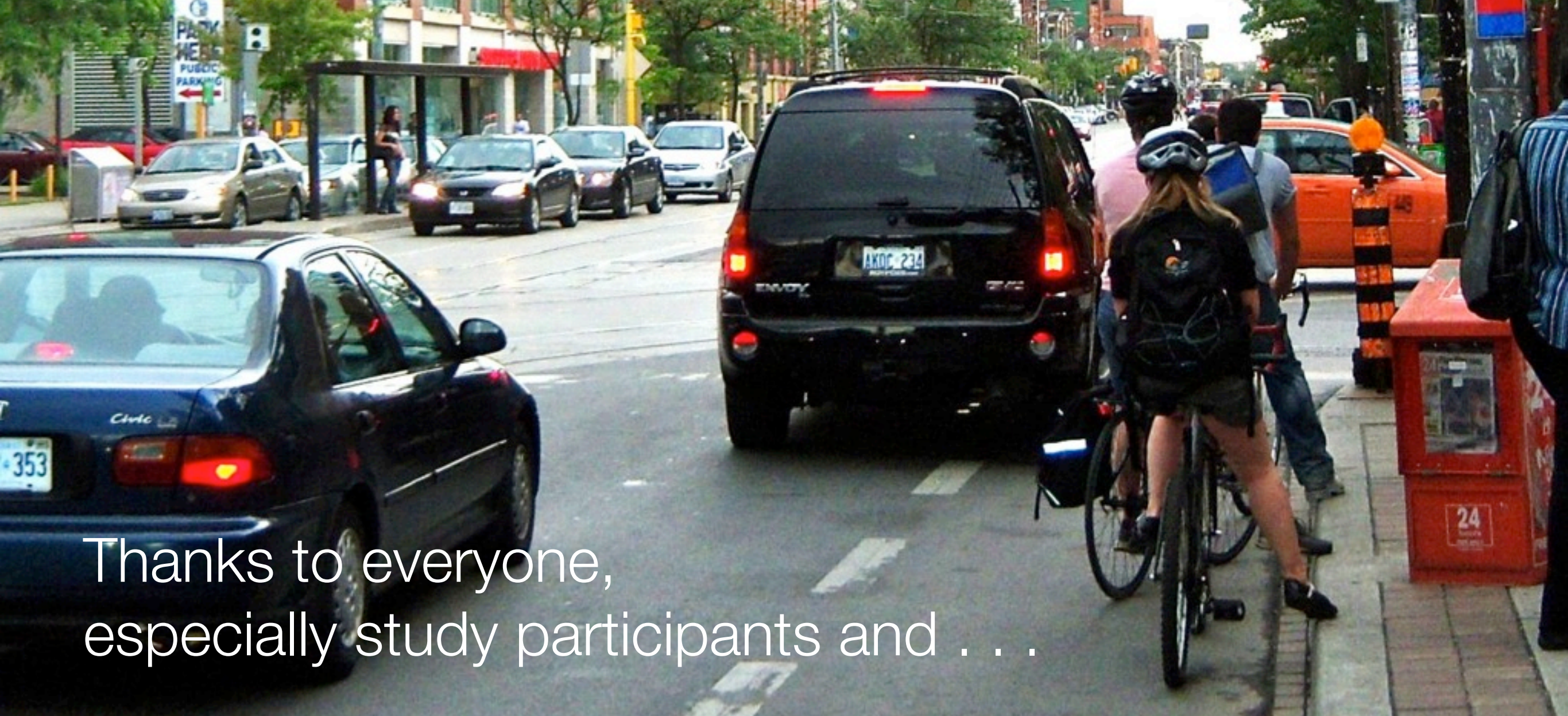Toronto only analyses: smaller N, less power

- results reinforce those for Vancouver, whole study

- & demonstrate one difference

Most severe and mildest injuries not included

- those who attended emergency department within 24 hours

Not possible to test many route designs available in Europe

Thanks to everyone,
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Toronto study team

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CIHR IRSC

HEART & STROKE FOUNDATION

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@kteschke

Comparing RMM & IMM models

Intersection   only RMM

\# of Junctions   RMM

IMM

Junction yes   RMM

IMM

Streetcar tracks   RMM

IMM

Uphill vs. flat   RMM

IMM

Downhill vs. uphill   RMM

IMM

Downhill vs flat   RMM

IMM
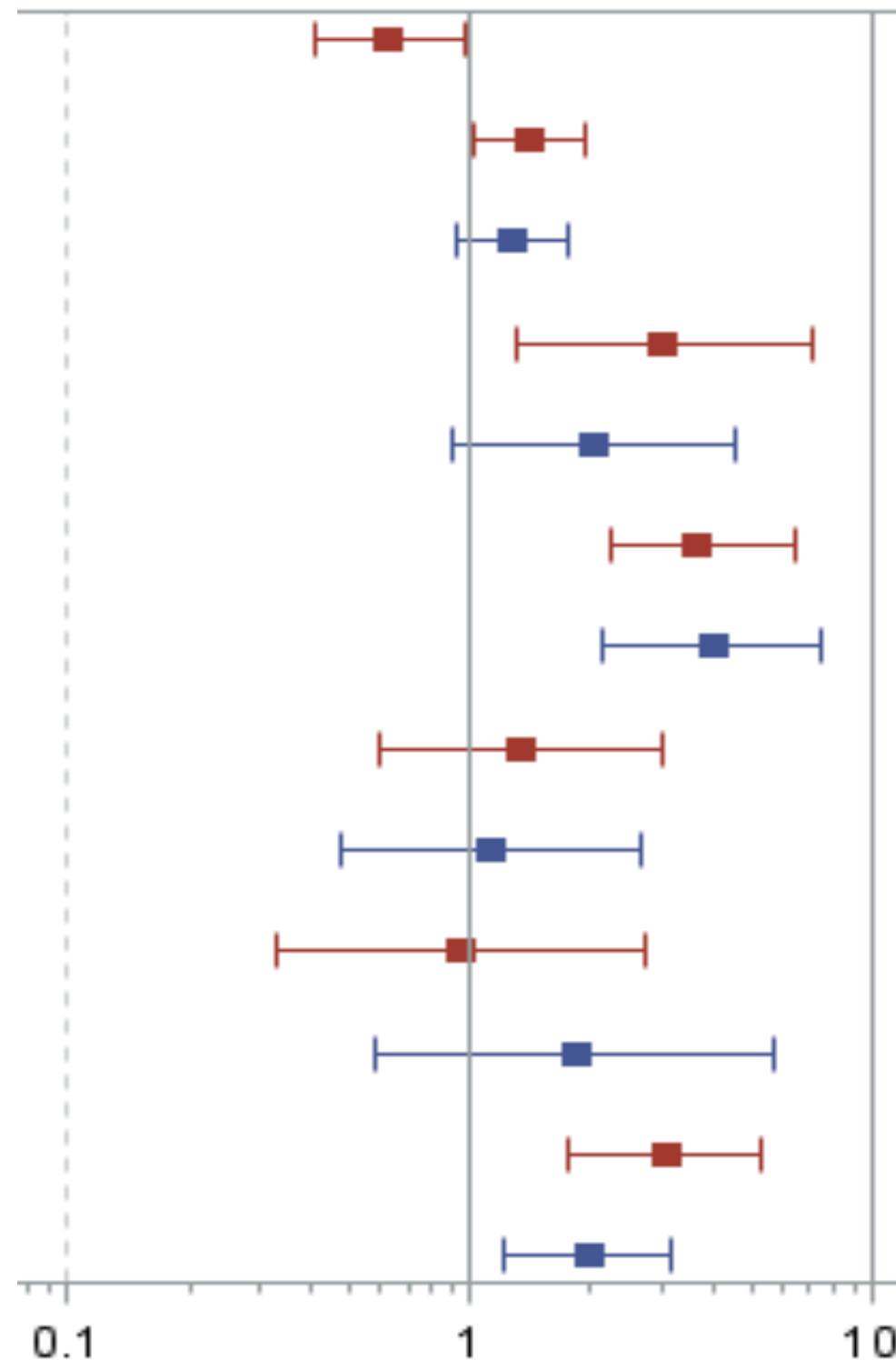
Forest plot showing ORs & 95% confidence limits

0.1   1   10