



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

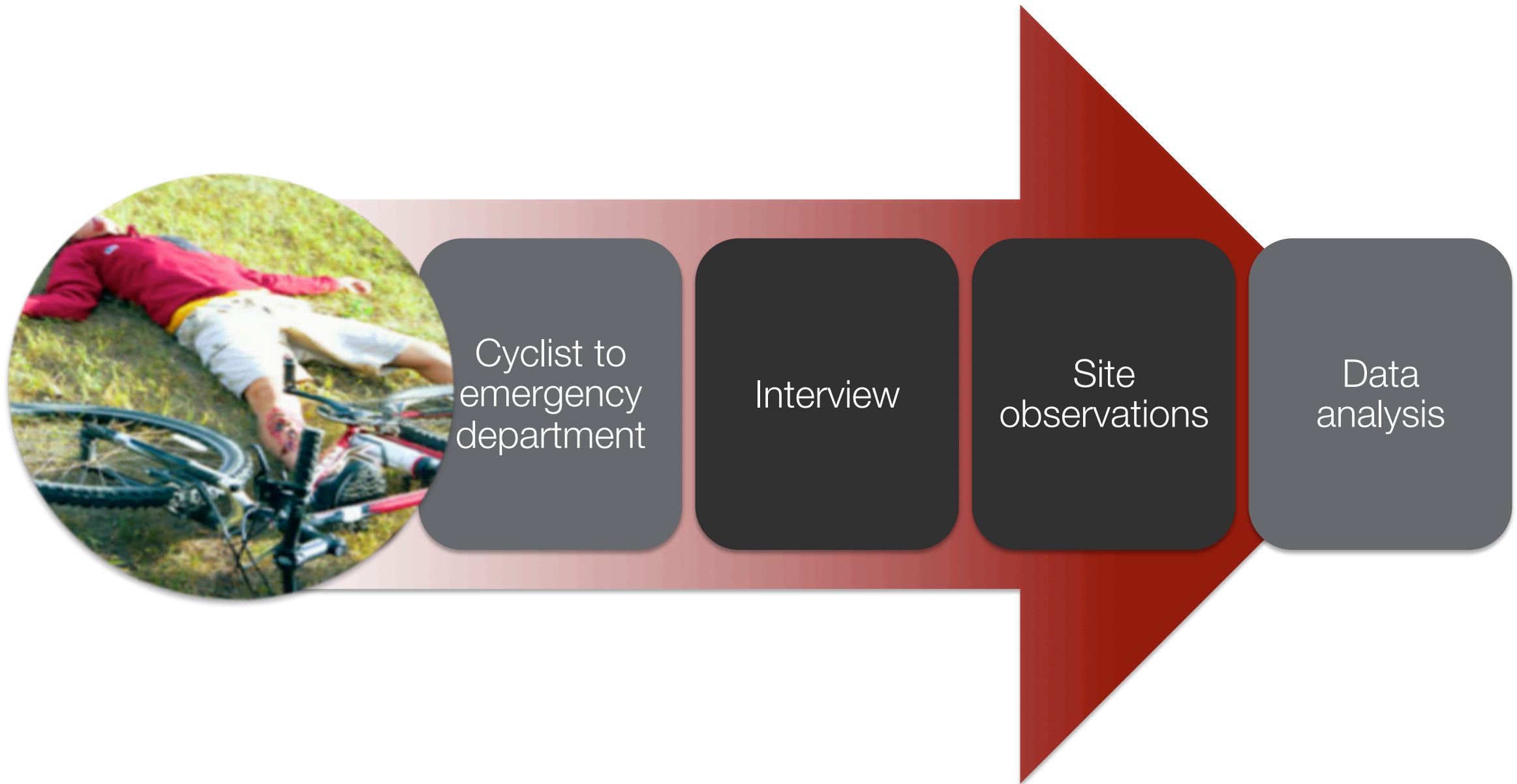
- 2 participating hospitals
- 0.6 million people
- rain in winter, temperate summer
- lots of hills
- 26 km of bike lanes & paths per 100,000 population
- 3.7% of trips by bike



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



Interview to map route & choose control sites

INTERVIEW FORM

Thanks so much, *[name of participant]*, for agreeing to take part in this study. The interview should take about 45 minutes.

I'll ask you about the route you cycled when you were injured, including the injury site, and two other sites, randomly selected along the route.

Did you receive a copy of the consent form with our letter of introduction to the study?

[If no, give a copy.]

[If yes:] Do you have it with you?

[If no, give a copy.]

Do you have any questions about it?

If you haven't already done so, could you please read it and sign 2 of them? I'll keep one, and you keep one.

[Proceed when the consent form has been signed.]

Are there any questions you'd like me to answer before we begin the interview?

[Give time to answer.]

Feel free to stop me and ask questions at any time during the interview. If there is a question that you feel uncomfortable answering, you are welcome to let me know that you don't want to answer it.

Sequential Number: _____

Hospital:
1. St. Michael's
2. TGH
3. St. Paul's
4. VGH

Date Attended ED: ____/____/____
DD MM YYYY

Came by ambulance:
0. No
1. Yes

Admitted to Hospital:
0. No
1. Yes

CTAS: _____

Interviewer: _____

Date of Interview: ____/____/____
DD MM YYYY

Observations of injury & control sites

injury
site

Sequential # - Site ID: _____

Injury Site **B.**
Additional Site **D.**
Additional Site **E.**

SITE OBSERVATION FORM

1. Instructions & Site ID

1.1 Preferred day of week: _____ *[Match weekday or week end]*
[From Interview Form, Q 1]

1.2 Preferred time of day: _____ am pm to _____ am pm
hr min hr min
[From Interview Form, Q 1.1 and 1.2]

1.3 Sections of this form to complete for this site

☒ Instructions & Site ID

☐ Off-road *If Question 11.2 = 1*
If Question 11.2 = 2

☐ Road *If Question 11.2 = 3*
If Question 11.1 = 1 and Question 11.2 = 2 *Based on Interview Form, Question 11*

☐ Intersection *If Question 11.1 = 2*

☒ General Route Characteristics

☒ Photographs

1.4 Find the site from the attached photo and Interview Form question 11 & site diagram. The following features should be indicated:

- Names of streets & other identifiable features
- The cyclist's location *(marked with an X)* including
 - o whether on the road, sidewalk, or path, and which side & which lane
 - o whether at an intersection or not
- The cyclist's direction of travel *(marked with an arrow, before and after the X)*

If the photo is incorrect (e.g. out of date), modify photo or provide corrected sketch of site with these features on flip side of the photo.

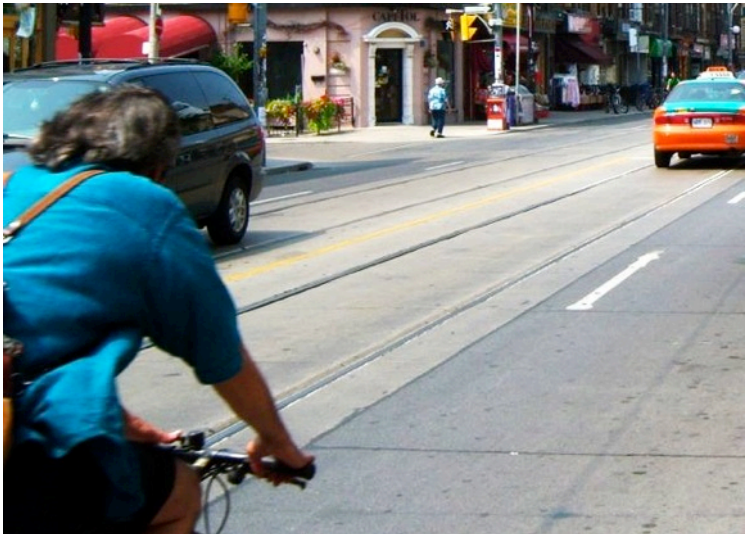
Site Observer: _____

Observation Day of Week: _____

Observation Date: DO / MM / YYYY

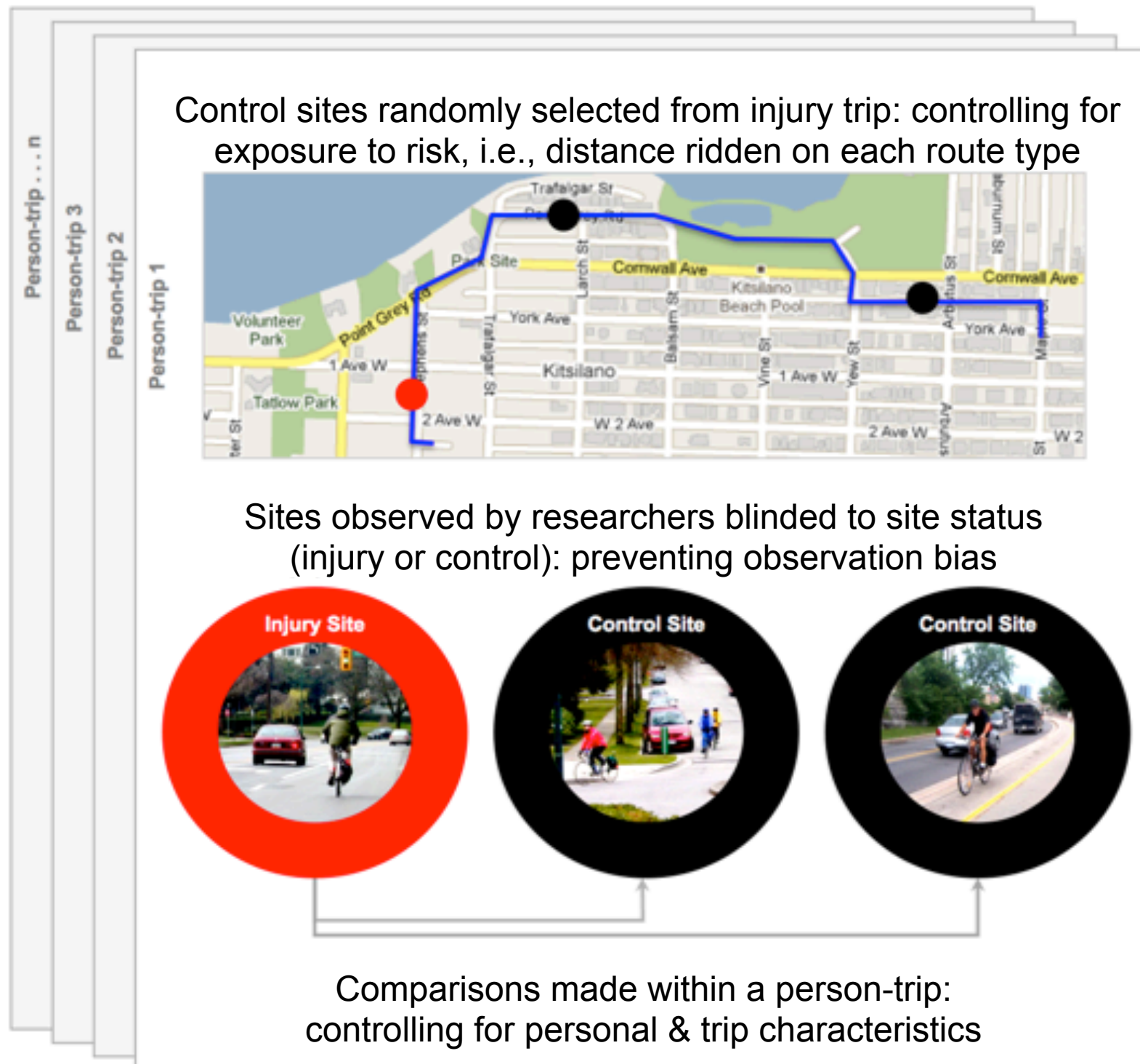
control
site 1

control
site 2



“Case-crossover” design features

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



Study results



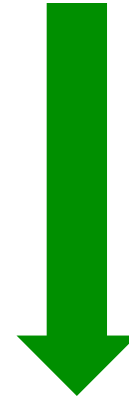
Participants & Trips

• Toronto	273	} 690
• Vancouver	417	
• 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

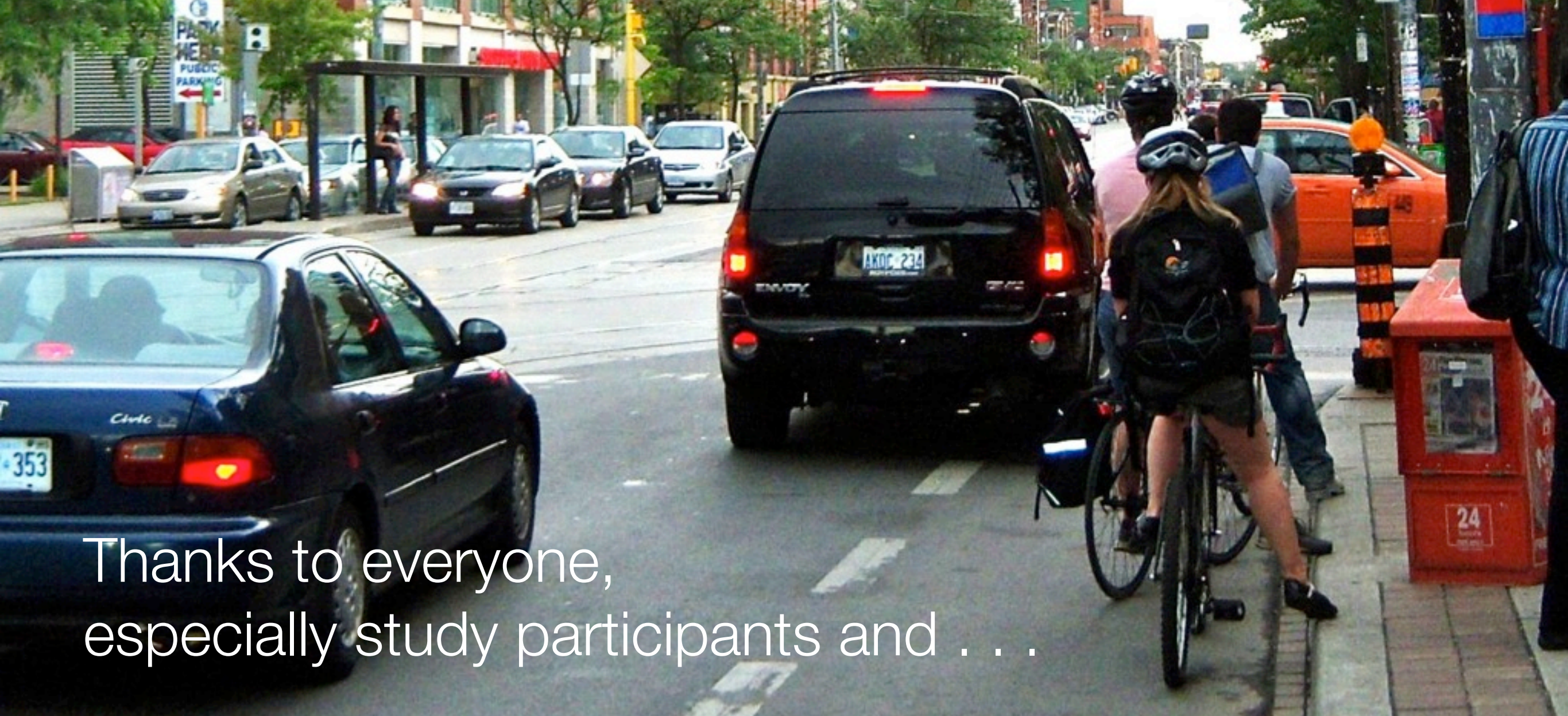
- results reinforce those for Vancouver, whole study
- & demonstrate one difference

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,
especially study participants and . . .

Toronto study team

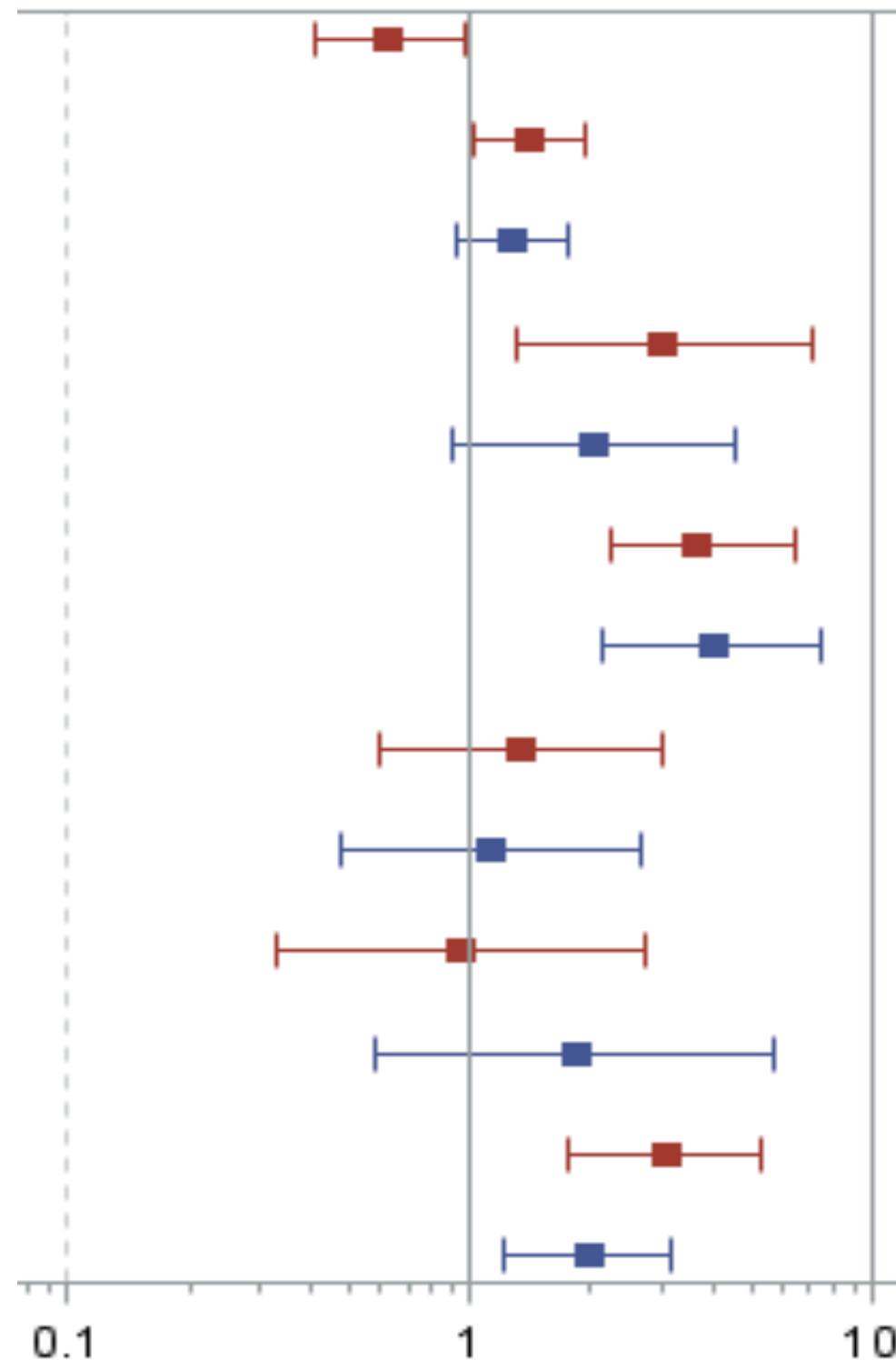
- Lee Vernich
- Vartouji Jazmaji
- Kevin McCurley
- Andrew Thomas
- Doug Chisholm
- Nancy Smith Lea
- Fred Sztabinski
- David Tomlinson
- Barbara Wentworth

cyclingincities.spph.ubc.ca

@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