



# Child pedestrian risk and social equity: The spatial distribution of roadway environment features in Toronto, Canada

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# BACKGROUND

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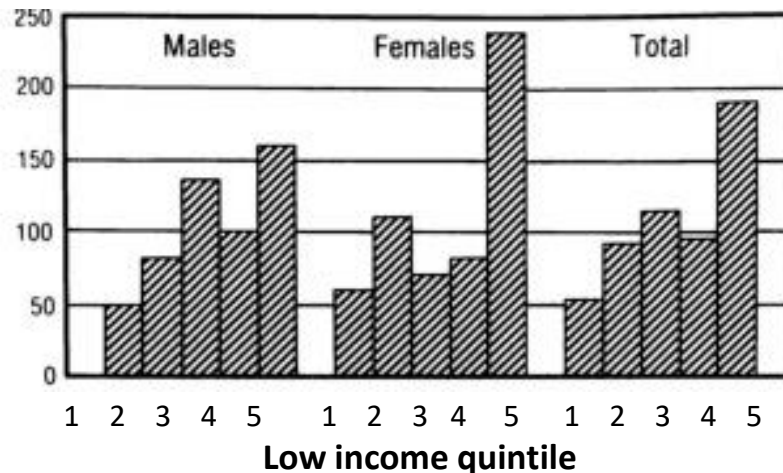
- Occupant fatalities trending downward, pedestrian motor vehicle collision (PMVC) fatalities have been increasing in Toronto
  - 24 (2012)
  - 37 (2017)<sup>1</sup>
- Since 2005, **six** school age children have been killed and **83** seriously injured in pedestrian motor vehicle collisions with **3** of the fatalities in the last year <sup>1</sup>
- A child is seriously injured or killed every 17 weeks on their way to/from school on Toronto roads



<sup>1</sup> City of Toronto, Traffic Safety Unit. Toronto Vision Zero Road Safety Plan, Data Report and Accomplishments, May 2018

- The relationship between socioeconomic status and child PMVC has been well documented

**Relative rates of pedestrian deaths ages 0-14 (1981) , by low income quintile of area of residence, Urban Canada<sup>1</sup>**



- School disadvantage was associated with higher child PMVC rates around schools in Toronto (2014), even after controlling for walking exposure<sup>2</sup>

<sup>1</sup>Doughtery et al. *CJPH* 1990

<sup>2</sup>Rothman et al. *Pediatrics* , 2014

# BACKGROUND



- SES disparities in road environments rarely studied
  - Road design interventions reduce pedestrian injuries by 50%-75%<sup>1</sup>
  - 43% reduction in child PMVC in Toronto with the installation of speed humps<sup>2</sup>
- SES disparities in other types of child injury reduced by equalizing the environment
  - Uniformly upgrading playground equipment to standards reduced the SES gradient for injuries (2010)

<sup>1</sup> Retting et al AJPH, 2003

<sup>2</sup> Rothman, BMC Public Health, 2015

# OBJECTIVES

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- To compare child PMVC rates in low versus high income census tract clusters
- To determine the distribution of roadway environment features related to child pedestrian safety in low versus high income clusters

# METHODS

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- **Socioeconomic status**

- 2006 Canadian Census
- % households below the after tax low income cutoff (ATLICO) within census tracts (CT)

- **Child PMVC**

- Toronto Police Service motor vehicle collision reports
- 2001-2010, ages 5-14
- Collision rates: # /100 km road

- **Roadway environment features**

- *Risk factors:* One-way streets (km/10 km road)
- *Protective factors:* Speed humps, local roads (km/10 km road)  
school crossing guards (#/10 km road)

# ANALYSES

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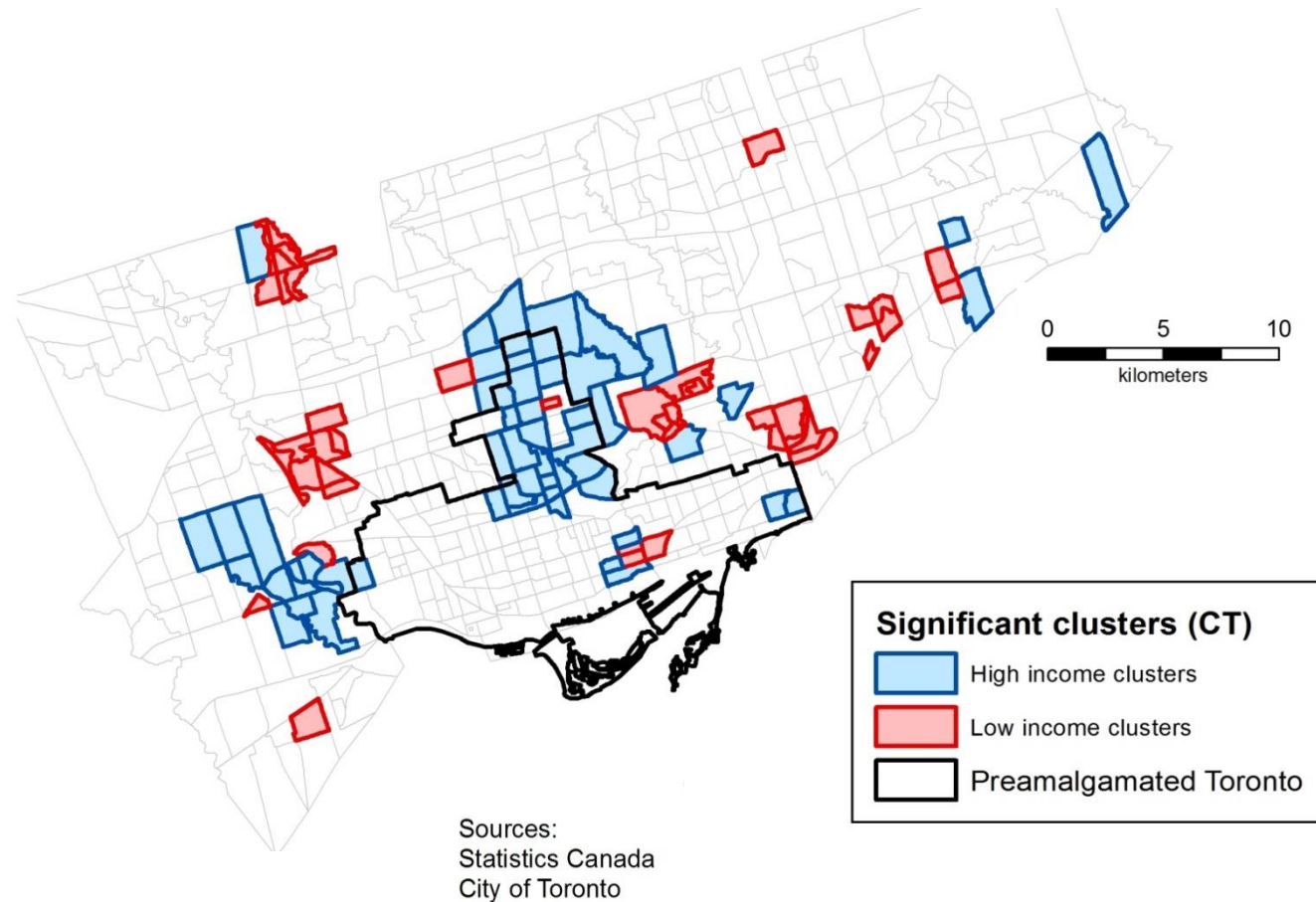
## Spatial analysis

- Significant spatial clusters of high versus low income by CT
- Local Moran's I tool
- Clusters and outliers were combined (HH and HL, LL and LH)

## Statistical analysis

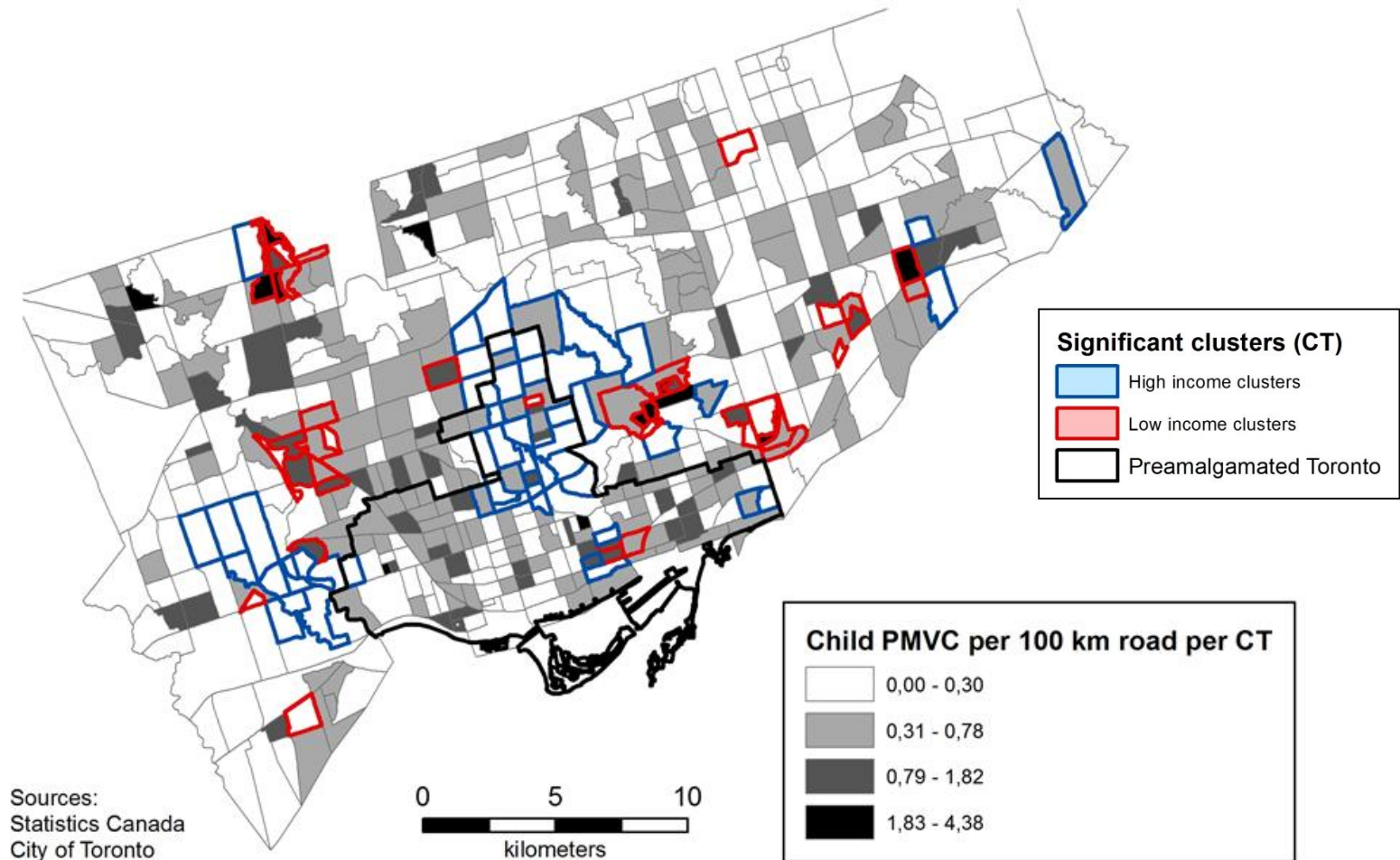
- Univariate comparisons (low vs high)
  - Collision rates, road environment features
  - Two-tailed T-tests
- Multivariate logistic regression
  - Outcome: Low versus high income cluster
  - Independent variables: Road environment features
  - Odds ratios and 95% confidence intervals

# Spatial distribution of significant income clusters



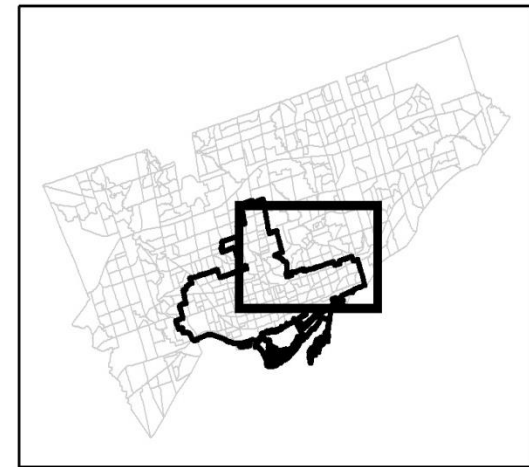
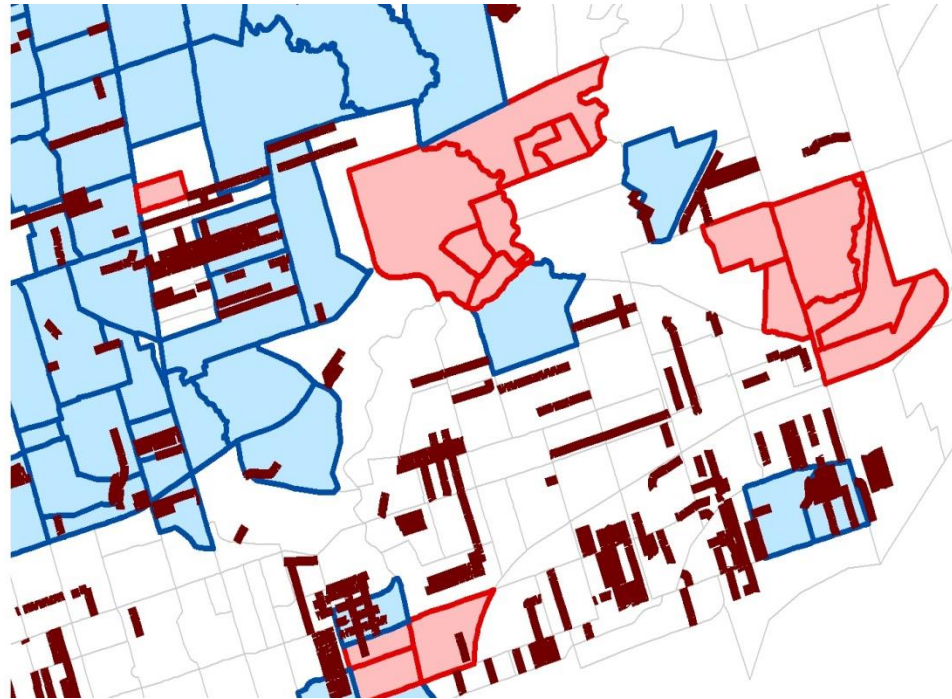
- 524 census tracts
  - 44 (8%) significant low, 58 (11%) high income clusters
  - Low income 7x higher in low compared to high income cluster (30.7% versus 4.4%)

# Spatial distribution of child PMVC/per 100 km per CT






- Child PMVC rates 6x higher in low versus high income clusters

# Spatial Distribution of Speed Humps



## Significant clusters (CT)

-  High income
-  Low income
-  Speed humps



Sources:  
Statistics Canada  
City of Toronto

# Multivariate analysis: Significant correlates of low income versus high income clusters

Roadway Environment	Adjusted Odds Ratios (95% CI)
Local road (km/10 km road)	0.62 (0.47, 0.82)
Speed humps (km/10 km road)	0.35 (0.15, 0.80)
Crossing guard (#/10 km road)	1.43 (1.03, 1.99)



# DISCUSSION

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- Local roads have lower posted speed limits and lower vehicle volumes
  - Fewer lower speed roads in lower income areas  
↑ risk
- Higher densities of guards in low income areas to ameliorate more dangerous road environments
  - Most guards at arterial road intersections (>90%)
  - Arterial roads overrepresented in low income areas
    - 37% of road network (low income) vs 27% (high income)

# DISCUSSION

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- Process of request for traffic calming initiated by the community
  - Level of knowledge regarding the process, political engagement favours those with higher SES
- Request-based process may not be the most equitable method of identifying need
- Objective methods of determining need warranted



# DISCUSSION

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- **Strengths**

- New study examining inequity in road environment
- Low versus high income clusters, which were the extreme ends of the income spectrum
  - Important to examine differences

- **Limitations**

- Lack of exposure pedestrian and motor vehicle volume data
- Innovative methods needed for measuring exposure

# CONCLUSION

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- There are SES inequities in PMVC and the road environment
- Results have implications for policies related to neighbourhood road design which must ensure equitable and safe pedestrian environments for everyone

