

# Social inequalities in child pedestrian collisions in Toronto, Canada: the role of the built environment

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# Background: Child Pedestrian Motor Vehicle Collisions (PMVC)

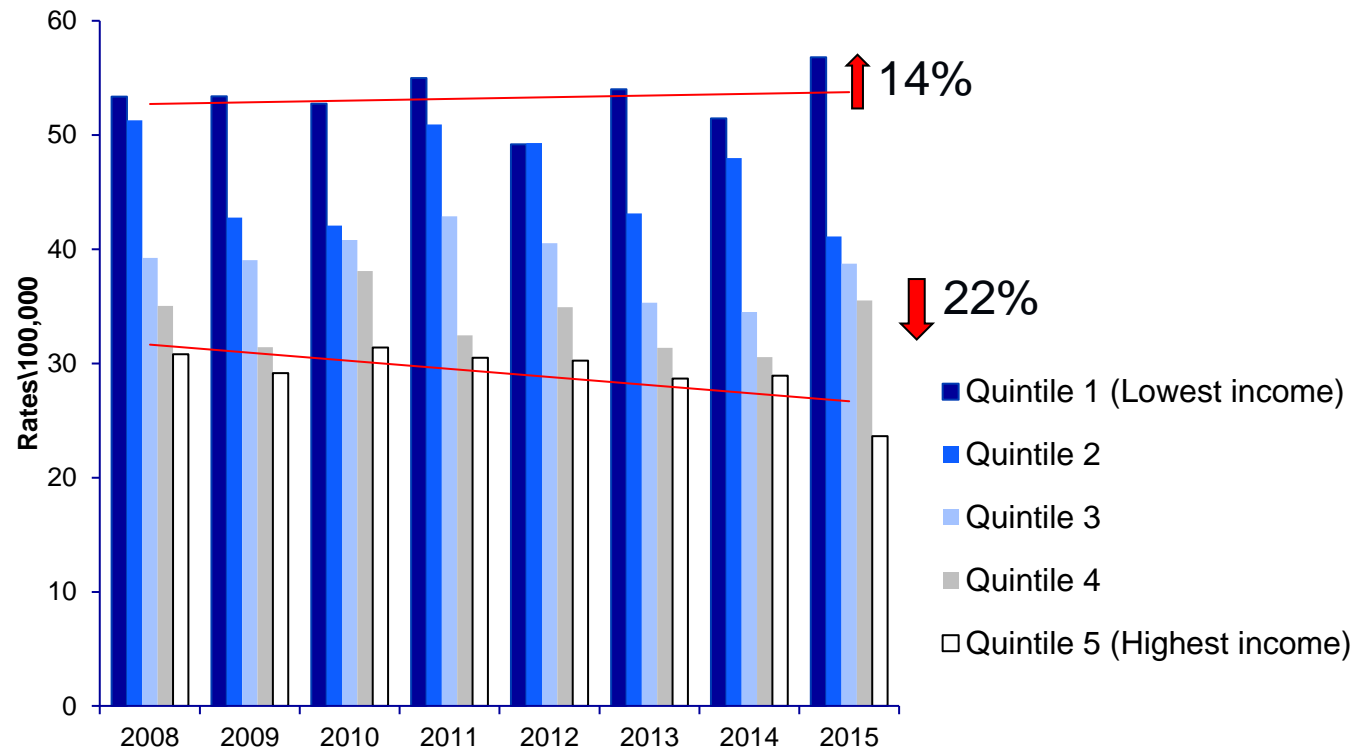
- Motor vehicle collisions are the third leading cause of death among children (age 5-14)<sup>1</sup>
- Child pedestrians are vulnerable <sup>2,3</sup>
  - Less ability to safely navigate traffic
  - Lower visibility
  - Smaller stature and more severe collisions
- More active transportation can increase child exposure to traffic
- However, this does not need to lead to injury if the environment is safe

1. Yao et al. HPCDP, 2019
2. Peden, WHO, 2004
3. Stevenson et al., 2015

# Background: Social Indicators and PMVC

- Social indicators associated with child PMVC
- Income related to ER visits for PMVC in children<sup>1</sup>
- What is causing this inequality?
  - Greater exposure to traffic
  - Unsupervised walking
  - Built environment differences<sup>2</sup>

PMVC Emergency Department Visit Rates per 100,000 children (0-19 years) in Ontario



1. Rothman et al. Injury Prevention, 2019a  
2. Rothman et al. Injury Prevention, 2019b

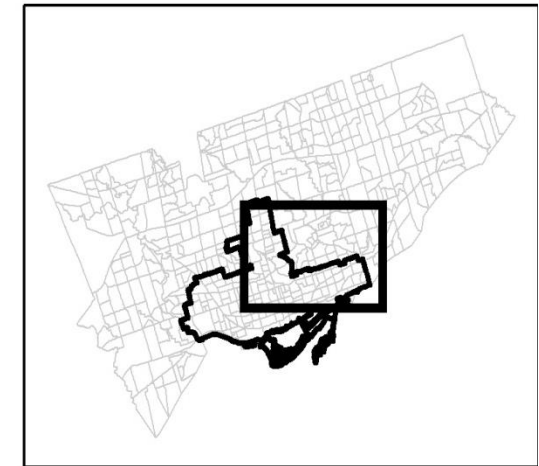
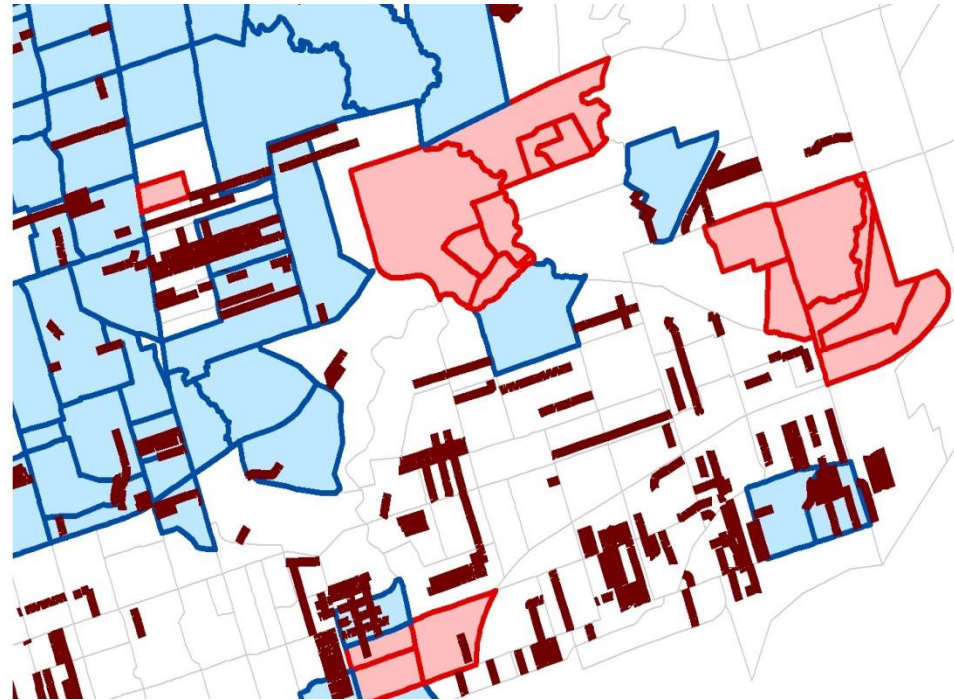
# Social Indicators of Risk

- Low income - strong evidence of higher risk
- Immigration (evidence from Europe, one study in Ontario showed lower risk)
- Race/ethnicity – higher for Hispanic and Black Children in the United States, Black Children in the UK
  - Likely context dependent
- What drives associations by race/ethnicity?
  - Economic marginalization?
  - Differences in the built environment?



# Background: Social Indicators and the Built Environment

- In highest income compared to lowest income census tracts<sup>1</sup>
  - Speed humps 4x higher
  - Lower speed local roads 1.4x higher<sup>1</sup>
- Speed humps<sup>2</sup>
  - 22% reduction in pedestrian collisions
  - 43% reduction in child pedestrian collisions



Significant clusters (CT)

- High income
- Low income
- Speed humps

<sup>1</sup>Rothman et al. Injury Prevention, 2019

<sup>2</sup>Rothman et al. BMC Public Health, 2015

# Study Objectives

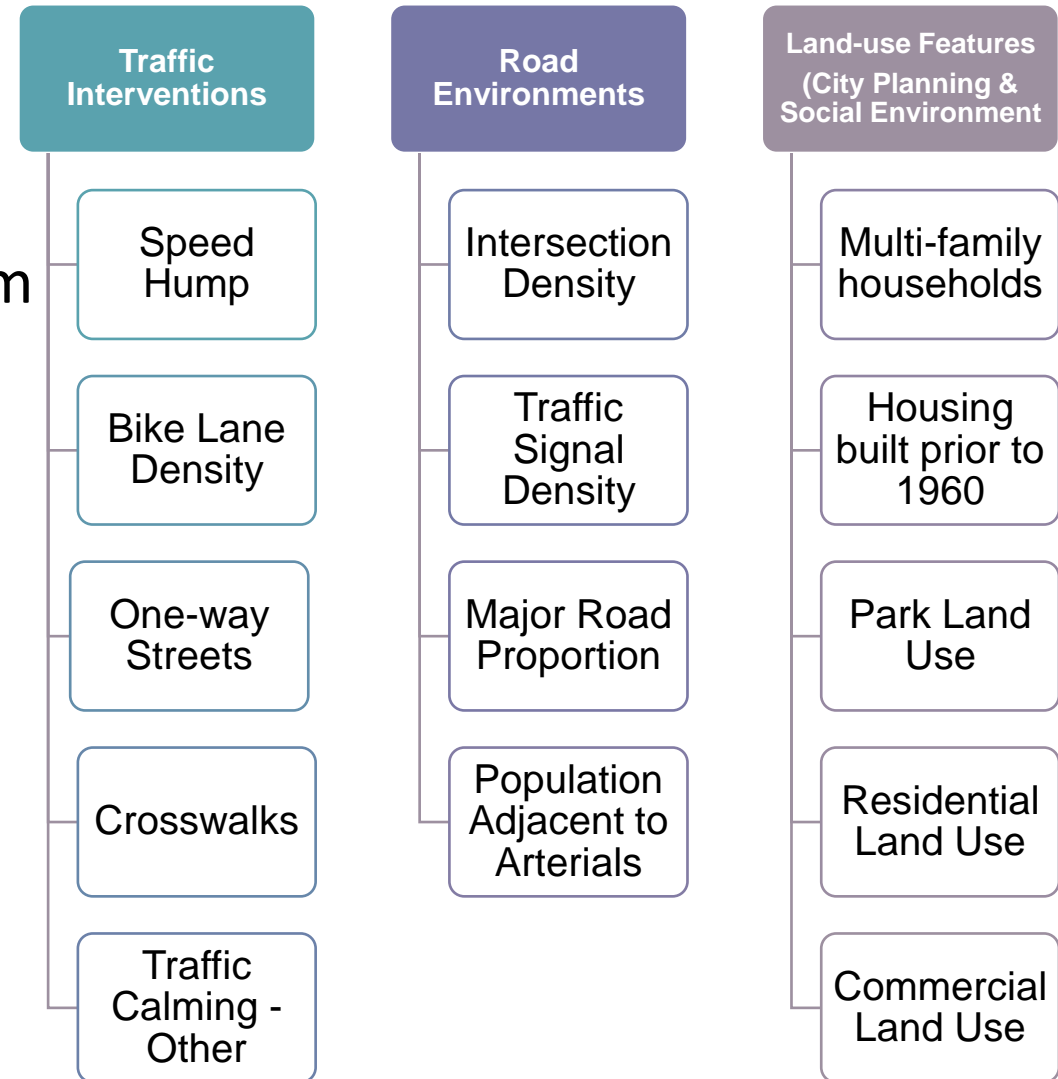
1. What is the relationship between area-level social indicators and child PMVC in Toronto, Canada?
2. Does the design of accessible and safe roadway environments modify the relationship between social indicators and outcomes of child PMVC?

Social indicators (area level):

- a. Material deprivation-Ontario Marginalization Index
- b. Recent immigrants (< 5 years) proportion from Canadian census (2016)
- c. Visible minority proportion of population- from Canadian census (2016)

# Methods Collision Analysis

- PMVC mapped by census tract in Toronto, Canada (530 census tracts)
- Negative binomial regression analysis
- Outcome: Toronto police reported PMVC per km of road among children (age 1-17) between 2010-2018
- Primary exposure:
  - a. Material deprivation –Ontario Marginalization Index
  - b. Recent immigrant proportion- Census
  - c. Visible minority proportion- Census
- Categories of built environment covariates:





# Methods - Spatial Hotspot Analysis

- Detected spatial clustering using Moran's I
- Getis-Ord GI\* spatial analysis to analyze hotspots:
  - Collisions per road kilometre
  - Material deprivation
  - Visible minority proportion
  - Recent immigrant proportion
  - Child population
  - Speed humps

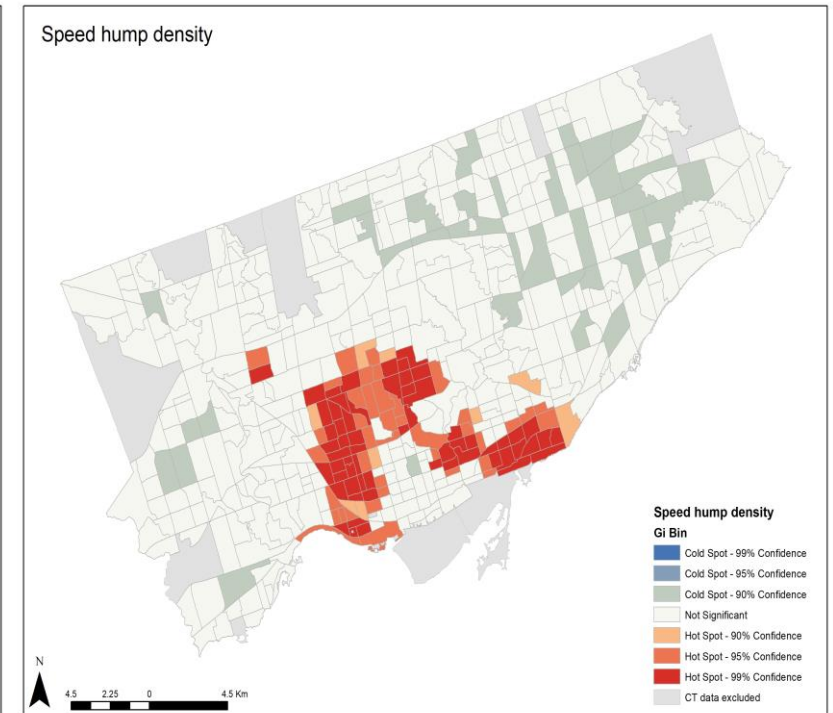
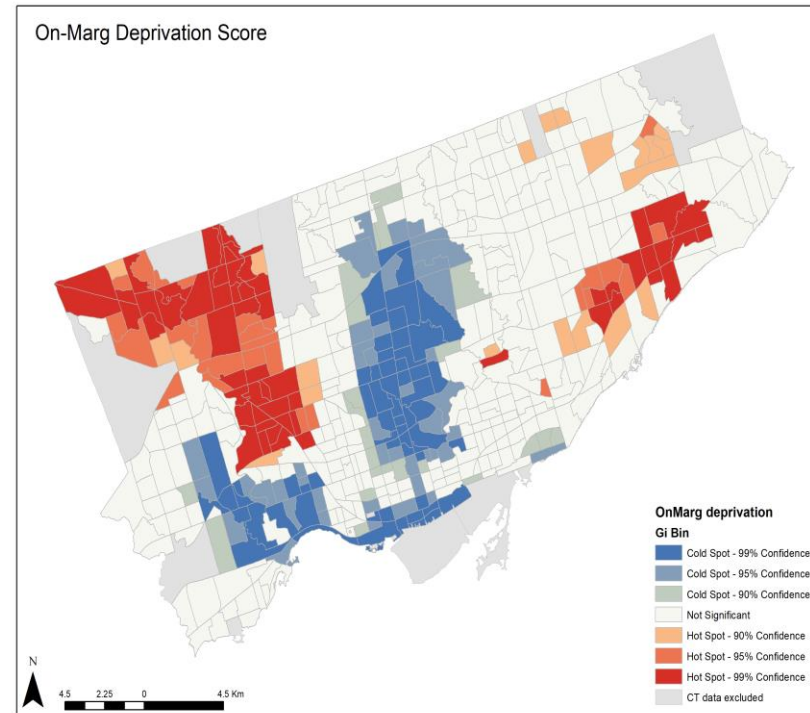
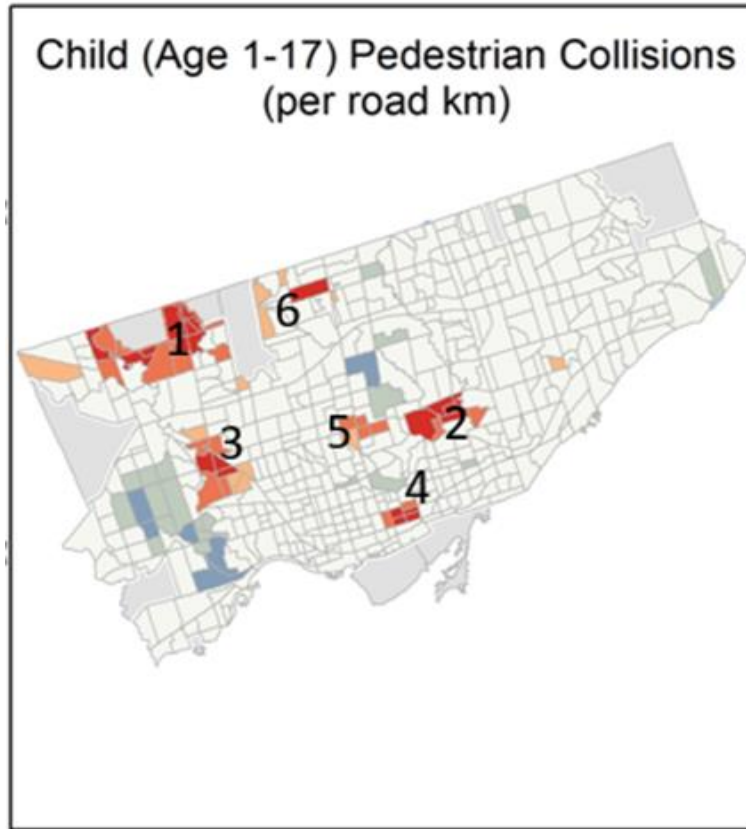
# Results - Social Indicators

- 2028 child PMVC in the study area
- Material deprivation was associated with child PMVC
  - Incidence Rate Ratio (IRR): **1.31**, 95% Confidence Interval (CI): 1.22-1.40
- Immigration was strongly associated with child PMVC
  - IRR: **1.58**, 95% CI: 1.30-1.92 (per 10% increase)
  - Remained significant when accounting for material deprivation
- Visible minority weakly associated with child PMVC
  - IRR: **1.09**, 95% CI: 1.05-1.12
  - No longer significant when accounting for material deprivation

# Results- The Built Environment

- The relationships between deprivation, new immigrants and child PMVCs did not disappear after taking built environment features into account.

# Toronto Child PMVC Hotspots



Six child PMVC hotspot clusters in Toronto (red = significant hotspot / blue = significant cold spot)

- Largest hotspots for PMVC, overlap with deprivation, recent immigrant, proportion hotspots.
- Collision hotspots generally did not overlap with traffic interventions, like speed humps.

# Discussion: Traffic Calming and Safety



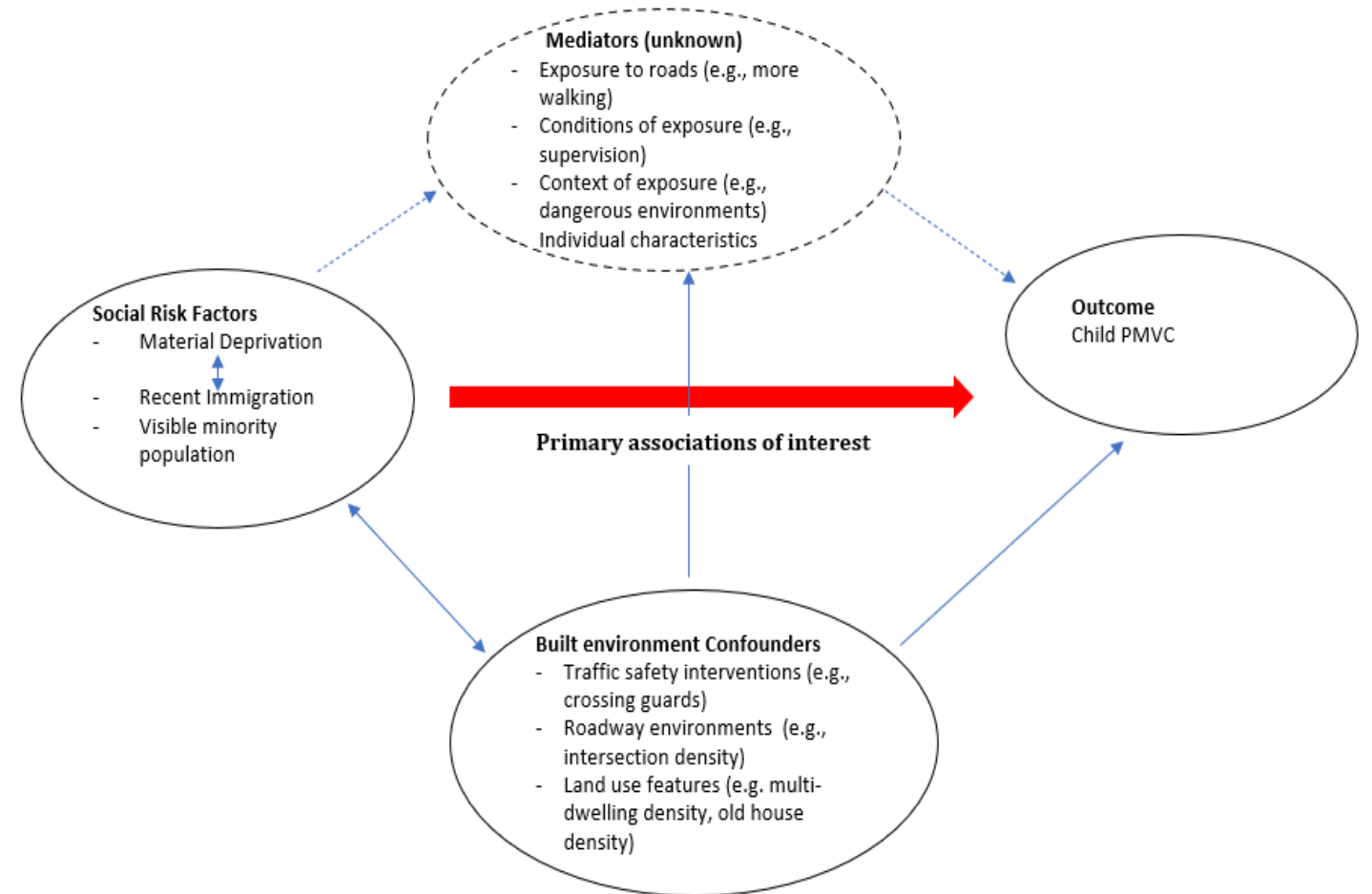
- Traffic calming interventions are effective for reducing child PMVC in natural experiments
  - Lower speed limits<sup>1</sup> (28% reduction in PMVC, 67% in major/fatal injury)
  - Speed humps (43% reduction in child PMVC)<sup>2</sup>
- Speed humps are very under-used in Toronto
  - less than 5% of roads covered by speed humps, 307 out of over 500 census tracts no speed humps
  - These are especially rare in low income, visible minority, and new immigrant hotspots
  - Hard to identify whether traffic calmed - built environments may modify these relationships

<sup>1</sup>Fridman et al. BMC Public Health, 2020

<sup>2</sup>Rothman et al. Injury Prevention, 2019

# Discussion

- Social indicators related to higher child PMVC
- Built environment did not change associations
- Deprived children walk more in dangerous environments<sup>1</sup>
- Potentially explained by:
  - Differences in exposure to roads
  - Conditions of exposure
  - Context of exposure (influenced by the built environment)



<sup>1</sup>Pabayo et al. Health & Place, 2012

**The Relationship between Social Indicators and Child PMVC in Toronto, Canada.**



# Conclusion

- Higher child pedestrian motor vehicle collisions found in areas with higher material deprivation and new immigrant population represents an important population inequality
- Need to target road safety interventions (e.g., speed humps) based on equity, including where children are more exposed to the road environment
  - Consider that children experiencing greater marginalization have fewer mobility choices, may walk more in dangerous environment

Questions?