Supplementary Material

Details of Two Step Floating Catchment Area Methods.

The 2SFCA is commonly used in geographic analyses of spatial accessibility to goods and services, including healthcare, transit, green space, and education facilities.[18,41–44]. It has been previously applied to road traffic crashes, looking at population centres' "accessibility" to crash sites,[45] and identifying pedestrian crash hotspots.[46] This method was used to create a school 'burden', with the number of assigned collisions per year calculated for each school area. Parallels to measures of spatial accessibility make 2SFCA an appropriate method for apportioning collisions to schools, including the importance of accounting for population overlap, and therefore discounting any one school's burden of injury in the presence of multiple schools,[47] and recognizing that a collision more proximate to a school is more directly related to that school's burden of injury.[18,48] Weighting was assigned proportionally to schools based on inverse distance along the road network (1/d, weight of zero after 1000m distance), with weights indexed to one to avoid population inflation where areas overlap.[48]

Independent Variables Detailed Methods

Social and land use correlates included percent of the population below the after-tax low income cut off (ATLICO) and percentage that are recent immigrants (within the last 5 years), derived from the 2016 Canadian census. Land use correlates were derived from Canadian land use data files obtained from DMTI spatial (proportion residential, proportion park land use) and the 2016 Canadian Census (population density, density of multi-dwelling homes, and old homes-built before 1960) and proportionally added for each 1000-m buffer zone.[14,15,49] . Census features were mapped by dissemination area and assigned to 1000m school buffer areas using area-weighted proportionate analysis, according to the proportion of the area of overlap.

Roadway environment correlates were obtained from municipal sources and the Canadian Road Network.[16] We included measures of road type, including proportion of major roads, intersections per km of road, and traffic signals per intersection. Major roads are classified as either arterial roads with high volumes and speed limits (40-60 km/h) and collector roads, distributing traffic between local and arterial roads (speed limits between 40-50 km/h).[16]

Traffic intervention data were obtained directly from municipal sources and included speed humps, crosswalks, bike paths, one-way streets, crossing guards, and other traffic calming (sum of raised crosswalks, traffic circles, midblock narrowings, curb extensions, diverters flashing crosswalks, speed activated signs). Traffic interventions were mapped to roadways and divided per kilometre of road within the buffer area.[16]

Supplemental Tables and Figures

Table A: Covariates and Data Sources

SOCIAL & BUILT ENVIRONMENT Correlates	Data Sources
Land use	
Multi-family dwelling (apartments, duplexes) (number per km^2)	2016 Canadian census
Housing built prior to 1960 (number per km^2)	2016 Canadian census
Park land (area proportion)	DMTI Spatial
Residential land use (area proportion)	DMTI Spatial
Social Environment	
Below after-tax low-income cut-off (% of population)	2016 Canadian census
Recent immigrants (< 5 years) (% of population)	2016 Canadian census
Road Design	
Intersection density (number per road km)	Municipal data sources
Traffic signal density (number per intersection)	Municipal data sources
Local road percentage (per total roads)	Municipal data sources
Traffic Safety Interventions	
Speed hump percentage (road km per 10 road km)	Municipal data sources
Traffic calming – other (number per road km)	Municipal data sources
Crosswalk (number per road km)	Municipal data sources
Bike path density (proportion of roads with bike lanes)	Municipal data sources
One-way street percentage (proportion of roads that are one-way)	Municipal data sources
Adult crossing guard density (number per road km)	Municipal data sources

Table B: City-specific models: Fully adjusted models imposed on cities

Variable	Calgary (n=133)	Laval (n=80)	Montreal (n=315)	Peel (n=112)	Toronto (n=390)	Overall (n=1030)
Road km-per 10% increase	**1.06 (1.01-1.11)**	1.00 (0.93-1.08)	**1.02 (1.00-1.04)**	1.08 (0.99-1.17)	**1.02 (1.01-1.04)**	**1.03 (1.02-1.04)**

Child population (per 1000 children)	1.27 (0.70-2.32)	3.36 (0.82-13.7)	**1.47 (1.27-1.71)**	1.39 (0.55-3.52)	**1.36 (1.09-1.70)**	**1.41 (1.25-1.58)**
Schools (per School)						
BUILT & SOCIAL ENVIRONMENT						
Crossing guard density (#/total road km)–per 10% increase	----	1.12 (0.78-1.60)	1.07 (0.98-1.16)	**1.15 (1.01-1.31)**	**1.13 (1.05-1.22)**	**1.10 (1.05-1.16)**
Road Environment						
Traffic signal density (per /Intersections)	1.01 (0.95-1.08)	0.90 (0.80-1.02)	**1.02 (1.00-1.03)**	1.01 (0.95-1.08)	**1.02 (0.99-1.03)**	**1.01 (1.00-1.02)**
Land use Features						
Multi-family dwelling (apartments, duplexes) (#/km^2)[b,2]	0.98 (0.69-1.40)	0.57 (0.22-1.45)	**1.11 (1.02-1.21)**	0.98 (0.69-1.40)	1.02 (0.98-1.07)	1.03 (0.99-1.06)
Housing built prior to 1960 (per 1000/km^2)[b,2]	1.18 (0.46-3.00)	2.11 (0.74-5.97)	**0.72 (0.63-0.81)**	1.77 (0.45-6.88)	0.89 (0.76-1.03)	**0.83 (0.77-0.90)**
Park land (per 10% of buffer)	1.05 (0.86-1.27)	**0.44 (0.21-0.91)**	1.04 (0.88-1.22)	1.20 (0.78-1.83)	**0.90 (0.82-0.99)**	**0.92 (0.86-0.99)**
Residential land use (per 10% of buffer)	0.95 (0.90-1.01)	0.84 (0.65-1.10)	0.94 (0.87-1.02)	0.98 (0.90-1.08)	0.98 (0.92-1.05)	**0.97 (0.94-0.99)**
Social Environment						
Below after tax low income cut off (per 10 % increase)	1.18 (0.90-1.56)	1.13 (0.75-1.71)	1.08 (0.98-1.19)	0.81 (0.48-1.38)	1.05 (0.96-1.15)	**1.08 (1.02-1.15)**
New immigrants (≤ 5 years) (per 10% increase)	**2.56 (1.58-4.18)**	3.47 (0.35-34.4)	0.88 (0.68-1.14)	1.05 (0.34-3.31)	1.13 (0.84-1.53)	**1.26 (1.06-1.50)**

Table C: Land use & Social Environment -without AST (n=389)

Variable	Calgary (*n*=125)	Laval (*n*=50)	Montreal (*n*=67)	Peel (*n*=71)	Toronto (*n*=76)	Overall (n=389)
Population (per 1000 children)	1.33 (0.72-2.45)	4.06 (0.86-19.2)	**1.74 (1.38-2.19)**	0.90 (0.26-3.17)	**1.56 (1.05-2.31)**	**1.48 (1.21-1.81)**
Road km no highway per km	**1.06 (1.01-1.11)**	0.98 (0.90-1.07)	0.99 (0.97-1.03)	1.10 (0.99-1.23)	1.01 (0.97-1.05)	**1.04 (1.02-1.06)**
Multi-family dwelling (apartments, duplexes) (#/km2)	1.06 (0.86-1.31)	1.22 (0.41-3.62)	**1.18 (1.03-1.34)**	1.16 (0.79-1.71)	0.99 (0.91-1.07)	1.01 (0.95-1.06)
Housing built prior to 1960 (per 1000/km2)	1.04 (0.38-2.84)	3.36 (0.91-12.4)	**0.81 (0.67-0.97)**	0.84 (0.15-4.60)	1.15 (0.83-1.58)	0.99 (0.86-1.14)
Residential land use (per 10% of buffer)	0.96 (0.91-1.02)	0.86 (0.62-1.19)	0.93 (0.83-1.04)	1.00 (0.83-1.21)	0.97 (0.82-1.13)	0.97 (0.93-1.01)
Park land (per 10% of buffer)	1.08 (0.88-1.32)	0.52 (0.21-1.34)	**0.69 (0.52-0.92)**	1.34 (0.73-2.48)	0.91 (0.74-1.12)	0.92 (0.83-1.02)
Below after tax low income cut off (per 10 %)	1.19 (0.90-1.57)	0.70 (0.37-1.34)	**1.19 (1.03-1.37)**	0.81 (0.44-1.49)	1.14 (0.94-1.39)	**1.17 (1.05 - 1.30)**
New Immigrants (per 10%)	**2.54 (1.56-4.15)**	1.16 (0.11-12.6)	0.98 (0.67-1.45)	1.60 (0.37-6.93)	1.07 (0.58-1.96)	**1.60 (1.21-2.10)**

Table D: Land use & Social Environment -with AST (n=389)

Variable	Calgary (*n*=125)	Laval (*n*=50)	Montreal (*n*=67)	Peel (*n*=71)	Toronto (*n*=76)	Overall (n=389)
Active School Transportation -per 10% increase	1.11 (0.98-1.26)	1.00 (0.88-1.14)	1.08 (0.99-1.18)	**1.25 (1.05-1.48)**	1.00 (0.86-1.17)	**1.08 (1.02-1.15)**
Population (per 1000 children)	1.13 (0.60-2.13)	4.05 (0.79-20.7)	**1.69 (1.35-2.12)**	0.70 (0.20-2.52)	**1.55 (1.01-2.38)**	**1.40 (1.14-1.72)**
Road km no highway per km	**1.06 (1.01-1.11)**	0.98 (0.90-1.07)	0.99 (0.97-1.03)	**1.12 (1.01-1.25)**	1.01 (0.97-1.05)	**1.05 (1.02-1.06)**
Multi-family dwelling (apartments, duplexes) (#/km^2)	1.01 (0.81-1.26)	1.22 (0.50-3.76)	**1.15 (1.01-1.31)**	1.17 (0.80-1.70)	0.99 (0.91-1.07)	0.99 (0.94-1.06)
Housing built prior to 1960 (per 1000/km^2)	1.03 (0.38-2.82)	3.35 (0.86-13.1)	**0.81 (0.67-0.97)**	0.72 (0.14-3.65)	1.14 (0.81-1.61)	0.97 (0.84-1.12)
Residential land use (per 10% of buffer)	0.97 (0.91-1.02)	0.86 (0.61-1.21)	0.95 (0.85-1.07)	1.02 (0.85-1.23)	0.97 (0.82-1.14)	0.98 (0.94-1.02)
Park land (per 10% of buffer)	1.07 (0.88-1.31)	0.52 (0.20-1.34)	**0.69 (0.52-0.91)**	1.55 (0.86-2.79)	0.91 (0.73-1.12)	0.92 (0.83-1.02)
Below after tax low income cut off (per 10 %)	1.19 (0.90-1.58)	0.70 (0.36-1.39)	**1.18 (1.02-1.35)**	0.79 (0.43-1.45)	1.14 (0.94-1.39)	**1.16 (1.04-1.29)**
New Immigrants (per 10%)	**2.54 (1.56-4.13)**	1.16 (0.10-13.2)	0.98 (0.68-1.43)	1.59 (0.40-6.46)	1.07 (0.58-1.96)	**1.57 (1.20-2.06)**

Table E: Road Environments - without AST (*n*=389)

Variable	Calgary (*n*=125)	Laval (*n*=50)	Montreal (*n*=67)	Peel (*n*=71)	Toronto (*n*=76)	Overall (n=389)
Population age 1-12 (per 1000 children)	**3.26 (2.05-5.20)**	**8.81 (2.64-29.4)**	**1.75 (1.35 - 2.29)**	1.28 (0.62-2.67)	1.39 (0.95-2.04)	**1.77 (1.48-2.13)**
Road km (no highway) per km	1.02 (0.98-1.06)	0.98 (0.91-1.06)	0.99 (0.96 - 1.02)	1.06 (0.97-1.16)	1.01 (0.97-1.05)	**1.02 (1.00-1.04)**
Road Design						
Intersection density (#/ total road km)	0.87 (0.73 - 1.05)	1.15 (0.72 - 1.85)	1.18 (0.96-1.46)	**1.48 (1.06, 2.07)**	1.15 (0.94, 1.41)	1.05 (0.95-1.17)
Traffic signal density (per 10/total road km)	1.02 (0.98 - 1.06)	1.08 (0.98 - 1.18)	1.01 (0.99, 1.04)	1.03 (0.95, 1.11)	1.04 (0.99, 1.08)	1.01 (0.99-1.03)
Local road density (km local roads/total road km)/10	0.90 (0.74 - 1.11)	1.31 (0.91 - 1.87)	0.99 (0.82, 1.21)	0.83 (0.61, 1.13)	1.03 (0.86, 1.23)	0.95 (0.86-1.04)

Table F: Road Environments - with AST (*n*=389)

Variable	Calgary (*n*=125)	Laval (*n*=50)	Montreal (*n*=67)	Peel (*n*=71)	Toronto (*n*=76)	Overall (n=389)
Active School Transportation -per 10% increase	1.11 (0.98-1.26)	1.03 (0.91-1.16)	**1.12 (1.02-1.24)**	**1.19 (1.01-1.41)**	1.01 (0.87-1.17)	**1.09 (1.03-1.16)**
Population age 1-12 (per 1000 children)	**2.80 (1.70-4.61)**	**8.59 (2.56-28.9)**	**1.64 (1.27-2.12)**	0.98 (0.45-2.13)	1.37 (0.87-2.14)	**1.62 (1.35-1.96)**
Road km (no highway) per km	1.02 (0.98 - 1.06)	0.98 (0.90-1.06)	0.99 (0.96-1.02)	1.09 (0.99-1.20)	1.01 (0.97-1.05)	**1.02 (1.00-1.04)**
Road Design						
Intersection density (#/ total road km)	0.88 (0.73-1.06)	1.17 (0.73-1.88)	1.21 (0.99-1.49)	**1.43 (1.03-1.98)**	1.14 (0.91-1.42)	1.04 (0.94-1.15)
Traffic signal density (per 10/total road km)	1.02 (0.98-1.06)	1.07 (0.97-1.18)	1.01 (0.99-1.03)	1.03 (0.96-1.12)	1.03 (0.99-1.08)	1.01 (0.99-1.03)
Local road density (km local roads/total road km)/10	0.90 (0.74-1.10)	1.29 (0.90, 1.86)	1.03 (0.85-1.25)	0.84 (0.62-1.14)	1.03 (0.86-1.23)	0.95 (0.87-1.04)

Table G: Traffic Safety Interventions without AST (*n*=389)

Variable	Calgary (n=125)	Laval (n=50)	Montreal (n=67)	Peel (n=71)	Toronto (n=76)	Overall (n=389)
Population age 1-12 (per 1000 children)	**2.79 (1.72-4.53)**	**6.12 (2.06-18.1)**	**1.63 (1.33-2.01)**	1.01 (0.51-2.01)	**1.39 (1.01-1.92)**	**1.78 (1.49-2.11)**
Road km (no highway) per km	1.03 (0.99-1.08)	1.02 (0.95-1.09)	1.01 (0.98-1.04)	**1.10 (1.01-1.19)**	**1.03 (1.00-1.06)**	**1.03 (1.01-1.05)**
Traffic Calming						
Speed hump (km/total road km)/10	0.49 (0.11-2.20)	0.14 (0.00, 287)	**0.86 (0.75-0.97)**	**-------**	0.96 (0.67-1.37)	**0.79 (0.69-0.92)**
Crosswalk #	1.09 (0.95-1.26)	-------	0.97 (0.90, 1.05)	1.47 (0.51, 4.18)	0.83 (0.62-1.13)	1.01 (0.95-1.09)
Bike path density (km/km2)	1.08 (0.88-1.33)	**1.40 (1.06-1.85)**	0.89 (0.75, 1.05)	1.06 (0.79, 1.43)	0.90 (0.73-1.12)	1.01 (0.91-1.11)
One-way street percentage (km/total road km) – per 10% increase	0.87 (0.64-1.18)	0.95 (0.76, 1.18)	**1.09 (1.02-1.17)**	1.00 (0.76, 1.32)	0.99 (0.87-1.12)	1.04 (0.97-1.11)
Traffic calming – other #	1.10 (0.88-1.38)	**0.58 (0.34-0.99)**	0.98 (0.95, 1.01)	-------	1.01 (0.87-1.18)	0.98 (0.94-1.01)
Crossing guard density (#/Road km)	----	1.11 (0.75-1.66)	1.12 (0.99-1.27)	1.16 (0.99-1.35)	**1.37 (1.09-1.71)**	**1.14 (1.05-1.24)**

Table H: Traffic Safety Interventions with AST (*n*=389)

Variable	Calgary (n=125)	Laval (n=50)	Montreal (n=67)	Peel (n=71)	Toronto (n=76)	Overall (n=389)
Active transportation –per 10% increase	**1.14 (1.00-1.30)**	1.00 (0.89-1.13)	1.09 (0.99-1.20)	1.19 (0.99-1.42)	1.03 (0.90-1.18)	**1.09 (1.02-1.15)**
Population age 1-12 (per 1000 children)	**2.29 (1.37-3.82)**	**6.11 (2.01-18.5)**	**1.57 (1.27-1.93)**	0.85 (0.42-1.72)	1.33 (0.91-1.94)	**1.66 (1.39-1.98)**
Road km (no highway) per km	1.04 (0.99-1.08)	1.02 (0.95-1.09)	1.01 (0.98-1.05)	**1.11 (1.02-1.21)**	**1.03 (1.00-1.06)**	**1.03 (1.01-1.05)**
Traffic Calming						
Speed hump (km/total road km)/10	0.47 (0.11-2.05)	0.14 (0.00-4.04)	0.88 (0.77-1.01)	-----	0.95 (0.67-1.36)	**0.80 (0.70-0.93)**
Crosswalk # [b]	1.11 (0.96-1.27)	----	0.96 (0.89-1.04)	1.29 (0.49-3.41)	0.84 (0.62-1.14)	1.02 (0.95-1.09)
Bike path density (km/km2)	1.07 (0.88-1.32)	**1.40 (1.06-1.85)**	**0.83 (0.70-0.99)**	1.01 (0.76-1.36)	0.91 (0.74-1.13)	0.99 (0.90-1.10)
One-way street percentage (km/total road km) – per 10% increase	0.90 (0.67-1.23)	0.95 (0.76-1.18)	1.06 (0.98-1.15)	0.99 (0.75-1.30)	0.98 (0.86-1.12)	1.02 (0.96-1.09)
Traffic calming – other #/Road km	1.12 (0.90-1.40)	**0.58 (0.34-0.99)**	0.98 (0.95-1.01)	-----	1.01 (0.87-1.18)	0.98 (0.94-1.01)
Crossing guard density (#/Road km)	----	1.11 (0.75-1.66)	1.10 (0.97-1.24)	1.13 (0.98-1.32)	**1.36 (1.09-1.70)**	**1.13 (1.04-1.22)**

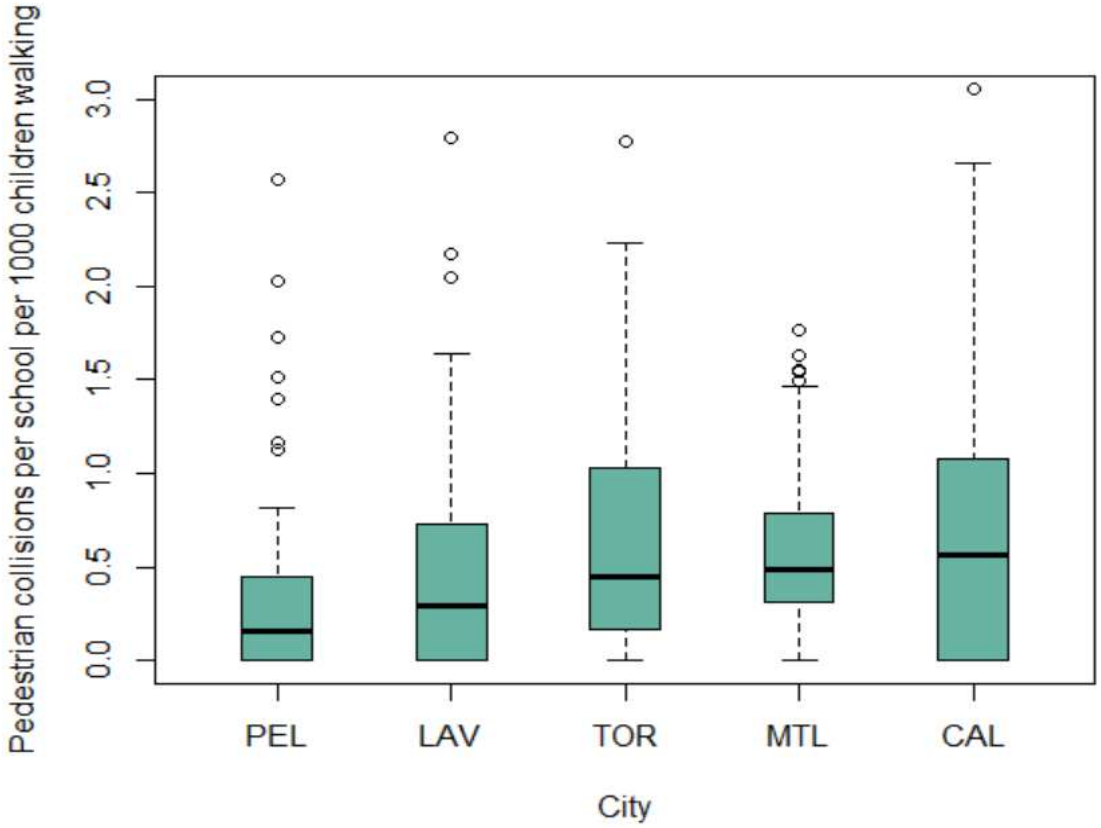

Fig 1b: Pedestrian Collision Rates per 1000 children walking at 389 Schools with AST measures

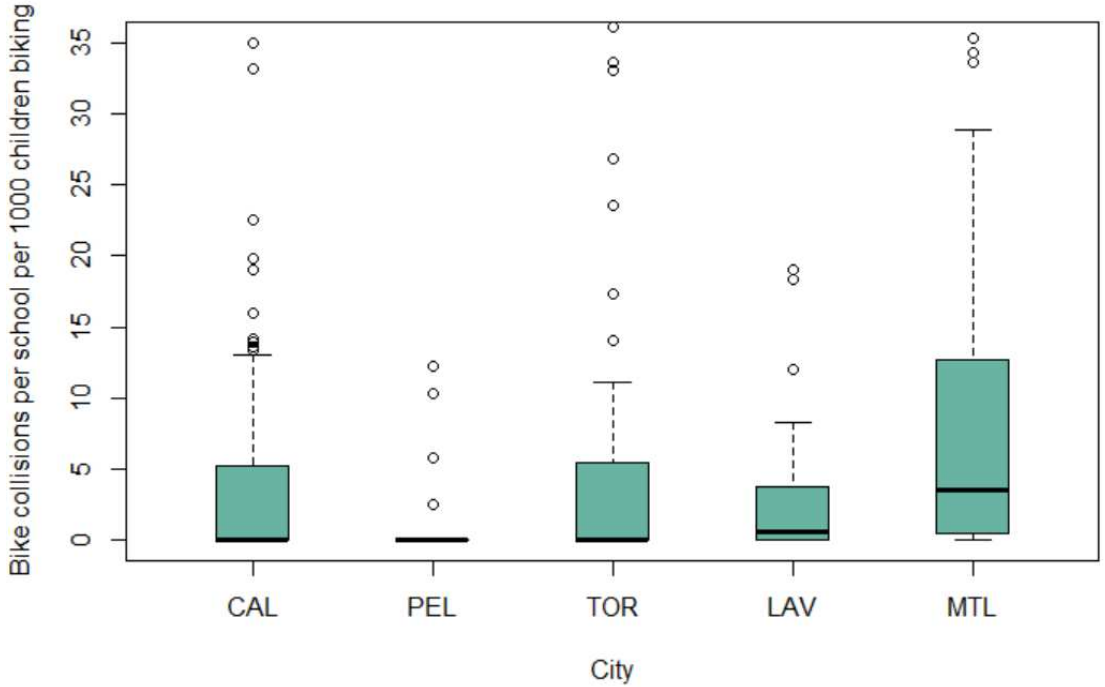

Fig 1c: Cycling collision rates per 1000 children biking at 389 Schools with AST measures

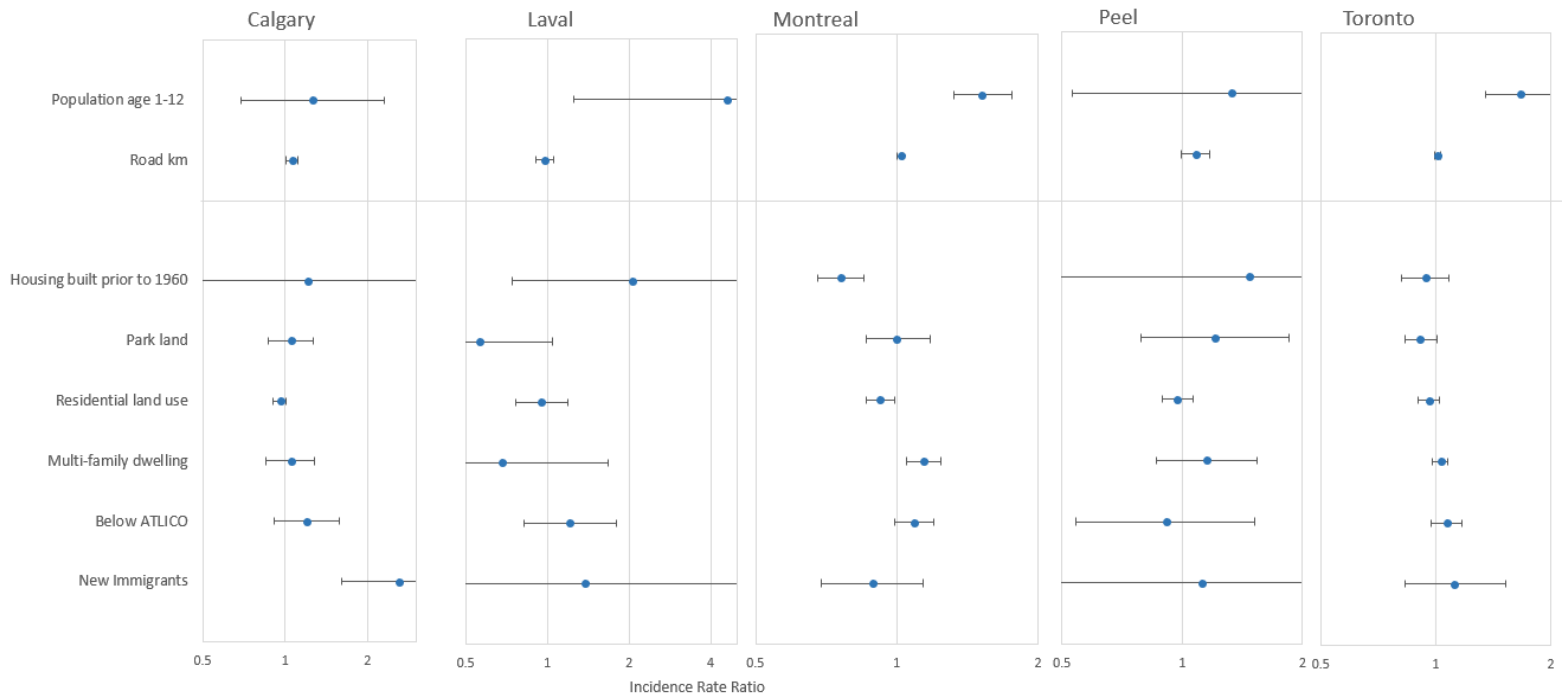

Figure 2b: City Specific Models, Land use and social environment features, IRR with 95% Confidence Intervals

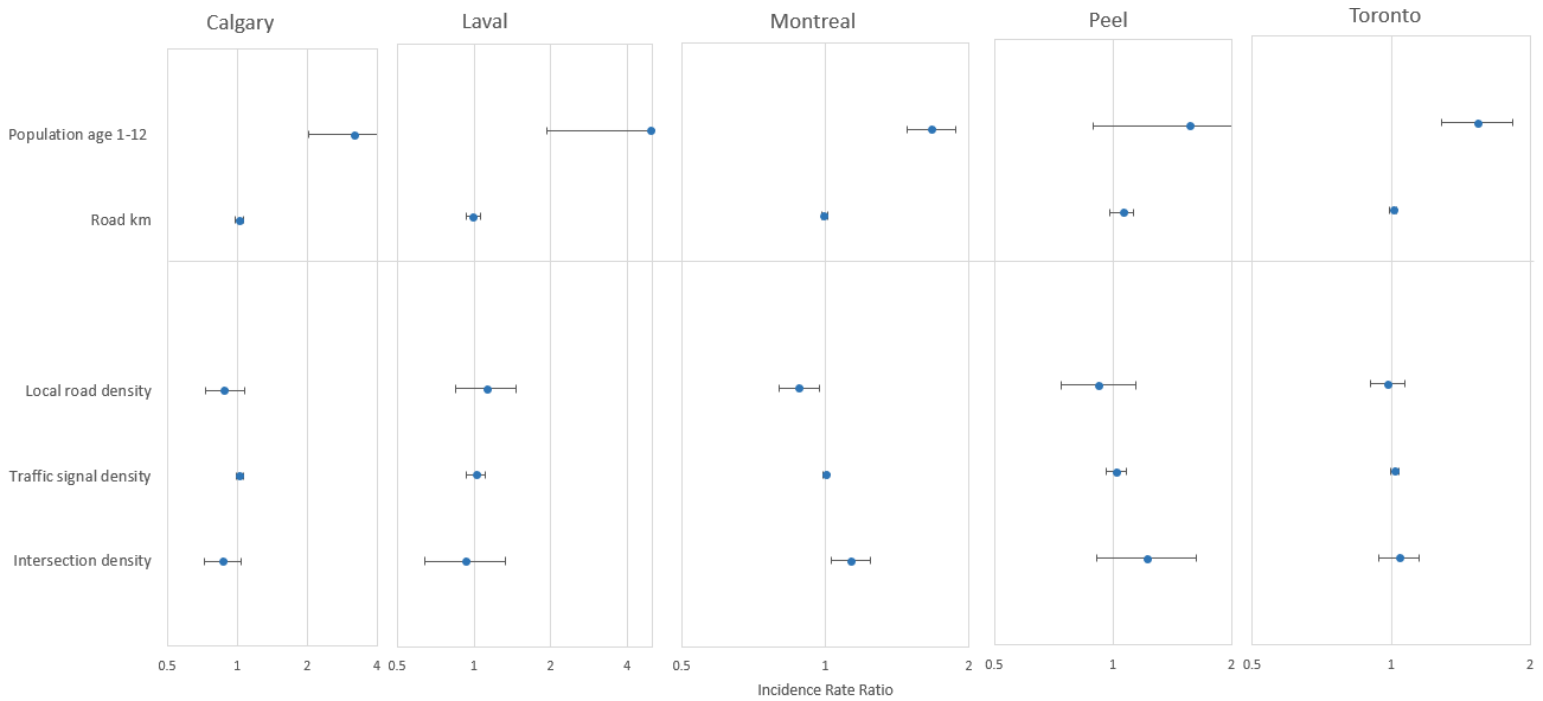

Figure 3b: City Specific Models- Road environments IRR with 95% Confidence Intervals

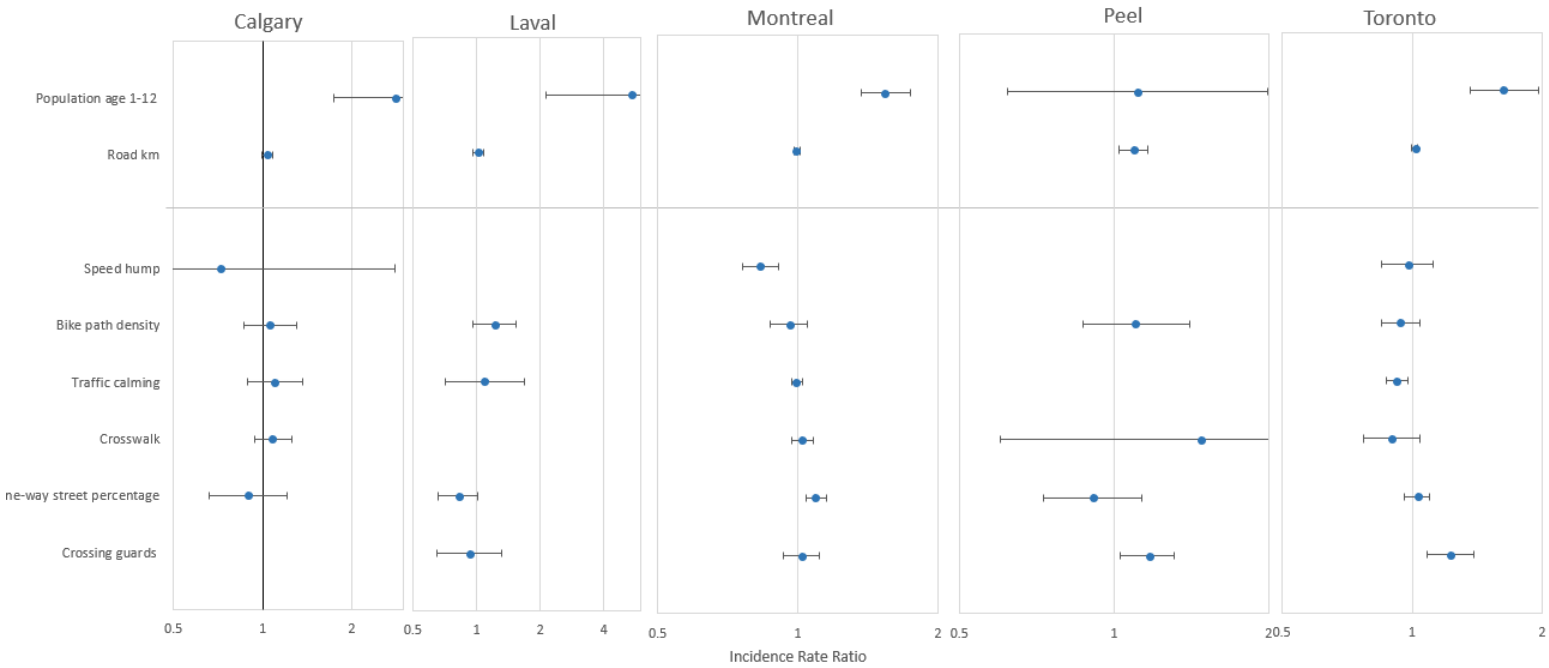

Figure 4b: City-Specific Models Traffic Safety Interventions-All Schools, IRR with 95% Confidence Intervals