Child and Adolescent Bicycling Injuries Involving Motor Vehicle Collisions

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June 19, 2017

- Background

- Objectives

- Methods

- Results

- Future Directions

- Bicycling improves physical, mental, environmental and social health

- Reduces road congestion and pollution

- Bicycling in children improves independent mobility, autonomy and self-esteem
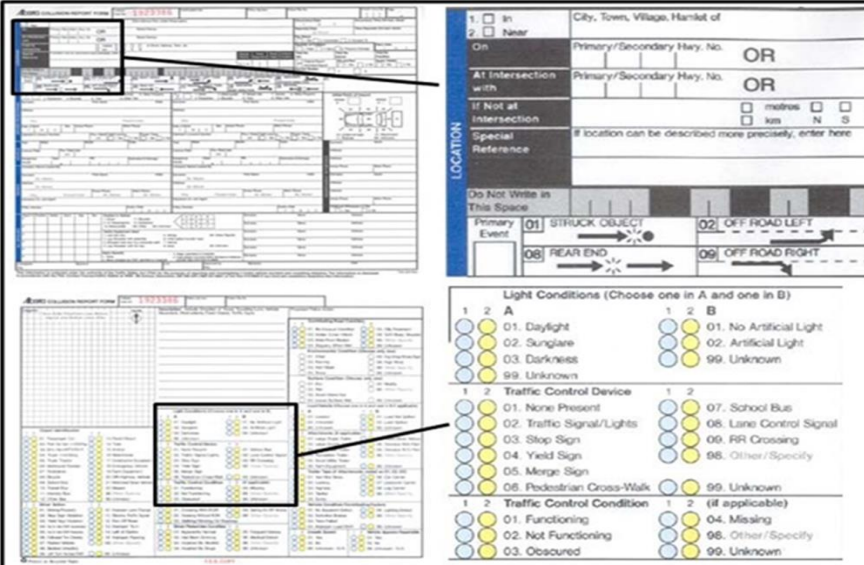
- Bike infrastructure is lacking in many cities

- Perceived risk of injury, especially by traffic exposure, often cited as leading deterrent to bicycling

  — 9,109 ED visits in Alberta due to cycling injuries

    ▪ 541 hospitalized

- Risk factors for hospitalization due to bicycle injury:
  - Less experienced cyclist

  - Male

  - Child and Adolescent

  - MV collision

  - Self-reported speed >24km/h

  - Not wearing a helmet

  - Poor visibility

  - Low socio-economic status

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- Bicycling is a leading cause of injury and hospitalization in children and adolescents in Canada

- Youth are particularly vulnerable:
  — Less situational awareness
  — Less cognitively developed
  — Less experience
  — Less developed motor skills

- 940 youth (<18 years old) cyclists hospitalized in Canada, annually *

- To examine the environmental, MV driver, and cyclist characteristics of reported paediatric (<18 years) BMV collisions resulting in police reported severe and non-severe injuries

- Data source:
  - Alberta Police Collision Reports, 2010-2014
  - Include all collisions between a moving MV and youth on bicycle (n=423)

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Variables considered:

- Child cyclist
  - Sex, age, safety equipment use, unsafe speed, condition of bicycle, injury severity, action, point of impact, impairment
- Environment
  - Road type, road surface condition, intersection status, time of day, peak traffic time, lighting, traffic control device (type and function), primary event, location
- Motor vehicle driver
  - Sex, age, unsafe speed, condition of vehicle, type of vehicle, HAR, action, point of impact, impairment (alcohol, drugs, etc)

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- 423 reported MV-Youth cyclist collisions
  - 42 hospitalizations, 1 fatality
  - 97 with no injury
  - 283 'minor injuries'
- 81% of cyclists were male
- 5% of cyclists travelling at police reported 'unsafe speed'
- Defective brakes in 7 collisions
- 3 youth impaired by alcohol, 1 by cannabis, 1 by illness
- 38% wearing helmets
  - 44% of those <12 years old wore helmets

- ## Median age of cyclists= 13 years
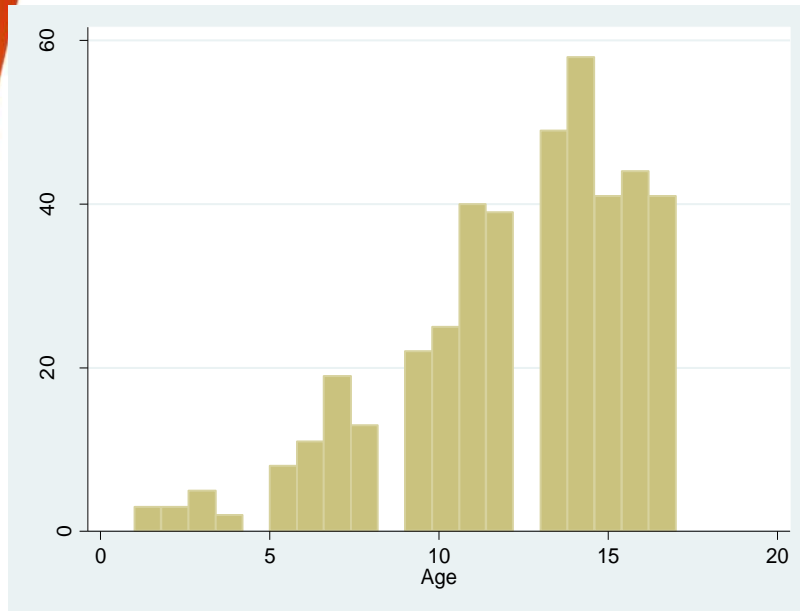
Children	n	Alberta population (StatCan, 2012)	Reported collisions/10,000
Age 0-6			
Female	6	162,970	0.37
Male	26	171,365	1.52
Overall	32	334,335	0.96
Age 7-12			
Female	31	127,295	2.44
Male	127	133,560	9.51
Overall	158	260,855	6.06
Age 13-17			
Female	42	112,265	3.74
Male	191	118,860	16.07
Overall	233	231,125	10.08
All Ages	423	826,315	5.12

- **Traffic Control Device Present**

TCD Present Age 0-6

- Yield Sign 3%
- Stop Sign 3%
- Traffic Signals/Lights 3%
- Pedestrian Cross-Walk 10%
- None Present 81%

TCD Present Age 13-17

- Missing 6%
- Pedestrian Cross-Walk 27%
- Yield Sign 2%
- Stop Sign 4%
- Traffic Signals/Lights 24%
- None Present 37%
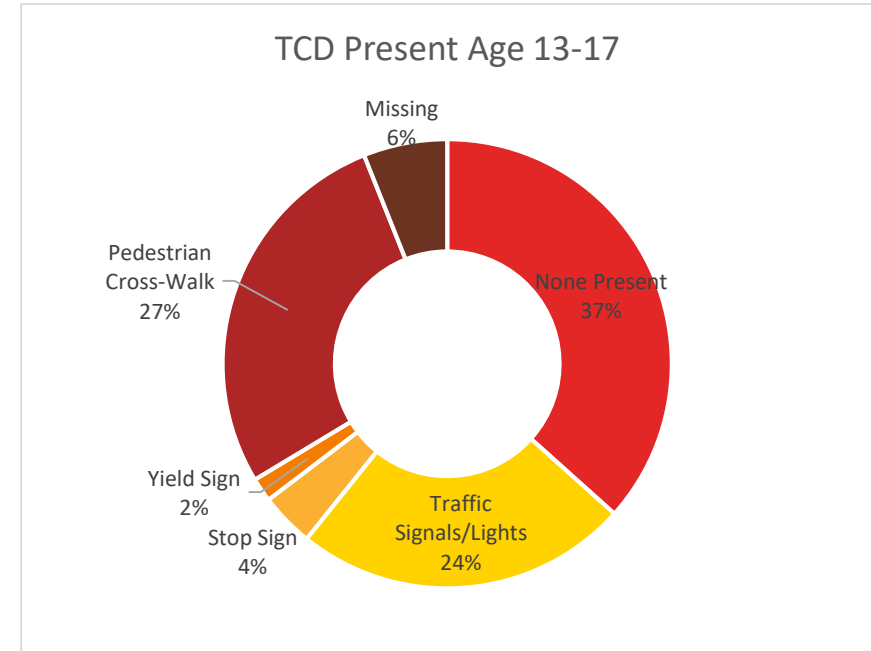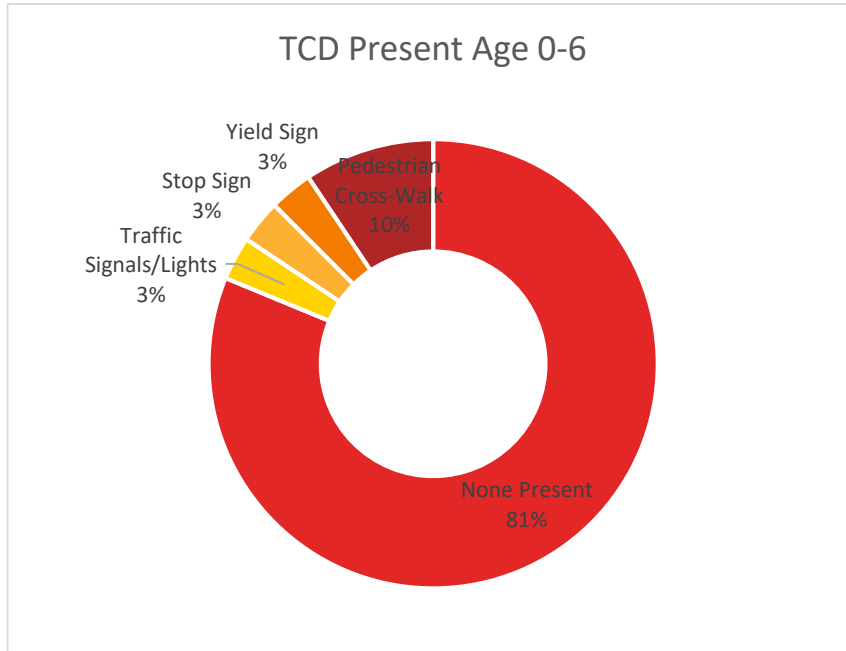
Road Type
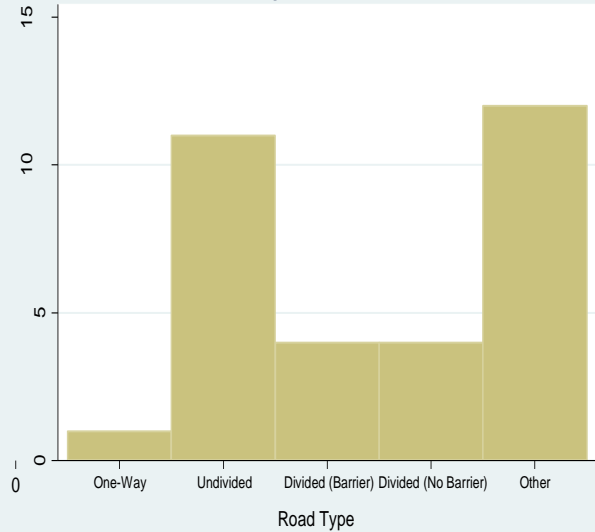
Age 0-6 (n=32), Age 7-12 (n=158), Age 13-17 (n=233) — histograms of Road Type

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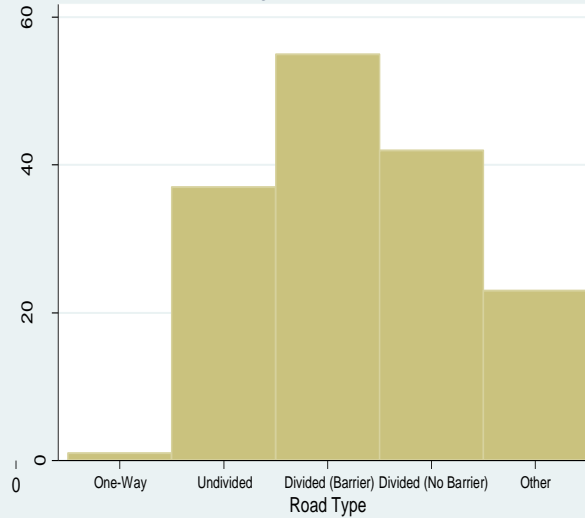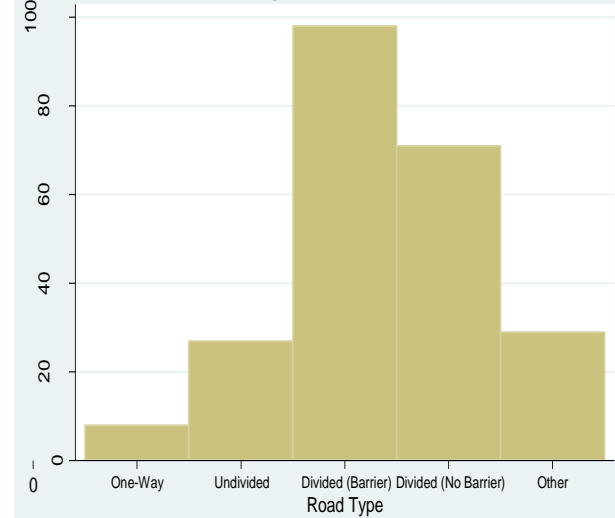
- 54% of drivers were male
- Median age of drivers= 45 years
- 2% of drivers travelling at 'unsafe speed'
- 13% of collisions are HAR
- Defective brakes in 1 collision
- Alcohol impairment in 1 collision

Type of Vehicle

- Type of Vehicle chart

Passenger Car	52%
Mini-Van/MPV	31%
Pick-Up/Van <4500 kg	11%
Truck >4500 kg	2%
Transit Bus	2%
Missing	2%

Primary point of impact

Front Centre	56%
Right Front	15%
Right Centre	6%
Left Front	6%
Missing	5%
Back Centre	4%
Left Centre	4%
Right Rear	2%
Left Rear	2%
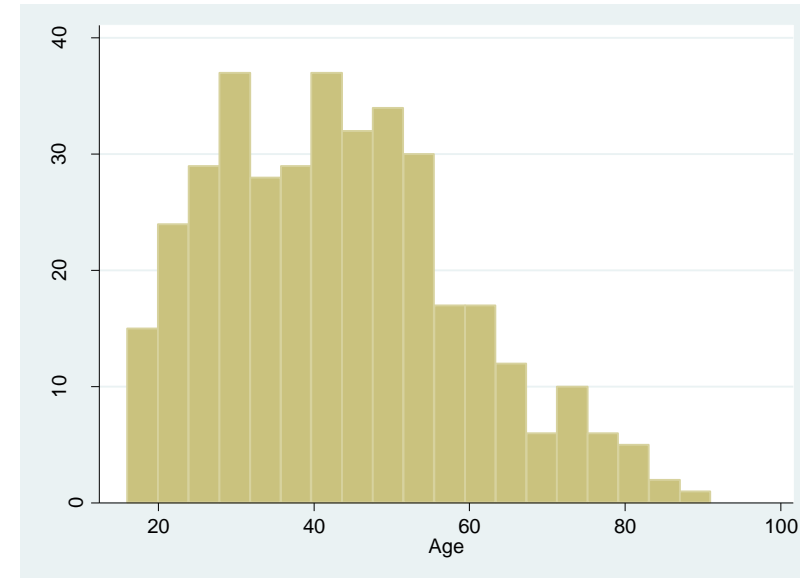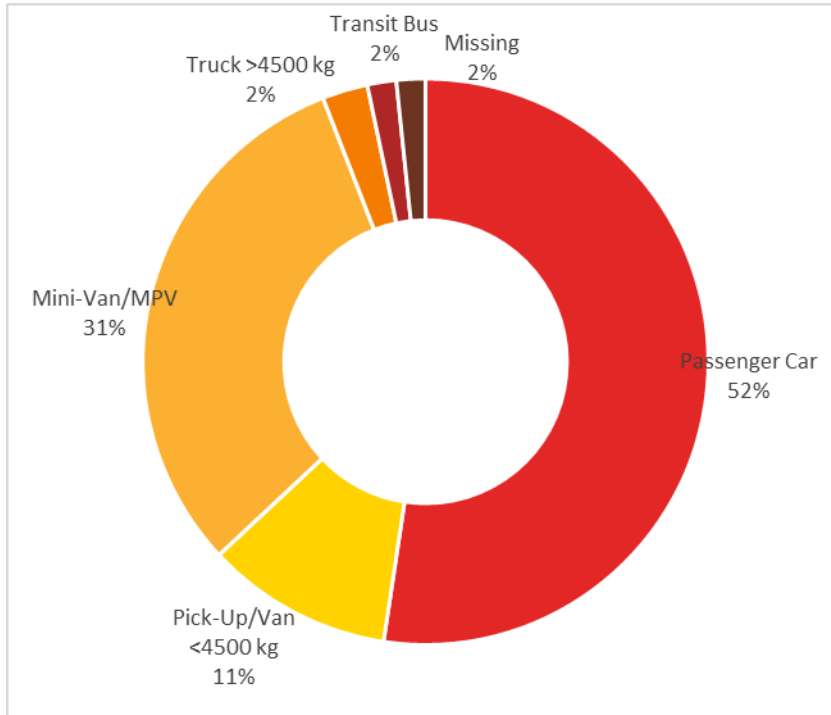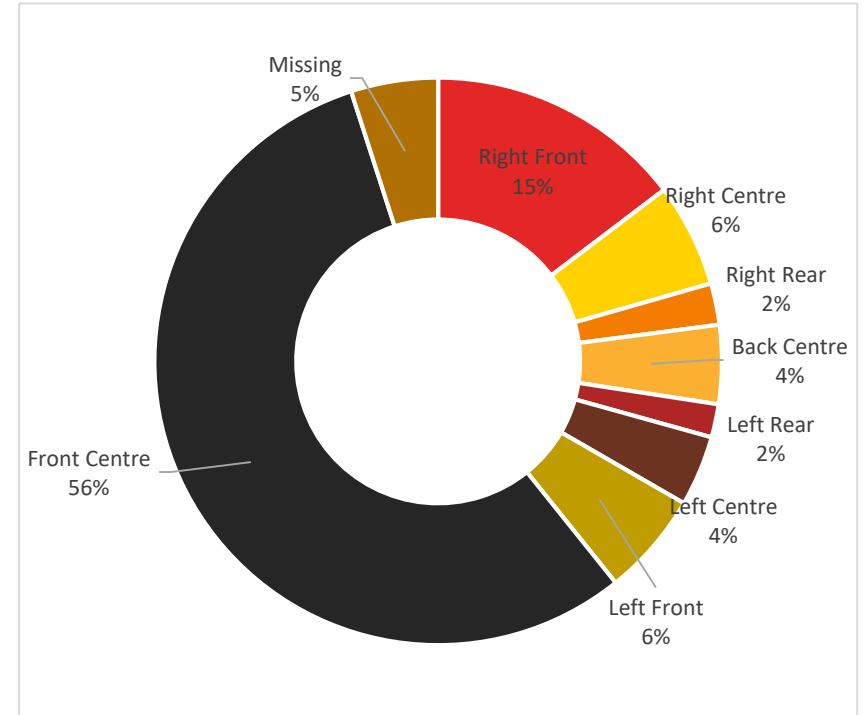
Top 5 Actions in collision

Cyclist Action	n
Riding Properly	109
Disobey Traffic Signal	39
Failed to Yield Right of Way Uncontrolled	32
Stop Sign Violation	8
Yield Sign Violation	6

Driver Action	n
Driving Properly	198
Fail to Yield Right-of-Way Pedestrian	69
Backed Unsafely	15
Stop Sign Violation	11
Left Turn Across Path	10

- 'Divided with barrier' roads were most frequent road class (n=157)
  - One-way is least frequent (n=10)
- 91% of collisions on clear days and dry roads
  - 14 collisions with sun glare; 24 in darkness
- 278 collisions 'intersection related' vs. 145 'non intersection'
- 17 collisions on graded surface
  - All others flat or unknown
- 22 collisions at curved road
  - All others straight or unknown

Time of collisions
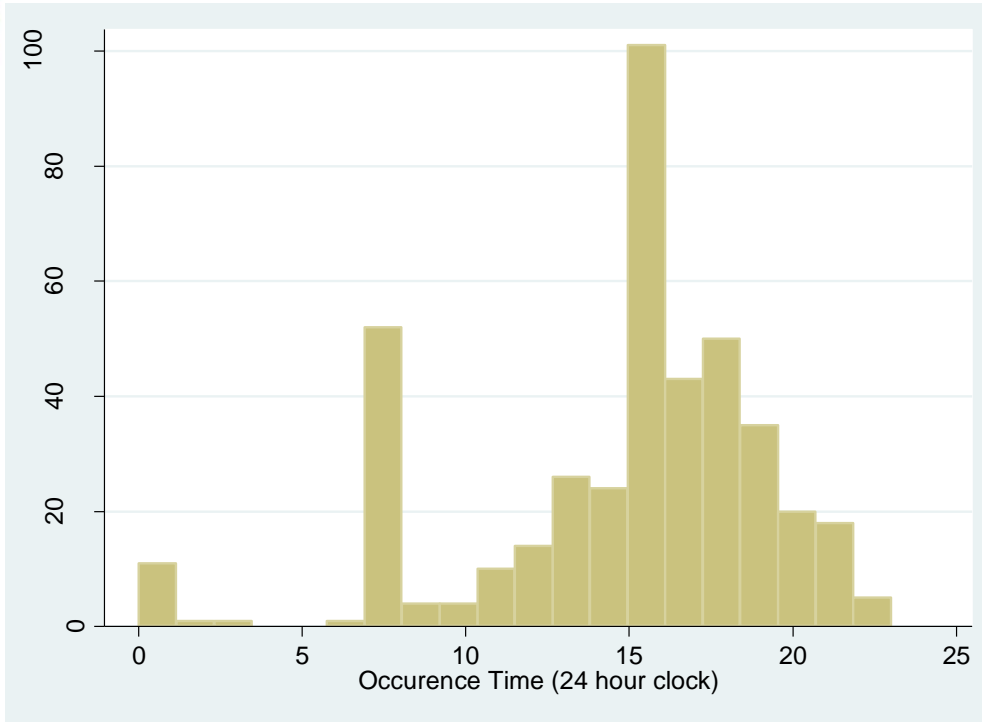
Driver Characteristics				
		Injury Control	Injury Case	Crude OR	95% CI
		n=380 (%)	n=43 (%)		
Sex					
	Male	192 (50.53)	28 (65.12)	1.79	0.90-3.58
	Female	160 (42.11)	13 (30.23)	1.00	Reference
Driver Action					
	Driving Properly	179 (47.11)	19 (44.19)	1.00	Reference
	Fail to Yield Right of Way Uncontrolled	18 (6.10)	2 (4.65)	0.98	0.40-2.45
	TCD Violation	67 (22.71)	7 (16.27)	1.05	0.23-4.86
	Backed unsafely	11(3.73)	4 (9.30)	3.43	0.99-11.82
	Improper Turn/Lane Change	20 (6.78)	3 (6.98)	1.18	0.25-5.52
Impact Location					
	Front Centre	206 (57.38)	30 (69.77)	1.00	Reference
	Side Impact	138 (38.44)	9 (20.93)	0.45	0.21-0.97
	Back Centre	15 (4.18)	4 (9.30)	1.83	0.57-5.88
Object ID					
	Passenger Car	203 (54.13)	18 (41.86)	1.00	Reference
	Mini-Van/SUV/Pick Up	156(41.6)	20(46.52)	1.45	0.74-2.83
	Commercial/Emergency Vehicles	16(4.27)	3(6.98)	2.11	0.56-7.95

Child Characteristics					
		Injury Control	Injury Case	Crude OR	95% CI
		n=380 (%)	n=43 (%)		
Child Age					
	Age 0-6	27 (7.11)	5 (11.63)	1.35	0.47-3.94
	Age 7-12	139 (36.58)	19 (44.19)	1.00	Reference
	Age 13-17	214 (56.32)	19 (44.19)	0.65	0.33-1.27
Sex					
	Female	75 (19.74)	4 (9.30)	1.00	Reference
	Male	305 (80.26)	39 (90.70)	2.40	0.83 - 6.91
Driver Action					
	Driving Properly	104 (27.37)	9 (20.93)	1.00	Reference
	TCD Violation	50 (13.16)	3 (6.98)	0.69	0.18-2.67
	Fail to Yield Right of Way Uncontrolled	32 (8.42)	5 (11.6)	1.80	0.56-5.78
	Improper Turn/Lane Change	14 (24.8)	2 (4.66)	1.65	0.32-8.43
Safety Equipment					
	Helmet	147 (38.68)	14 (32.56)	1.00	Reference
	None	183 (48.16)	25 (58.14)	1.43	0.72-2.86

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Built Environment Factors				
	Injury Control	Injury Case	Crude OR	95% CI
	n=380 (%)	n=43 (%)		
Collision Location				
Non Intersection	128 (13.95)	17 (16.28)	1.00	Reference
Intersection Related	252 (30.79)	26 (41.86)	0.78	0.41-1.48
Peak Time				
Peak Time	114 (95.0)	6 (5.0)	0.38	0.15-0.91
Not Peak	264 (87.7)	37 (12.29)	1.00	Reference
Road Class				
Undivided Two Way	66 (17.37)	8 (18.6)	0.88	0.37-2.12
Divided with Barrier	138 (36.32)	19 (44.19)	1.00	Reference
Divided no Barrier	112 (29.47)	6 (13.95)	0.39	0.15-1.01
Undivided One Way	8 (2.11)	2 (4.65)	1.82	0.39-9.19
Other	56 (14.74)	8 (18.6)	1.04	0.43-2.51
TCD Present				
None Present	153 (40.26)	21 (48.84)	1.00	Reference
Traffic Signals/Lights	95 (25.00)	7 (16.28)	0.54	0.22-1.31
Pedestrian Cross-Walk	54 (14.21)	10 (23.26)	1.35	0.60-3.05
Signs	60 (16.57)	2 (4.66)	0.24	0.06-1.07

- Multiple logistic regression to identify factors associated with hospitalized cases vs. non-hospitalized controls
- Multiple imputation to deal with missing data

- Limitations
  - Smaller data set with missing information

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Funding: Paediatrics Innovation Award, University of Calgary