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Driver and road characteristics associated with child pedestrian injuries

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ABSTRACT

Background: Child pedestrians make up a significant proportion of all road traffic deaths. Our primary objective was to examine the association of driver characteristics with child pedestrian injuries with a secondary objective to broadly describe the road characteristics surrounding these collisions.

Methods: We included drivers involved in child (< 18 years old) pedestrian motor-vehicle collisions (PMVCs) in Calgary and Edmonton, Alberta (2010–2015). These drivers were compared with not at fault (Alberta adaptation of a Canadian culpability scoring tool) drivers involved in vehicle-only collisions. The data were analyzed with unconditional logistic regression.

Results: Seven hundred ninety-three drivers collided with 826 children. One quarter of child PMVC drivers were 40–54 years old (25.2%). Younger drivers, 16–24 (adjusted odds ratio [aOR] = 1.62, 95% CI: 1.27–2.09), and older drivers, ≥55 (aOR = 1.57, 95% CI: 1.24–1.99) were more likely to be involved in a child PMVC. Time of day between 06:01 – 09:00 (aOR = 1.46, 95% CI: 1.16–1.85) and 18:01 – 24:00 (aOR = 1.68, 95% CI: 1.30–2.17), no seatbelt use (aOR = 2.30, 95% CI: 1.09–4.85), having a child passenger in the vehicle (aOR = 2.15, 95% CI: 1.56–2.96), and impairment including 'had been drinking' (aOR = 7.70, 95% CI: 2.85–20.86) and 'fatigued/asleep/medical defect' (aOR = 27.15, 95% CI: 8.30–88.88) were also associated with being a driver involved in a child PMVC.

Conclusions: Age, time, impairment and distraction were risk factors for being a driver involved in a child PMVC. Because child PMVC driver characteristics differ from the general driver population, driver-based interventions are a rational additional means of preventing child PMVCs.

1. Introduction

Road traffic injury is the leading cause of death for children and youth in Canada. Thirty-three percent of child road traffic fatalities are pedestrians, compared with 11% in adults (Transport Canada, 2013). In 2013, 45 children were killed on Canada's roadways as pedestrians and some fifty times more were hospitalized with severe pedestrian injuries (Transport Canada, 2013). This amounted to an economic burden of \$437 million dollars in direct costs to Canadians (Parachute Canada, 2015). In principle, all of these deaths and hospitalizations are preventable. Prevention of child pedestrian motor vehicle collisions (PMVCs) has often focused on changing the road crossing behaviour of the child, an approach which at best is ineffective, and at worst blames the victim and is counterproductive (Brubacher et al., 2012; Duperré et al., 2002). Previous studies have examined environmental and road

characteristics associated with child PMVCs (Amoh-Gyimah et al., 2017; Koopmans et al., 2015). While the effects of pedestrian training and environmental conditions on PMVC rates have been studied, little is known about whether drivers who are involved in a child PMVC differ from the general driving population. If there are differences between drivers involved in a child PMVC and drivers in not at fault collisions future interventions may be implemented that target driver behaviour such as graduated drivers licensing programs.

Responsibility (culpability) studies have been used in the past to determine driver risk factors such as distracted driving and alcohol consumption (Asbridge et al., 2012; Salmi et al., 2014). Responsibility studies assess whether the exposure to various road and driver conditions increases the risk of being responsible for causing the crash rather than being involved in the crash (Kim and Mooney, 2016). Responsibility assignment can be based on police citations, and ratings based on

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validated tools where those scoring are blind to demographic or individual factors that could potentially bias their assessment of fault (e.g. age, sex, alcohol impairment) (Kim and Mooney, 2016). The assumption is that non-at-fault parties in vehicle-vehicle collisions represent a random sample of the population of drivers on the road (af Wählberg and Dorn, 2007; Méndez and Izquierdo, 2009). The public health perspective looks at culpability as a surrogate to causality, with the goal being to identify risk factors and potential targets for prevention and control rather than to place blame on an individual party (Salmi et al., 2014). By studying the behaviours of drivers involved in child PMVCs and potential risk factors in the environment in which these crashes occurred, we can inform policies that affect drivers such as distracted driving laws and speed limit reductions. The primary aim of our study was to examine the association of driver characteristics with child pedestrian injuries in Calgary and Edmonton Alberta, with a secondary aim to broadly describe the road characteristics surrounding these collisions.

2. Materials and methods

We used a modified quasi-induced exposure approach to examine driver characteristics associated with child PMVCs. The quasi-induced exposure method is used to estimate exposure and risks for a variety of groups of drivers and vehicles.

“In the quasi-induced exposure method, the estimate for the drivers’ exposure is derived from the distribution of not-at-fault drivers in the crash database. The key assumption is that the distribution of not-at-fault drivers closely represents the distribution of all drivers exposed to crash hazards. In other words, the distribution of the not-at-fault drivers is assumed to be a sample of the total population exposed to the particular crash hazard.” (Chandraratna and Stamatidis, 2009).

If drivers who are found to be not-at-fault in a collision are representative of the source population for child PMVCs, then by ascertaining fault across a number of motor vehicle collisions a relevant control group would be identified. We obtained data from Alberta Transportation on all police reported traffic collisions between 2010 and 2015 in Calgary and Edmonton, AB. The quasi-induced exposure approach was modified to examine driver characteristics for drivers who collided with a child pedestrian (cases). We compared the characteristics of this case group with the characteristics of a separate group of drivers who were involved in motor vehicle-only collision, but deemed not-at-fault according to an automated culpability scoring tool. This not-at-fault driver group is assumed to represent the general driving population (controls).

2.1. Culpability scoring tool

To assign responsibility for the drivers involved in vehicle-only collisions, we used an Alberta adaptation of the Canadian culpability scoring tool. Brubacher et al. developed and validated a crash culpability scoring tool capable of rapidly scoring police crash reports from large administrative data sets (Brubacher et al., 2012). The tool developed by Brubacher et al. (2012) was based on previous work by Robertson and Drummer (1994) but specific to the data used in British Columbia police traffic collision reports. Although generally similar, the way data are captured differs between provinces. Through input from provincial traffic experts (within Alberta Transportation) the scoring tool was mapped to Alberta police report data; and thus usable in an Alberta context. After mapping, reliability of the scoring tool was assessed by two raters and agreement was excellent on 175 independently rated collisions ($k = 0.95$; 95% CI: 0.92–0.99). The differences that existed between raters were discussed with traffic safety experts. Using this input, a final scoring tool and algorithm to automate this scoring was developed (Pitt et al., 2019). The final scoring tool included 7 factors: 1) road type (one vs. two-way traffic); 2) driving condition

(road surface, visibility and weather); 3) vehicle conditions; 4) unsafe driving actions; 5) contribution from other parties (if more than one party was involved); 6) type of collision (e.g. multi-vehicle/single-crash) and 7) task involved (e.g. avoiding object on the road). Drivers with a low total score (≤ 13) were coded as culpable and high total scores (≥ 16) indicated that the driver was nonculpable. A detailed description of the scoring for each criterion is available in Appendix B of the adapted scoring tool (Pitt et al., 2019).

2.2. Data analysis

The characteristics of all drivers who struck a child (i.e., driver behaviour and motor vehicle type) and the road environment where the collision occurred were reported and compared with the characteristics of those non-culpable drivers involved in motor-vehicle only collisions. Unconditional logistic regression was used to identify the determinants of a child PMVC event (cases) using the not-at-fault drivers in collisions with at least one other motor vehicle as controls. All analyses were conducted with STATA (version 12). We present descriptive road and environmental characteristics for drivers involved in a child PMVC to provide context of the crashes, however much of this information went into determining culpability and therefore cannot be used in the modeling. The criteria for selecting variables to include in our adjusted model followed the methods described by Hosmer, Lemeshow, & Sturdivant (Hosmer et al., 2013). We used purposeful selection of covariates to build our multivariable regression model (Hosmer et al., 2013). Ethics approval was received from the University of Calgary (REB17-2320).

3. Results

Of 903 collision reports reviewed for eligibility, 77 were excluded, primarily due to descriptions of pedestrians riding a scooter, skateboard, rollerblades, etc. or pedestrians being classified as a fixed object (i.e. in a restaurant when driver went through the doors, Fig. 1).

The descriptive characteristics for the eligible child pedestrians and drivers are presented in Table 1. Over one third of drivers who struck a child pedestrian failed to yield the right of way ($n = 305$, 38.5%). Most child pedestrians were struck by the front of the vehicle ($n = 487$, 61.4%) and just over half of drivers were in passenger cars ($n = 403$, 50.8%).

3.1. Pedestrian and driver characteristics

Of the 826 pedestrians involved in a child PMVC, 70.2% ($n = 580$) were between 10 and 17 years old and 54.1% were male ($n = 447$). The majority of child pedestrians struck by a motor vehicle sustained minor injuries ($n = 545$, 66.0%) and nearly one quarter sustained major injuries (i.e. required hospital admission) ($n = 196$, 23.7%) according to police officer assessment. There were 793 drivers involved in a child PMVC between 2010 and 2015 in Calgary and Edmonton, AB. The most common age and sex categories of these drivers were 40–54 years ($n = 200$, 25.2%) and just over half the sample was male ($n = 406$, 51.2%).

3.2. Road and environmental characteristics

We considered road and environmental characteristics for cases in Table 2. Child PMVCs occurred most frequently when no traffic control device was present ($n = 359$, 45.3%), in daylight ($n = 576$, 72.6%), and in clear ($n = 688$, 86.8%), dry ($n = 556$, 70.1%) conditions. Where information on road type and alignment was available, the majority of child PMVCs occurred on undivided two-way roads ($n = 212$, 26.7%) and straight roads ($n = 328$, 41.4%). Finally, two thirds of child PMVCs occurred in an intersection ($n = 516$, 65.1%). These results contextualize the group of child PMVCs, however comparison to the

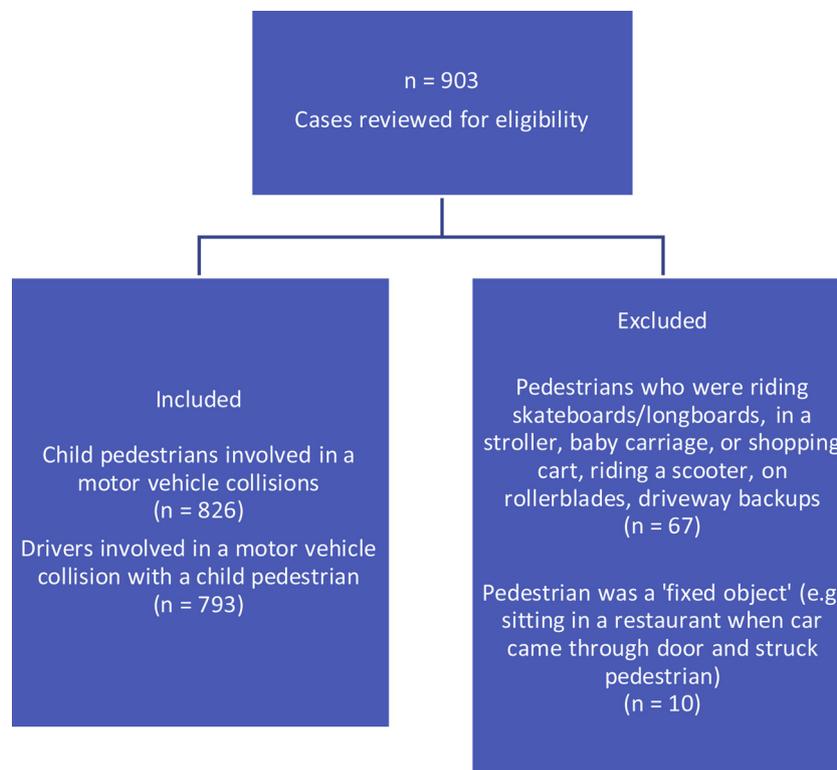


Fig. 1. Flowchart of included/excluded child PMVCs.

control group must exclude those road or environmental characteristics used in culpability scoring.

3.3. Multivariable model

The unadjusted odds ratios (ORs) and variables considered for multivariable modeling are presented in Table 3. The final model indicated that age group, time-block, seatbelt use, having passengers in the vehicle, and driver impairment were significantly associated with being involved in a child PMVC (Table 4). Drivers aged 16–24 years old (OR = 1.62, 95% CI: 1.27–2.09) and drivers ≥ 55 years old (OR = 1.57, 95% CI: 1.24–1.99) were at higher odds of child PMVC than middle aged drivers (25–39 years). Driving between the hours of 06:01– 09:00 (OR = 1.46, 95% CI: 1.16–1.85) and 18:01– 24:00 (OR = 1.68, 95% CI: 1.30–2.17) were significantly associated with increased odds of child PMVC compared with driving between 15:01 – 18:00. Conversely, driving between 00:01 – 06:00 (OR = 0.34, 95% CI: 0.16 – 0.74) decreased odds of being involved in a child PMVC. Drivers who were not wearing a seatbelt were 2.3 times more likely to be in a child PMVC (95% CI: 1.09–4.35). Drivers who had a child passenger were at increased odds of a child PMVC (OR = 2.15, 95% CI: 1.56–2.96) compared with those with no passengers. Drivers who had an adult passenger were at decreased odds for a child PMVC (OR = 0.47, 95% CI: 0.31–0.71). Finally, drivers who had been drinking (OR = 7.70, 95% CI: 2.85–20.86) as well as those drivers who were fatigued/asleep or had a medical defect (OR = 27.15, 95% CI: 8.30–88.88) were also at greater odds of being involved in a child PMVC compared with those who were coded as “apparently normal” in the police collision report.

4. Discussion

In this study, child PMVCs involved older children (10–17) 70% of the time, and children 9 and under 30% of the time. The ages of drivers involved in child PMVCs included a higher proportion of both young (16–24) and older (> 55) drivers compared with the control group.

Most drivers struck child pedestrians with the front of the vehicle and over one third failed to yield the right-of-way. Child pedestrians most frequently sustained minor injuries. Considering the road and environment, child PMVCs occurred most frequently when no traffic control device was present, during daytime, and in clear and dry conditions.

The multivariable model showed that driver age, time-block, seatbelt use, having child passengers in the vehicle, and impairment were all significantly associated with increased odds of child PMVCs. Being a younger (16–24) or older (55+) driver increased the odds of child PMVCs. The at-risk time blocks included both the morning and the afternoon commute and school trip period. Non-use of seatbelts, driving impaired, and carrying a child passenger conferred a statistically significant increase in child PMVC risk, but applied to a minority of drivers.

Similar findings have been previously reported in other studies, Koopmans et al. studied urban crash-related child pedestrian injuries in Chicago IL (Koopmans et al., 2015). They found that most crashes occurred at sites with no traffic control devices, and crashes were more likely to occur during daytime on clear, dry roads for young children. Amoh-Gymah et al. (2017) also found that pedestrian crashes occurred most often during the daytime, in clear and dry conditions, and at non-signalized intersections. Another study from San Francisco CA used 10 years of crash data to examine key determinants of crash severity for pedestrians and cyclists; fault was determined by the police officer at the scene (Salon and McIntyre, 2018). The authors concluded that the strongest associations for crashes involving pedestrians are advanced age (69+ years), driver impairment, vehicle type, and environmental factors such as daylight, highway status, driver turning, speed limit, and time of crash (Salon and McIntyre, 2018). Although we were unable to analyze environmental factors in our study because they were used in determining culpability, our study showed similar findings with respect to driver age, sobriety, and time of crash. In contrast to our study however, Maasalo et al. (2016) found that male drivers with a child passenger (0–17 years) were less often culpable than female drivers

Table 1
Descriptive Characteristics of Pedestrians and Drivers involved in child PMVCs.

	Pedestrian n = 826 (%)	Driver n = 793 (%)
Age Group		
1 – 9 years	246 (29.8%)	–
10 – 17 years	580 (70.2%)	38 (4.8%)
18 – 25 years	–	99 (12.5%)
26 – 39 years	–	191 (24.1%)
40 – 54 years	–	200 (25.2%)
55+ years	–	160 (20.2%)
Missing	–	105 (13.2%)
Sex		
Male	447 (54.1%)	406 (51.2%)
Female	376 (45.5%)	308 (38.8%)
Unknown/Missing	3 (0.4%)	79 (10.0%)
Injury Severity		
Minor Injury	545 (66.0%)	–
Major Injury	196 (23.7%)	–
None	78 (9.4%)	–
Fatal	5 (0.6%)	–
Missing	2 (0.3%)	–
Driver Action		
Fail to Yield Right-of-Way Pedestrian	–	305 (38.5%)
Driving Properly	–	276 (34.8%)
Unknown	–	115 (14.5%)
Other	–	61 (7.7%)
Backed Unsafely	–	20 (2.5%)
Improper Turn	–	15 (2.0%)
Impact Location		
Front	–	487 (61.4%)
Right Side	–	142 (17.9%)
Left Side	–	93 (11.7%)
Back	–	20 (2.5%)
Other	–	51 (6.5%)
Vehicle Type		
Passenger Car	–	403 (50.8%)
Truck/Van/SUV	–	346 (43.6%)
Commercial	–	18 (2.3%)
Other	–	3.3%

who were traveling with a child passenger between 0 and 4 years of age. However, the outcome in Maasalo et al.'s study was crash culpability as opposed to child PMVCs. Maasalo used multidisciplinary road collision investigation teams to assign responsibility instead of an automated culpability tool, which could reflect a reporting bias. We found that drivers were at 2.15-fold higher odds of being involved in a child PMVC when they had a child passenger in the vehicle. This finding may be attributed to travel times as drivers are more likely to have a child passenger in the car during morning and afternoon school drop off times. Similarly, certain time periods (early morning and late afternoon) may also be related to visibility conditions (i.e. dawn and dusk).

4.1. Implications

Past studies have focused on child pedestrian training programs and modifying children's road crossing behaviors, which has proven to be ineffective according to systematic reviews (Duperrex et al., 2002). A more promising avenue to prevent fatal injuries lies with policies affecting drivers (e.g., distracted driving laws, speed limit reductions) and with environmental modifications (e.g., traffic calming strategies). Different interventions may be needed for drivers at the young and old age of the driving spectrum, as the crashes may be related to inexperience for young drivers, and sensory, cognitive, or physical decline in older drivers. Graduated driver's licensing programs for example could be modified so that training focuses on vulnerable road users for new drivers, and virtual reality technology such as driving simulators may be used to renew licenses for older drivers (Albert et al.,

Table 2
Road and environmental characteristics of child PMVCs.

	n = 793 (%)
Traffic Control Devices	
None	359 (45.3%)
Traffic Signals/Lights	176 (22.2%)
Cross Walk	166 (20.9%)
Signs (Stop/Yield/Merge)	56 (7.1%)
Other/Missing	36 (4.5%)
Lighting Condition	
Daylight	576 (72.6%)
Darkness	156 (19.7%)
Sunglare	42 (5.3%)
Unknown	19 (2.4%)
Environmental Condition	
Clear	688 (86.8%)
Raining	36 (4.6%)
Snow	32 (4.0%)
Hail/Sleet	5 (0.6%)
Other/Missing	32 (4.0%)
Surface Condition	
Dry	556 (70.1%)
Slush/Snow/Ice	116 (14.6%)
Wet	83 (10.5%)
Loose Surface Material	6 (0.8%)
Other/Missing	32 (4.0%)
Road Type	
Undivided two way	212 (26.7%)
Divided with barrier	94 (11.8%)
Divided with no barrier	28 (3.5%)
Undivided one way	12 (1.5%)
Other/Missing	447 (56.4%)
Road Alignment	
Straight	328 (41.4%)
Curved	27 (3.4%)
Other/Missing	438 (55.2%)
Location	
Non-Intersection	277 (34.9%)
Intersection	516 (65.1%)

2018).

4.2. Strengths

This is the first study to our knowledge that uses a culpability analysis approach to determine the characteristics of drivers, pedestrians, and the environment in which child PMVCs occur. Induced exposure studies assume that non-culpable drivers are representative of the characteristics of the general population of drivers (Salmi et al., 2014). Culpability analysis provides researchers with new opportunities to obtain control groups in a quick and cost-effective way. The major strength of this study is that we were able to obtain nearly 300,000 controls by applying a modified version of Brubacher et al. culpability scoring tool (Pitt et al., 2019).

4.3. Limitations

We used an automated culpability scoring tool to obtain our non-culpable control group in this study; therefore, we could not analyze any variables in our multivariable model that were used in determining culpability. These variables included: road type, driving condition, vehicle condition, unsafe driving actions, contribution from other parties, type of collision, and task involved. Table 2 presents the road and environmental characteristics associated only with child PMVCs (cases) as these variables are used to provide the context in which these collisions occurred. Similar summaries for the control group were omitted as the control group road and environmental characteristics were a function of our selection of non-culpable crashes.

Table 3
Unadjusted odds ratios (95% CI) for candidate variables ($p \leq 0.2$) for multivariable modelling.

	Cases n = 793 (%)	Controls n = 293,835 (%)	OR (95% CI)
Age			
16 – 24 years	127 (16.0%)	40,754 (13.9%)	1.58 (1.26 – 1.97)
25 – 39 years	201 (25.4%)	101,606 (34.6%)	1.00 (reference)
40 – 54 years	200 (25.2%)	88,893 (30.3%)	1.14 (0.93 – 1.38)
55+ years	160 (20.2%)	57,304 (19.5%)	1.41 (1.15 – 1.74)
Missing	105 (13.2%)	5278 (1.7%)	–
Sex			
Male	406 (51.2%)	172,140 (58.6%)	1.00 (reference)
Female	308 (38.8%)	118,799 (40.4%)	1.10 (0.95 – 1.27)
Missing	79 (10.0%)	2896 (1.0%)	–
Vehicle Type			
Passenger Car	403 (50.8%)	142,089 (48.4%)	1.00 (reference)
Truck/Van/SUV	333 (42.0%)	137,319 (46.7%)	0.86 (0.74 – 0.99)
Commercial	28 (3.5%)	9352 (3.2%)	1.05 (0.72 – 1.55)
Missing	29 (3.7%)	5075 (1.7%)	–
Time Block			
00:01 – 06:00	18 (2.3%)	11,812 (4.0%)	0.62 (0.38 – 1.01)
06:01 – 09:00	198 (25.0%)	48,036 (16.3%)	1.69 (1.39 – 2.06)
09:01 – 12:00	72 (9.1%)	47,979 (16.3%)	0.61 (0.47 – 0.80)
12:01 – 15:00	168 (21.2%)	66,928 (22.8%)	1.03 (0.84 – 1.26)
15:01 – 18:00	199 (25.1%)	81,470 (27.8%)	1.00 (reference)
18:01 – 24:00	137 (17.2%)	35,286 (12.0%)	1.59 (1.28 – 1.98)
Missing	1 (0.1%)	2324 (0.8%)	–
Day of Week			
Weekday	674 (85%)	234,277 (79.7%)	1.00 (reference)
Weekend	119 (15%)	59,558 (20.3%)	0.69 (0.57 – 0.84)
Seatbelt			
Yes	560 (70.6%)	257,215 (87.5%)	1.00 (reference)
No/Other	7 (0.9%)	1501 (0.5%)	2.14 (1.01 – 4.52)
Missing	226 (28.5%)	35,119 (12.0%)	–
Passengers			
None	695 (87.6%)	248,579 (84.6%)	1.00 (reference)
Child Passenger	46 (5.8%)	10,222 (3.5%)	1.61 (1.19 – 2.17)
Adult Passenger	33 (4.2%)	25,235 (8.6%)	0.47 (0.33 – 0.66)
Both Passengers	7 (0.9%)	4957 (1.7%)	0.51 (0.24 – 1.06)
Missing	12 (1.5%)	4842 (1.6%)	–
Impaired			
Apparently Normal	633 (79.8%)	258,081 (87.8%)	1.00 (reference)
Had Been Drinking	7 (0.9%)	335 (0.1%)	8.52 (4.01 – 18.08)
Impaired by Alcohol or Drugs	1 (0.1%)	170 (0.1%)	2.39 (0.34 – 17.15)
Fatigued/Asleep/Medical Defect	4 (0.5%)	56 (0.0002%)	29.12 (10.53 – 80.55)
Missing	148 (18.7%)	35,193 (12.0%)	1.71 (1.43 – 2.05)

We could not assign culpability to the cases in the study as the Alberta Transportation traffic collision reports do not have fields that explicitly outline child pedestrian actions in a collision with a motor vehicle.

Although we used a method that has been validated, there is no perfectly accepted assessment of culpability. However, we have automated our assessment tool, consulted with traffic experts, and used consistent criteria as [Brubacher et al. \(2012\)](#) and [Robertson and Drummer \(1994\)](#) to try to ensure that our assessment of culpability reflected a random sample of the driving population.

We found that 90% of individuals involved in a collision were injured and so the characteristics of collisions with no injured parties may be underrepresented. Although we reviewed the collision descriptions to determine case eligibility, there is a possibility that some cases could have incorrectly been coded as bicyclists and therefore excluded (e.g. if a pedestrian was walking with their bicycle but the collision description said “bicyclist crossing at a crosswalk”).

Both behavioural characteristics and exposure can influence crash risk, but these differences are often difficult to disentangle. Differences related to increased exposure include factors such as driver age and experience. These factors may have direct effects on behaviour and crash risk for the driver, child pedestrian, or both parties. However, in

our study, the use of a non-culpable control group provides information on the exposure distribution of all drivers. We also examined some characteristics that could be proxies for behaviour in our study including age and sex. Additionally, older drivers may drive more frequently in areas with higher pedestrian densities such as urban environments and on local streets as opposed to larger urban thoroughfares. Therefore, increased odds of child PMVC for older drivers may be related to differences in exposure ([Benekohal et al., 1994](#); [Charlton et al., 2006](#); [Keall and Frith, 2006](#); [Oxley et al., 2010](#)).

5. Conclusions

Culpability studies allow researchers to examine child pedestrian and driver characteristics as well as modifiable risk factors within the environment that could influence collision risk. Higher risk age groups, certain time periods, impairment and distraction are all important risk factors to consider when examining collisions with vulnerable road users. Policy implications include considering effective means of modifying driver risk behaviour to potentially reduce collisions with vulnerable road users.

Table 4
Multivariable logistic regression comparing drivers involved in child PMVC and drivers deemed not-at-fault in vehicle-only collisions.

	OR	95% Confidence Interval
Age		
16 – 24 years	1.62	1.27 – 2.09
25 – 39 years	1.00	Reference
40 – 54 years	1.23	0.99 – 1.53
55 years +	1.57	1.24 – 1.99
Time Block		
00:01 – 06:00	0.34	0.16 – 0.74
06:01 – 09:00	1.46	1.16 – 1.85
09:01 – 12:00	0.52	0.38 – 0.73
12:01 – 15:00	0.99	0.78 – 1.26
15:01 – 18:00	1.00	Reference
18:01 – 24:00	1.68	1.30 – 2.17
Seatbelt		
Yes	1.00	Reference
No	2.30	1.09 – 4.85
Passengers		
None	1.00	Reference
Child passenger	2.15	1.56 – 2.96
Adult passenger	0.47	0.31 – 0.71
Both passengers	0.66	0.30 – 1.49
Impaired		
Apparently Normal	1.00	Reference
Had Been Drinking	7.70	2.85 – 20.86
Impaired by Alcohol or Drugs	–	–
Fatigued/Asleep/Medical Defect	27.15	8.30 – 88.88
Missing	0.60	– 0.85

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Declaration of Competing Interest

The authors have no competing interests relevant to this article to disclose.

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