Effects of Large Vehicles on Pedestrian and Pedal-Cyclist Injury Severity

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Abstract

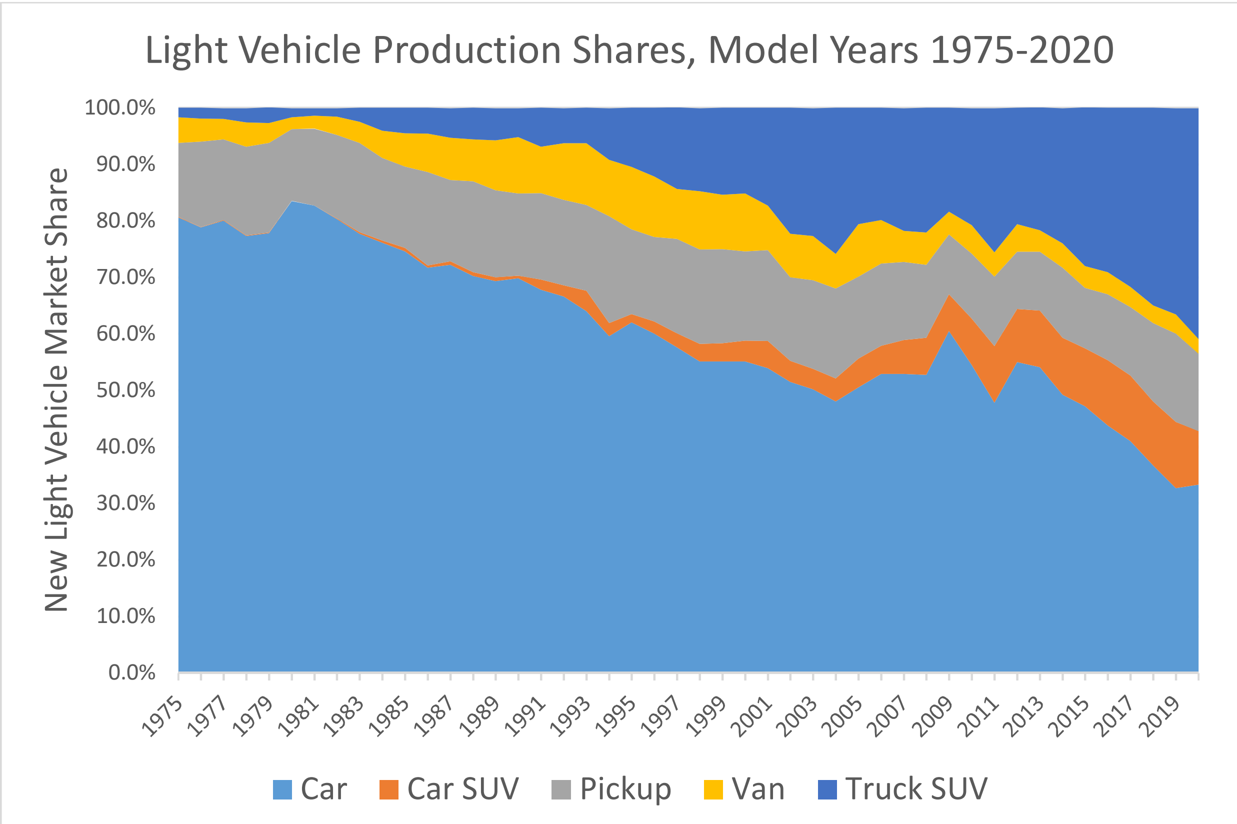
Fatal pedestrian and pedal-cyclist crashes have been on the rise in the U.S. since 2009. This rise in fatalities coincides with the rise of large vehicles on American roadways, continuing a trend that began years earlier. Through rare access to both crash and hospital records, this report investigates the relationship between striking vehicle type and medical outcomes of pedestrian and pedal-cyclist cases. Results suggest that children are eight times more likely to die when struck by a SUV compared to those struck by a passenger car. Passenger cars were the striking vehicle in most fatal pedestrian and pedal-cyclist crashes, though they were underrepresented relative to the proportion of all crashes in which they were involved. Though pickup trucks were the striking vehicle in just 5.6% of pedestrian and pedal-cyclist crashes, they were involved in 12.6% of fatalities. SUVs were similarly overrepresented in fatalities relative to the proportion of their involvement in all crashes. SUVs struck 14.7% of the pedestrians and pedal-cyclists investigated here, but were involved in 25.4% of the fatalities. Head and thorax injury severities are examined by vehicle type and age. Hospital charges of pedestrian and pedal-cycle crash victims are also analyzed by striking vehicle type and victim age. Findings suggest larger vehicles are involved in pedestrian and pedal-cyclist crashes with more severe injuries that result in higher hospital charges. Blacks are also found to be overrepresented as pedestrian and pedal-cyclist crash victims.

1. Introduction

Pedestrian and pedal-cyclist fatalities in the U.S. have been rising in recent years even as fatalities for motorists has declined or remained relatively flat (Coleman and Mizenko, 2018). Fatalities among motorists, pedestrians, and pedal-cyclists alike were on the decline in the U.S. starting around 1980. But in 2009 the data trend lines diverged as pedestrian and pedal-cyclist fatalities began rising (Arias et al., 2021). In fact, from 2010 to 2019 pedestrian fatalities increased by 46% to 6,301 deaths in 2019 (GHSA, 2021). Further, in 2016, which corresponds to this study's timeframe, 4,074 children were killed in motor vehicle crashes in the U.S. – making crashes the number one killer of American children (Cunningham, et al., 2018).

The 1980's saw the production and sales volume of large motor vehicles begin to command an increasing share of the U.S. automobile market (Figure 1). Large vehicles are commonly considered those classified as light trucks: pickup trucks, SUVs, and vans/minivans – a consideration also applied here. But is the growing American predilection for large vehicles associated with increased pedestrian and pedal-cyclist fatalities? By one estimate, the external cost of one person choosing to drive one large motor vehicle rather than a passenger car on pedestrian death risk alone is \$75, \$98, and \$114 per year for each SUV, pickup truck, and van/minivan respectively (Tyndall, 2021). Still, a growing number of Americans are choosing large motor vehicles over the traditional passenger car. Figure 1 depicts the diminishing share of car production over the past decades as it gave way to the growing "Truck SUV," "Car SUV," and "Pickup" categories. In fact, passenger car sales in the U.S. dropped at an annual rate of 2.4% from 2008 to 2018 alone, while pickup truck sales increased at an annual rate of 6.4% (Davis and Boundy, 2020). In 2008 light trucks were about 40% of light vehicles produced, in 2018 they were nearly half (Ibid).

*Figure 1: Light vehicle production shares, model years 1975-2020**



**Created by authors using EPA data*

Larger vehicles not only produce excess carbon emissions but may also pose a greater threat to pedestrian and pedal-cyclist safety. Tyndall (2021) uses pedestrian fatality data from across the United States to estimate that a 100kg increase in average motor vehicle weight correlates with a 2.4% increase in pedestrian fatalities for a median fatality rate region. He further finds that converting 10% of a regional vehicle fleet from cars to light trucks correlates with a 3.6% increase in fatal pedestrian crashes (Ibid). Desapriaya et al. (2010) estimate in their meta-analysis that pedestrians struck by a pickup truck were 50% more likely to be killed compared to those struck by a passenger car. Roudsari et al. (2004) find that those hit by light trucks (including SUVs, vans/minivans, and pickup trucks) had higher rates of severe brain injury (33%) relative to those hit by cars. In their review of the pedestrian safety literature, Doggett et al. (2018) find that unreported pedestrian and pedal-cyclist crashes underestimate injuries by 21%. They find that crashes are more likely to go unreported if the pedestrian or pedal-cyclist is less likely to receive an insurance payout, Black, or male. Crashes that happened on a state road, Y-intersection, or divided highway were also less likely to be reported. These studies imply the true scope of pedestrian and pedal-cyclist crashes is likely worse than can be estimated by relying only on crash databases. What we *do* know by relying on crash databases is that pedestrian and pedal-cyclist crashes disproportionately affect poor and minority communities, though perhaps to a greater degree than previously believed (GHSA, 2021). Further, Braun et al. (2021) find that the health risks associated with cycling in Los Angeles (pollution, injury, fatality) are disproportionately high among communities of lower income, lower educational attainment, and greater proportions of racial/ethnic minorities.

There is still much to learn. This paper aims to contribute by utilizing uncommon government agency access to crash and hospital records to investigate those who are disproportionately affected by pedestrian and pedal-cyclist crashes – especially those most vulnerable among us.

2. Sources and methods

Linking crash and hospital data files

Funded by a grant from the Centers for Disease Control and Prevention, the Illinois Department of Public Health in collaboration with the Illinois Department of Transportation and the University of Illinois at Springfield successfully linked Illinois crash and hospital records for the years 2016 through 2018. The linkage was accomplished using an advanced method developed in the National Highway Traffic Safety Administration's Crash Outcome Data Evaluation System program (McGlincy, 2021). Using LinkSolv software to complete the linkage, a combination of data fields were identified as those with the highest success rate: county, victim age, crash date, victim date of birth, and victim sex. Cook County, home to Chicago, is where some 40% of the Illinois population resides, effectively making county a relatively indiscriminate match field – which is a factor controlled for in the LinkSolv software. Two versions of data are applied here and communicated in the text of which version is used for each analysis. The report begins with an analysis of the crash file alone to investigate the effect of vehicle type on pedestrian and pedal-cyclist fatalities, as the crash file is considered the authoritative source for fatalities. The second half of the report employs only linked crash and hospital data, as this permits a higher fidelity investigation of bodily injury location, severity, and ultimately hospital charges. These linked files are critical in our understanding of the effects of motor vehicles on the lives of the citizens of Illinois. Such an investigation as presented here would not be possible without the successful linkage of the disparate crash and hospital files.

Data independence and strength of association

Some 69.4% of linked crash and hospital pedestrian and pedal-cyclist records occurred in Cook County, and an additional 11% of linked records are in counties bordering Cook County. This fact may result in some data bias, manifesting in the analysis results skewing toward the characteristics of Cook County. When appropriate throughout this paper cases are disaggregated between Chicago and the rest of Illinois for analysis. Given the nature of data linkage and innate inaccuracy in records, the data are likely incomplete and may contain mismatched records despite using advanced linking software and methods. Still, the Pearson's chi-squared alpha value and Cramer's-V are presented in each table to demonstrate both variable independence and the strength of association between variables.

Logistic regression model

A logistic regression was performed to estimate the effects of vehicle type, road conditions, and victim demographics on the likelihood of a fatal pedestrian or pedal-cyclist crash event occurring. Full results are presented below in the Results portion of this manuscript. The logistic regression model was statistically significant with a Chi-square value of 146, 18 degrees of freedom, and a *p* value of less than 0.000. The model correctly classified 98% of cases and explains about 14% (Nagelkerke R^2) of the variance in fatal pedestrian and pedal-cyclist crash events.

3. Results

Summary statistics

The analysis begins within the unlinked crash file, which contains an aggregated 23,090 pedestrian and pedal-cyclist cases across 2016, 2017, and 2018. Some 14,552 cases (63%) involved a pedestrian, and 8,538 cases (37%) involved a pedal-cyclist. Pedestrians were overrepresented in the 477 fatalities reported by police with 85.5% of deaths; the remaining 14.5% were pedal-cyclists. Of note, if not specified throughout this report pedestrians and pedal-cyclists are considered together. In 14,324 cases (62%) the striking vehicle was classified as a passenger vehicle, commonly referred to as a car. In 3,396 (14.7%) cases the striking vehicle was classified as a sport utility vehicle (SUV). Vans/minivans and pickup trucks were the striking vehicle classifications in 1,343 (5.8%) and 1,291 (5.6%) cases, respectively. Thirteen various other motor vehicle classifications comprised the remaining 11.8% of cases.

Injury severity by striking vehicle type

Taller and heavier vehicle types, like pickup trucks, SUVs, and vans/minivans combined to make up just 26.1% of pedestrian and pedal-cyclist crashes, but were the striking vehicle in 44.1% of fatalities (Table 1). SUVs were especially overrepresented in fatalities. Though SUVs were the striking vehicle in 14.7% of cases, they were involved in greater than one-in-four (25.4%) fatalities. Pickup trucks were also overrepresented in fatal pedestrian and pedal-cyclist crashes relative to the proportion of all cases. Of all pedestrian and pedal-cycle fatalities, 12.6% involved a pickup truck – some two and a quarter times the proportion of all cases involving a pickup. Conversely, though passenger cars were the striking vehicle in 62% of cases, they were involved in just 38.4% of fatalities. Though males made up about 62% of pedestrian and pedal-cyclist crash victims, they were overrepresented in fatalities at about 72% of cases.

*Table 1: Injury severity distribution of pedestrians and pedal-cyclists by striking vehicle type cross tabulated and totaled by columns for Illinois 2016-18 (counts in parentheses)**

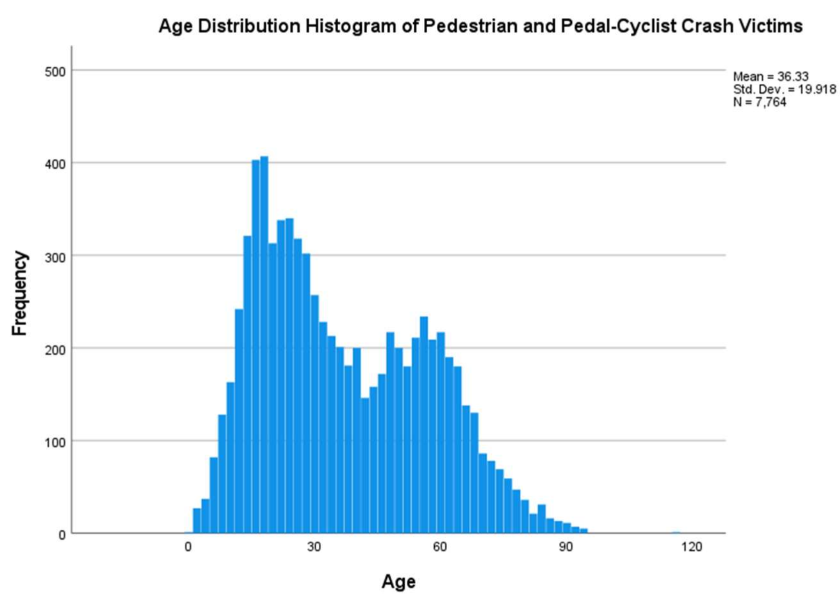
	Injury Severity					
Vehicle Type	O	C	B	A	K	**% of all**
Passenger Car	64.7% (534)	64.7% (4,099)	62.5% (7,257)	58.6% (2,251)	38.4% (183)	62% (14,324)
Pickup Truck	4.5% (37)	5.1% (323)	5.2% (603)	7.0% (268)	12.6% (60)	5.6% (1,291)
SUV	14.9% (123)	14.2% (897)	14.4% (1,673)	15.1% (582)	25.4% (121)	14.7% (3,396)
Van/Minivan	4.4% (36)	5.6% (353)	6.0% (693)	6.0% (232)	6.1% (29)	5.8% (1,343)

**Other vehicle types not presented in table (columns do not total 100%); K: Fatality, A: Incapacitating Injury, B: Non-incapacitating injury, C: Possible injury, O: No indication of injury; Pearson chi-square alpha value <0.01, Cramer's-V = 0.15*

Injury severity by age distribution

Figure 2 demonstrates the bimodal age distribution of pedestrian and pedal-cyclist crash victims. Victim age distribution roughly follows the shape of age distribution across Illinois, though the peaks in either mode are taller here. One explanation, among others, for the tall bimodal distribution may be that those at the top and bottom of the age distribution have a diminished capacity to drive, and thus walk and cycle more frequently while increasing their exposure to motor vehicle traffic. Further, the most frequently occurring victim age was 15 followed by age 14, representing 2.8% and 2.7% of all pedestrian and pedal-cycle crash victims, respectively. The following section investigates the distribution of injury severity across age groups in more detail.

Figure 2: Age distribution of linked pedestrian and pedal-cyclist crash victims in Illinois 2016-18



Injury severity by age and striking vehicle type

A useful way to study the danger posed to pedestrians and pedal-cyclists by vehicle type is to investigate whether certain types cause more severe injuries more frequently. One would expect injury severity levels to be roughly evenly distributed across vehicle types in proportion to the frequency with which each vehicle type is involved in a pedestrian or pedal-cyclist crash. But injury severities were not roughly evenly distributed. Large and heavy vehicles caused much more damage to human bodies relative to passenger cars; though passenger cars also caused many severe injuries.

A child (under age 18) struck by a SUV was eight times more likely to be killed than a child struck by a passenger car (Table 2). An adult (aged 18-64) struck by a pickup truck was four times more likely to be killed than an adult struck by a passenger car. And a senior (aged 65 and over) struck by a pickup truck was nearly three times more likely to be killed compared to a senior struck by a passenger car.

In every age group passenger cars represented the greatest proportion of fatalities, though they were underrepresented relative to the proportion of cases in which they were involved. For example, passenger cars were the striking vehicle in almost 62% of pedestrian and pedal-cyclist crashes involving children, but just about 19% of childhood fatalities.

In contrast, the proportion of fatalities involving pickup trucks was more than double the overall proportion of pickup trucks involved in pedestrian and pedal-cyclist crashes for all age groups. For example, pickup trucks were the striking vehicle in 6.1% of all cases involving seniors, but represent 13.5% of all senior pedestrian and pedal-cyclist fatalities.

SUVs were particularly deadly for children. SUVs were the striking vehicle in greater than 40% of childhood fatalities, even though SUVs were involved in just 16.9% of childhood cases. Further, children represented 21% of all pedestrian and pedal-cyclist crash victims but 26.1% of cases involving SUVs – implying SUVs were not only more deadly, but also disproportionately struck children. Vans/minivans are also overrepresented in cases involving childhood fatalities. Just under 6% of child pedestrians and pedal-cyclists were struck by a van/minivan, but 12.5% of childhood fatalities involved a van/minivan. Together, SUVs, pickup trucks, and vans/minivans combined to cause two-thirds of fatalities involving child pedestrians and pedal-cyclists (Table 2).

*Table 2: Injury severity distribution by striking vehicle type and age group**

Age Group	Vehicle Type		K	A	B	C	O	Total
			Injury Severity Scale					
Under 18	Passenger Car	Within Cars	0.2%	12.9%	55.7%	28.1%	3.1%	100%
		Within Severity	18.8%	57.8%	61.9%	64.8%	60.9%	61.8%
	Pickup Truck	Within Pickups	1.4%	19.0%	52.0%	24.5%	3.1%	100%
		Within Severity	12.5%	8.4%	5.7%	5.6%	6.0%	6.1%
	SUV	Within SUVs	1.6%	14.3%	57.4%	23.6%	3.1%	100%
		Within Severity	40.6%	17.5%	17.4%	14.9%	16.6%	16.9%
	Van/Minivan	Within Vans	1.4%	15.9%	55.1%	25.1%	2.5%	100%
		Within Severity	12.5%	6.8%	5.8%	5.5%	4.6%	5.9%
	Counts		32	664	2,679	1,290	151	
18-64	Passenger Car	Within Cars	1.2%	16.1%	50.4%	29.2%	3.1%	100%
		Within Severity	36.9%	58.5%	62.7%	64.8%	65.5%	62.1%
	Pickup Truck	Within Pickups	4.8%	21.8%	45.3%	25.2%	2.8%	100%
		Within Severity	12.6%	7.0%	5.0%	4.9%	5.2%	5.5%
	SUV	Within SUVs	3.6%	18.0%	47.9%	27.9%	2.7%	100%
		Within Severity	23.7%	14.6%	13.3%	13.8%	12.7%	13.9%
	Van/Minivan	Within Vans	2.0%	16.8%	52.1%	27.1%	2.0%	100%
		Within Severity	5.5%	5.7%	6.0%	5.6%	3.9%	5.8%
	Counts		325	2,657	7,776	4,364	458	
65+	Passenger Car	Within Cars	4.6%	22.4%	47.7%	23.9%	1.5%	100%
		Within Severity	47.7%	60.8%	62.7%	63.7%	60.7%	61.6%
	Pickup Truck	Within Pickups	13.2%	16.7%	43.9%	25.4%	0.9%	100%
		Within Severity	13.5%	4.5%	5.7%	6.7%	3.6%	6.1%
	SUV	Within SUVs	9.8%	21.7%	45.8%	21.0%	1.7%	100%
		Within Severity	26.1%	15.0%	15.3%	14.3%	17.9%	15.7%
	Van/Minivan	Within Vans	5.5%	27.6%	40.9%	23.6%	2.4%	100%
		Within Severity	6.3%	8.2%	5.9%	6.9%	10.7%	6.8%
	Counts		111	426	881	435	28	

**Other vehicle types not presented in table (columns do not total 100%); K: Fatality, A: Incapacitating Injury, B: Non-incapacitating injury, C: Possible injury, O: No indication of injury; All Pearson chi-square alpha values <0.01, Cramer's-V: Under 18: 0.191, 18-64: 0.17, 65+: 0.15*

Logistic regression model results

The logistic regression model used the linked data file, so both crash and hospital records were used to estimate the effects of crash characteristics on a fatal event occurring. Six variables are predicted to add significantly to the model at the 5% level: pickup truck, SUV, van/minivan, intersection, child, and senior. Since the explanatory variables are binary, the odds ratio value is the true value of the estimated effect on the likelihood of a fatal crash. For example, the model estimates that a pedestrian or pedal-cyclist struck by a pickup truck was 4.7 times more likely die as a result. Those struck by a SUV or van were 3.37 times and 4.58 times more likely to be killed, respectively.

Difficulty in recording accurate crash data may contribute to some of the variables not significantly contributing to the logistic model. The day of week of the crash variable is a relatively easy data point to collect at the crash scene, yet does not add significantly to the model. Yet other crash factors that also do not add significantly to the model are relatively more difficult to accurately record in the crash report. Fields such as "distracted," "impaired," and "speed" are intuitively related to a higher propensity for a fatal crash event occurring, but the model does not reflect this. A driver could simply self-report to police at the crash scene that they were neither distracted nor speeding, and without sufficient evidence to the contrary the crash file would record such an assertion. Both the crash file and the hospital file record fields indicative of substance use impairment. Police at the crash scene record whether the evidence present warrants flagging the case as impaired. The hospital records reflect a medical substance test conducted at the hospital and the subsequent positive or negative diagnoses. Several variations of the impaired field variable from both the crash and hospital files were attempted in preparation for the logistic regression model, none were estimated to add significantly to the model. That impairment does not significantly add to the model is probably more indicative of administrative record-keeping shortcomings than of a diminished role of impairment on pedestrian and pedal-cyclist crash fatalities. The model results presented in Table 3 uses the binary impaired field from the crash file.

*Table 3: Logistic regression modeling the likelihood of a fatal pedestrian or pedal-cyclist crash occurring**

Variable	*Coefficient*	*Odds Ratio*	*Significance*
Passenger Car	.146	1.16	.651
Pickup Truck	**1.55**	**4.70**	**.000**
SUV	**1.22**	**3.37**	**.000**
Van/Minivan	**1.52**	**4.58**	**.000**
Weekend	.111	1.12	.609
Rural	-.309	.734	.271
Distracted	.187	1.21	.695
Impaired	.029	1.03	.952
Speed	.350	1.42	.128
Intersection	**-.707**	**.493**	**.000**
Female	-.366	.694	.077
Child	**-1.13**	**.322**	**.005**
Senior	**1.55**	**4.72**	**.000**
Race: White	.081	1.09	.760
Race: Black	-.687	.503	.063
Race: Asian	-.277	.758	.630
Ethnicity: Hispanic	-1.12	.326	.155

Variables that add significantly to the model at the 5% level appear in **bold*

The logistic regression model suggests that intersections are somewhat protective of pedestrians and pedal-cyclists – estimating a diminished likelihood of a fatal crash occurring at an intersection. Succeeding sections of this paper demonstrate that relatively large vehicles were deadlier for all crash victims, including children. Yet, intuitively, the model implies that being a child is associated with a greater likelihood of surviving being struck by any vehicle type, while being a senior is associated with an increased likelihood (4.72 times) of death when struck.

Though the logistic regression model is useful in estimating statistically significant factors associated with an event occurring, fatal pedestrian and pedal-cyclist crashes in this case, it is somewhat of a blunt instrument. A finer, more nuanced investigation is necessary to achieve a richer understanding of the factors related to these fatal crashes. The following sections are an attempt at deepening that understanding.

Head and thorax injury severity by vehicle type

Similar to the logistic regression model presented above, this section uses only those pedestrian and pedal-cyclist cases in which the crash and hospital files were successfully linked (7,764 cases; 36%). Pedal-cyclists made up about 34% of linked cases, and were victims in about 37% of crashes reported by police. This proportionate representation of pedestrians and pedal-cyclists implies the linked data were not biased toward either transport mode.

Since large motor vehicles are commonly taller than a passenger car, one would expect more severe injuries to a pedestrian's or pedal-cyclist's thorax and head. This is because when a relatively short passenger car strikes a pedestrian it likely makes contact with the victim's legs while forcing the upper body onto the car hood. When a taller, heavier motor vehicle strikes a pedestrian it is more likely to strike the victim's body (thorax) and head while also knocking them to the street and potentially running them over (Roudsari et al., 2004).

Table 4 shows that each vehicle type studied is overrepresented in their proportion of non-minor head injuries relative to their overall involvement in striking pedestrians and pedal-cyclists. (Other vehicle types not analyzed here, like ATV or Farm Equipment, are likely underrepresented in non-minor head injuries.) For example, SUVs were involved in 13.5% of linked pedestrian and pedal-cyclist crashes but 16.2% of cases with a non-minor head injury. Looking at the proportion of non-minor head injuries within vehicle types offers a bit more insight. For example, greater than 11% of pedestrians and pedal-cyclists struck by a pickup truck had a non-minor head injury compared to 9.5% of those struck by a passenger car. For children, 12.7% and 11% of cases involving a van/minivan and a pickup truck resulted in a non-minor head injury, respectively.

Pedestrians and pedal-cyclists struck by a large motor vehicle were more likely to suffer moderate or worse injuries to their thorax compared to those struck by a passenger car (Table 4). Though the proportion of pickup trucks involved in all cases examined here was 5.6%, that proportion nearly doubles to 11.1% of all non-minor thorax injuries. Further, nearly 10% of all occurrences of a pickup truck striking a pedestrian or pedal-cyclists resulted in a non-minor thorax injury. For passenger cars, only 3.8% of occurrences resulted in such injuries. Finally, though passenger cars represent 54.1% of all cases here they are underrepresented as causing non-minor thorax injuries at 42.1% of all such injuries.

*Table 4: Distribution of moderate (greater than or equal to 2 on the abbreviated injury scale) and worse head and thorax injuries by vehicle type**

		Head Injury Severity		**Thorax Injury Severity**	
Vehicle Type	*Proportion Involved in Crashes*	*Proportion of all ≥ 2 Head Injuries*	*Proportion of ≥ 2 Within Vehicle Type*	*Proportion of all ≥ 2 Thorax Injuries*	*Proportion of ≥ 2 Within Vehicle Type*
Passenger Car	54.1%	58.6%	9.5%	42.1%	3.8%
Pickup Truck	5.6%	7%	11.1%	11.1%	9.7%
SUV	13.5%	16.2%	9.9%	17.4%	6.3%
Van/Minivan	5.7%	8.2%	10.6%	7.6%	6.6%

**Other vehicle types not presented in table; Abbreviated Injury Scale (AIS) 1: Minor, 2: Moderate, 3: Serious, 4: Severe, 5: Critical, 6: Maximal (untreatable); Pearson chi-square alpha value < 0.01, Cramer's-V = 0.142*

Hospital charges by vehicle type and age

Figure 3 demonstrates that not only are pedestrians and pedal-cyclists more likely to be more severely injured when struck by a large motor vehicle relative to a passenger car, but those more severe injuries, intuitively, result in higher hospital charges. Both median and average hospital charges are presented to demonstrate the effect a few very high hospital bills can have on the calculation of a mean. So the typical pedestrian or pedal-cyclist crash victim struck by a large motor vehicle could expect an additional \$1,230 in median hospital charges compared to those struck by a passenger car; and an additional \$4,380 in average hospital charges. Further, those struck by a pickup truck could expect to be charged the most for hospital treatment. This finding is consistent with the above analysis which demonstrated that a greater proportion of cases involving striking pickup trucks resulted in non-minor injuries to both the head and thorax.

Figure 4 shows that hospital charges increase by nearly a factor of three from children to senior pedestrian and pedal-cyclist crash victims – a finding supported by the logistic regression presented above. One cause of higher charges is likely due to a greater likelihood of seniors suffering a more severe injury compared to other age groups, according the maximum abbreviated injury scale (MAIS) field in the hospital data file.

Figure 3: Average and median hospital charges of pedestrian and pedal-cyclist crash victims by vehicle type

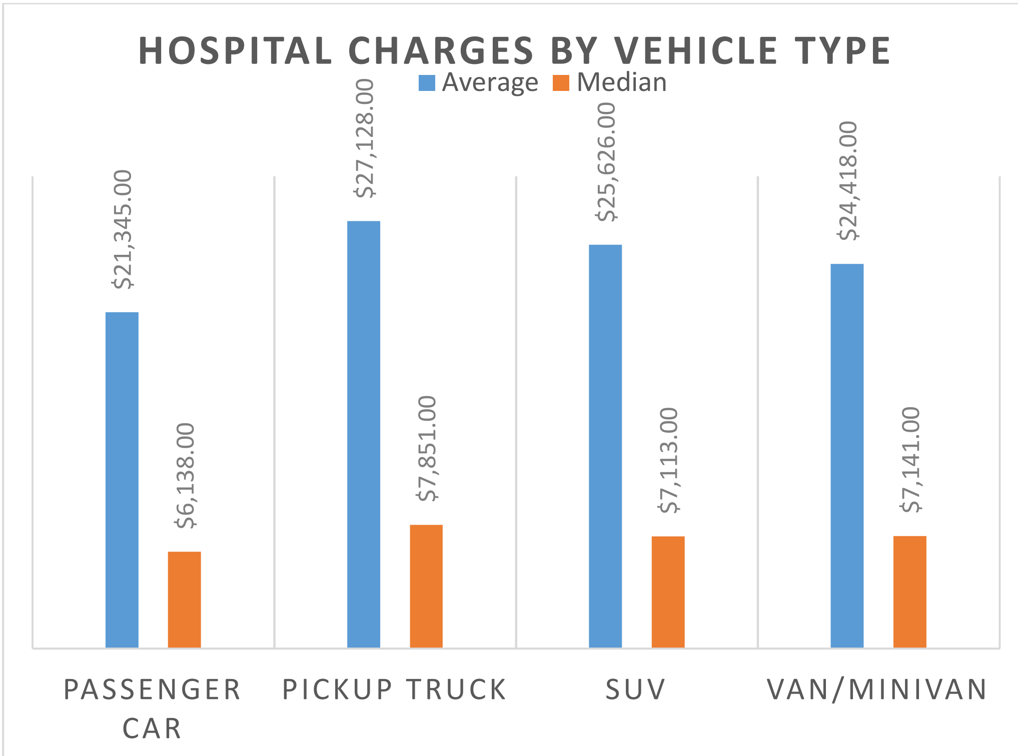
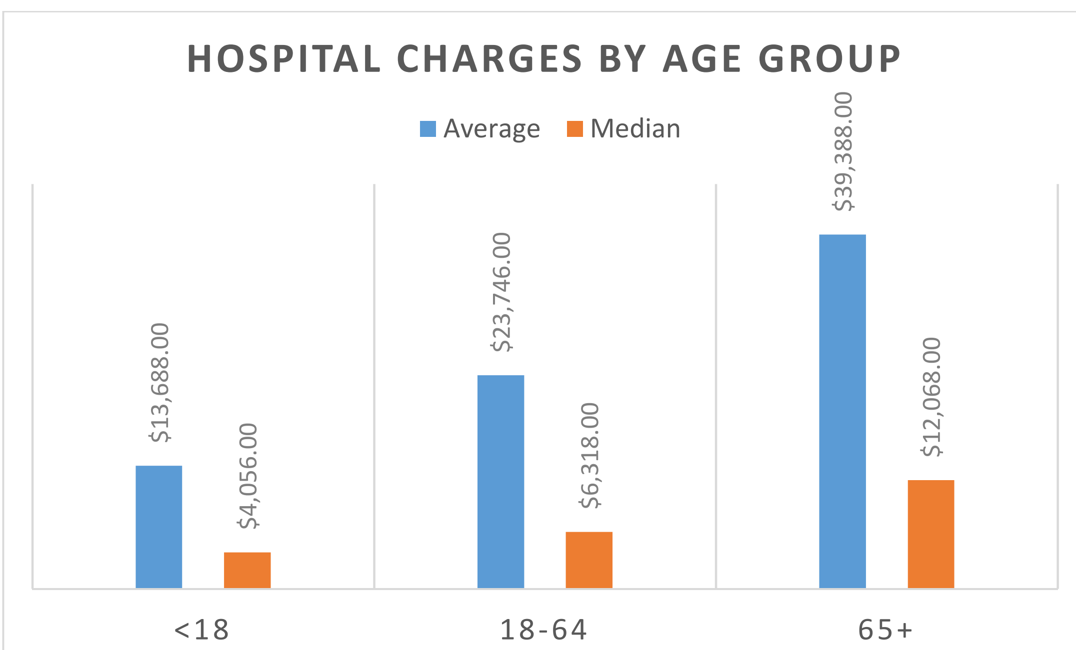


Figure 4: Average and median hospital charges of pedestrian and pedal-cyclist crash victims by age group



Race and ethnicity

Blacks were overrepresented as victims of pedestrian and pedal-cyclist crashes throughout Illinois. Outside of the City of Chicago 23% (945) of pedestrian and pedal-cyclist crash victims were Black, despite Blacks making up only about 10% of the population of Illinois outside of Chicago (ACS 2019 5-Year Estimates). Within Chicago 31% (1,154) of pedestrian and pedal-cycle crash victims were Black, where 29.6% of the population is Black (Ibid). Statewide (all of Illinois and Chicago), 27% (2,099) of victims were Black despite representing just 14.2% of the population (Ibid).

The Hispanic/Latino population was underrepresented as victims of pedestrian and pedal-cyclist crashes throughout Illinois. Some 20% (719) of crash victims were Hispanic/Latino within Chicago, despite making up about 29% of the population there (Ibid). And 14% (562) of pedestrian and pedal-cyclist crash victims in the rest of Illinois (exclusive of Chicago) were Hispanic/Latino where they make up 14.4% of the population (Ibid). Statewide, 16.5% (1,281) of victims were Hispanic/Latino despite representing 17.5% of the population. This finding of underrepresentation of the Hispanic/Latino population likely has several causes. One to note for this particular study is the potential for communication difficulties between a responding emergency professional and a Hispanic/Latino crash victim. If the crash victim lacks identification and their personal information is recorded incorrectly in the crash file, that case has a greater likelihood of not being linked with hospital data – from which the race/ethnicity fields are drawn.

Still, minority children were overrepresented as pedestrian and pedal-cyclist crash victims. Though 27% of cases involved a Black victim, closer to 30% of cases involving children were Black. And 16.5% of all crash victims were Hispanic/Latino, yet 23.2% of all cases involving children were Hispanic/Latino. White seniors were also significantly overrepresented as victims of pedestrian and pedal-cycle crashes. While Whites made up about 47% of cases, greater than 57% of crashes involving a senior was White.

4. Discussion

Three topic areas for future research are suggested: 1) A robust and nuanced understanding of the relationship between the rise of large vehicles and pedestrian/pedal-cyclist fatalities and severe injuries. Clearly part of the explanation is that large vehicles carry more momentum and more severely harm human bodies compared to passenger cars. Still, another factor may be socioeconomic. Pedestrian fatalities began rising in 2009 just as the Great Recession was taking hold, and those on the fringe of financial failure began to lose their grip on car ownership – leaving few transport choices but for walking and cycling. That same year also saw the first dip in national vehicle miles traveled for the first time since 1981, presumably leaving fewer opportunities for crashes. The right answer is likely a confluence of factors ranging from the physical (big vehicles) to the socioeconomic (more people walking during tough times) to the behavioral (feelings of security in a high-tech car that leads to speeding), as they commonly are in the social sciences. 2) Future research should investigate why Blacks are overrepresented and Hispanics/Latinos are underrepresented as pedestrian and pedal-cyclist crash victims in Illinois. One possible reason for the underrepresentation of the Hispanic/Latino population could be that their crash and hospital files go unlinked because of miscommunication resulting in errors being recorded in a data field of either the crash or hospital file. Lack of state-issued identification may also contribute to the recording of erroneous patient information. Other possible explanations may simply be a distrust of police or lack of health insurance. 3) Future research should also examine the neighborhoods and communities in which cases are found to be most frequent. Findings in this area would provide powerful insights into interventions that may be tailored to narrowly target the most at-risk populations.

5. Conclusion

This paper has demonstrated the high cost of large motor vehicles on pedestrian and pedal-cyclist injury severity, fatalities, and hospital charges. And once more, the most vulnerable among us seem to bear the greatest burden. Various solutions have been proposed and/or are in the works to address the mounting danger posed to pedestrians and pedal-cyclists. The City of Chicago has taken aim at reducing all traffic injuries and fatalities, especially pedestrian and pedal-cyclist, through their Vision Zero Chicago (VZC) Action Plan. VZC (2017) articulates several goals: invest resources in communities equitably, foster a culture of safety, make streets safer for all users, and create safer drivers and vehicles. Accomplishing these stated VZC goals should go a long way in reducing death and injury on Chicago roadways. Though some Vision Zero U.S. cities, including Chicago, may have actually seen pedestrian deaths increase since implementation (Bliss and Montgomery, 2019). At the federal level, the Government Accountability Office (GAO) reports that something as simple as reducing posted speed limits could reduce injury and death, findings also reflected by Arias et al. (2021). The GAO (2021) finds that 81% of pedestrian and 78% of cyclist fatalities occurred on a road with a posted speed limit of at least 35 miles per hour. Tiwari (2020) also finds that lowering motor vehicle speed through enforcement has been effective at reducing pedestrian injuries and fatalities, while attempts at altering pedestrian behavior has largely not resulted in a reduction.

Other proposals are aimed directly at large motor vehicles. A bill originating in the New York State Senate would create a pedestrian rating system for motor vehicles that would be posted on the Department of Motor Vehicle's website (S7876, 2020). The intent there is to educate consumers of the danger posed to pedestrians and pedal-cyclists by rating motor vehicles 1-5 based on the relative frequency of which they strike people. The rating system may also be used by insurance companies to charge drivers of high incidence vehicles higher premiums. Another more direct method of internalizing the external societal cost of driving large motor vehicles has been proposed by Tyndall (2021), among other economists and social scientists. Such proposals include implementing a Pigouvian tax at the federal, state, or local level equivalent to the marginal cost each example places upon society.

The widespread application of advanced automotive technology also has a role to play in harm reduction. Auto-braking and blind spot monitoring technology is not yet standard equipment on all motor vehicles sold in the U.S., and the automakers' technologies do not all perform equally. One study found Subaru's EyeSight crash avoidance system with pedestrian detection reduced pedestrian-related insurance claims by 35% (HLDI, 2017). While another study of the Chevrolet Malibu, Honda Accord, Tesla Model 3, and Toyota Camry equipped with automatic emergency braking systems found their pedestrian detection systems were “significantly challenged” (AAA, 2019 p 4) in detecting pedestrians in three key metrics. Regulators should consider requiring detection technology to be standard vehicle equipment that also meets a minimum performance threshold for crash reduction.

As articulated here and in the VZC Plan, the identification of neighborhoods, roads, and intersections with a high frequency of occurrences is an important first step in the reduction of pedestrian and pedal-cyclist injuries and fatalities. Arming communities with the knowledge, resources, and agency they require to address this important public health crisis is critical in achieving the goal of making our roads safe for all. Left to fester, the problem of pedestrian and pedal-cyclist injuries and fatalities is certain to worsen.

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