Pedestrian injuries from cars and SUVs: updated crash outcomes from the Vulnerable Road User Injury Prevention Alliance (VIPA)

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Samuel S. Monfort
Becky C. Mueller
ABSTRACT

Objective: The current short communication was written to update research on real-world pedestrian crashes from the late 70s and mid-90s. In particular, our analysis offers a preliminary update on SUV-pedestrian crash outcomes and how they differ from car-pedestrian crash outcomes. Detailed injury data were linked to vehicle features to offer a better understanding of pedestrian injury etiology.

Methods: We analyzed 79 single-vehicle crashes from the Vulnerable Road User Injury Prevention Alliance (VIPA) pedestrian crash database, focusing on crashes involving an SUV or car. Each crash from this database includes an in-depth analysis of police reports, pedestrian medical records, crash reconstructions, and injury attribution by a panel of experts.

Results: SUVs remain disproportionately likely to injure and kill pedestrians compared with cars, but these differences emerged primarily at crashes of intermediate speed. Crashes at low speeds and high speeds tend to produce similar injury outcomes independent of striking vehicle type (mild and fatal, respectively). The data suggest that the elevated danger to pedestrians from SUVs in these crashes may be largely related to injuries caused by impacts with the vehicles’ leading edge: the bumper, grille, and headlights.

Conclusions: Although the current analysis was based on a non-nationally representative dataset, the elevated pedestrian injury risk originating from SUVs’ leading edge is consistent with past research on the subject. That is, despite the changes in vehicle design and fleet composition over the past two decades, SUVs may remain disproportionately likely to injure pedestrians compared with cars.
INTRODUCTION

Annual pedestrian fatalities have increased nearly every year since 2009, and the rate per 100,000 people observed in 2018 was at its highest since 1998. In fact, pedestrians now account for 17% of all traffic fatalities, a proportion unseen since 1982.\(^1\)\(^2\) Past research has found that SUVs, pickup trucks, and passenger vans pose an outsized risk to pedestrians. Compared with cars, these vehicles (collectively known as LTVs) are 2-3 times more likely to kill the pedestrian in a crash.\(^3\)^\(^4\) The elevated injury risk associated with LTVs seems to stem from their higher leading edge, which tends to impart greater injury to the middle and upper body (including the thorax and abdomen) than cars, which instead tend to cause injury to the lower extremities.\(^5\)^\(^-\)^\(^7\)

The objective of the current study was to offer a preliminary update on SUV-pedestrian crash outcomes and how they differ from car-pedestrian crash outcomes. To date, research on real-world pedestrian crash outcomes has largely been restricted to two NHTSA datasets: the Pedestrian Injury Causation Study (PICS) from 1977 and the Pedestrian Crash Data Study (PCDS) from 1994. Vehicle design and fleet composition have changed substantially in the decades since these two data collections were completed.\(^8\) In particular, SUVs have adopted more car-like features in the intervening decades (e.g., unibody construction and a lower center of gravity). Although these changes have contributed to a lower risk to occupants of cars in collisions with SUVs, single-vehicle pedestrian fatalities involving SUVs have increased more than those involving other vehicle types over the past decade.\(^9\) Understanding the pedestrian risk factors unique to the modern SUV fleet is important for informing how these vehicles are designed going forward.

METHODS

VIPA pedestrian crash data were collected by the International Center for Automotive Medicine Pedestrian Consortium. The consortium began data collection in 2015, producing a detailed database of Michigan pedestrian and bicyclist crashes where police were called to the scene. These data are not necessarily nationally representative, but include an in-depth analysis of police reports, scene information, medical records, crash reconstructions, and injury attribution by a panel of experts. The median model year for involved vehicles was 2009 (SD=5 years). Pickup crashes were excluded because there were too few in the dataset to support valid conclusions. The current study focused on the 79 completed pedestrian crashes involving exactly one pedestrian over the age of 13 and one SUV (n=24) or car/minivan (n=55) and the injury analyses were conducted using the single most severe injury for each pedestrian. Injuries were coded using the 2005/2008 Abbreviated Injury Scale (AIS) and Injury Severity Score (ISS), the squared sum of the three highest AIS scores.

RESULTS

Controlling for preimpact speed, as well as pedestrian age, gender, and weight, we found SUVs to cause significantly more severe pedestrian injuries than cars did (\(p=.003\); median ISS 17 vs. 9). The discrepancy in pedestrian injury outcomes between cars and SUVs was largest at higher preimpact speeds. In fact, pedestrians struck at 19 mph or slower exhibited roughly similar outcomes regardless of the striking vehicle type. Preimpact speeds exceeding
19 mph, however, produced substantially worse injury outcomes for pedestrians struck by SUVs than by cars (Figure 1). This effect was generally mirrored by fatality rates in struck pedestrians (Figure 2).

Consistent with past research,7 SUVs were more likely to throw struck pedestrians forward than cars were (36% vs. 26%). Pedestrians struck by SUVs were also nearly twice as likely to be severely injured in the thigh/hip compared with pedestrians struck by cars (24% of all SUV crashes resulted in AIS 3+ injuries compared with just 16% for cars). Severe thigh/hip injuries for pedestrians struck by SUVs were disproportionately caused by impacts with features on those vehicles’ leading edges: the bumper, the grille, or the headlights (Figure 3).

DISCUSSION

Despite the changes in vehicle design over the past two decades, SUVs remain disproportionately likely to injure pedestrians compared with cars. Interestingly, the danger that SUVs pose to pedestrians seems to be most pronounced in crashes where the striking vehicle was traveling faster than 19 mph The data suggest that crash characteristics tend to overpower vehicle characteristics for low-speed crashes. That is, low-speed crashes tend to be benign enough that pedestrians emerge with only minor injuries regardless of vehicle type. Crashes at faster speeds are where vehicle design differences begin to predict injury outcomes.

Although recent vehicle crash data suggest that being struck by an SUV while driving a car is now equivalent to being struck by another car,8,10 the same equivalence may not apply to being struck while walking. Of note, the VIPA data are not necessarily nationally representative, as crashes were only collected from three urban areas in Michigan. As a result, the conclusions presented in the current short communication should be considered preliminary until a more diverse dataset can be compiled. Future research should investigate whether the findings contained in the current short communication can be replicated in a more generalizable set.

Limited generalizability notwithstanding, the detailed injury data in the VIPA database revealed that the elevated danger to pedestrians from SUVs may be largely related to injuries caused by high-speed impacts with the vehicles’ leading edge. In all, the data suggest that despite improvements in vehicle crash compatibility, SUVs may remain more disproportionately dangerous to pedestrians.

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REFERENCES


FIGURES

Figure 1. ISS by preimpact speed and striking vehicle type

Figure 2. Pedestrian fatality rate by striking vehicle type and preimpact speed.
Figure 3. Source of AIS 3+ thigh/hip injury by striking vehicle type