



# Injuries to Occupants of Passenger Cars Involved in Motor Vehicle Crashes, California, 2009-2013



Safe and Active Communities Branch • California Department of Public Health

## Introduction

In California, passenger cars (e.g., cars, station wagons, minivans, sport utility vehicles) account for most of the vehicle miles traveled and are the most common vehicle type involved in motor vehicle traffic crashes. From 2009-2013, there were a total of 805,672 motor vehicle traffic crashes in California that resulted in 1,137,405 victims injured. Passenger cars made up 61 percent of motor vehicles involved in these crashes with 737,962 injured occupants.



## Crash Medical Outcomes Data (CMOD) Program

To better understand injury outcomes of crash victims, the CMOD Program combines crash report data (California Highway Patrol Statewide Integrated Traffic Records System) with health data from emergency department (ED) visits and hospitalizations (Office of Statewide Health Planning and Development) using probabilistic linkage. For the years 2009-2013, 56 percent of injured victims linked to a medical record. The distributions of crash and victim characteristics were similar between cases with a linked crash-medical record and non-linked cases. Injured crash victims

that linked to a medical record were also demographically similar to those victims that did not link to a medical record. The driving parties of crashes had similar age distributions, and the environmental characteristics of these crashes were similar. In this report, injured occupants are crash victims who were occupants (driver or passenger) of a passenger car involved in a motor vehicle crash that linked to a medical record.

## Injury Crashes Involving Passenger Cars

From 2009 to 2013, of the 737,962 total injured occupants (drivers and passengers), 408,753 linked to a medical record.

### Environmental Characteristics

- Most victims were injured in crashes that occurred on a weekday (73 percent); during the daytime hours of 6 a.m. - 5:59 p.m. (68 percent); and in an urban area (64 percent) (Table 1).

### Crash Characteristics

- Eighty-one percent of injured victims were in a crash involving another motor vehicle (Table 2).
- Alcohol-involved crashes accounted for 12 percent of the crashes involving a passenger car in which occupants were injured; drug-involved crashes accounted for 1 percent of these crashes (Table 2).

### Driver Characteristics

- Forty percent of injured victims were in a passenger car with a driver that was 25-44 years (Table 3).
- More than half of injured victims (55 percent) were in a passenger car with a female driver (Table 3).
- Forty-four percent of injured victims were in a passenger car in which the driver was at fault.

### Victim Characteristics

- Most injured victims were drivers (73 percent) (Table 4).
- The average age of all injured occupants was 37 years and more than half were female (Table 4).
- Most injured occupants (89 percent) were in the front seats of a passenger car and 93 percent were using safety equipment at the time of the crash (Table 4).

## Medical Outcomes of Injured Occupants

### Injury Severity Score

The injury severity score (ISS) is a standard summary metric of injury ranging from 1 to 75 used to assess the severity of injury using emergency department and hospital record International Classification of Disease 9<sup>th</sup> Revision – Clinical Modification (ICD-9-CM) diagnoses codes. Scores of 15 or less represent non-severe injury, and 16-75 represent severe injury.

- Most injured victims had non-severe injuries (98 percent), with an overall mean injury severity score of 3 for all victims.
- Ninety-one percent of victims were treated in the ED.
- The most common body parts injured were spine and back (29 percent), torso (15 percent), and upper extremities (11 percent).
- The most common types of injuries were sprains or strains (35 percent), contusion or superficial injury (22 percent), and fractures (9 percent).

### Severe Injuries

- Severe injuries were seen in 8,145 (2 percent) of injured victims, of which most were hospitalized.
- The mean ISS for severely injured occupants was 23.
- The average age of severely injured occupants was 41 years, and 55 percent were male.
- The most common body parts severely injured were traumatic brain injuries (36 percent), injuries to the torso (30 percent), and injuries to lower extremities (13 percent).
- Fractures (49 percent) and internal injuries (45 percent) were the most common types of severe injuries.

### Significant Factors Associated with Severe Injury

Associations of environmental, crash, driver, and victim factors are measured with the outcome of a severe injury (ISS > 15) using Wald Chi-Square tests and reported by odds ratios (OR) and 95 percent confidence intervals (95 percent CI) with statistical significance based on p-value < 0.05.

### Environmental Factors (Table 1)

- Victims were nearly two times as likely (OR=1.93) to have severe injuries in crashes that occurred at night or early morning (6 p.m. - 5:59 a.m.), in rural areas (OR=1.87), and on weekends (OR=1.4).

Table 1. Environmental Characteristics of Motor Vehicle Crashes Involving Passenger Cars Resulting in Injured Occupants, California, 2009-2013.

Environmental Characteristics	Number of Injured Occupants (%)	Odds Ratio of Victim Severe Injury (95% CI) *
Day of Week		
Weekend	111,235 (27%)	1.40 (1.33, 1.47) †
Weekday	297,518 (73%)	*
Time of Day		
6 p.m. - 5:59 a.m.	131,601 (32%)	1.93 (1.84, 2.02) †
6 a.m. - 5:59 p.m.	276,702 (68%)	*
Unknown	777 (0.1%)	-
Location		
Rural area (Population ≤50,000)	147,050 (36%)	1.87 (1.79, 1.96) †
Urban area (Population >50,000)	261,703 (64%)	*
Occurred at Intersection	129,145 (32%)	0.73 (0.69, 0.77) †
Unknown	1,399 (0.3%)	-
Occurred on state highway	156,509 (38%)	1.23 (1.18, 1.29) †
Unknown	68 (<0.01%)	-

\* Missings and Unknowns not included in Wald Chi-Square test

† Wald Chi-Square p-value < 0.001

\* Reference Category

### Crash Factors (Table 2)

- Victims were more likely to have severe injuries in single party crashes when compared to crashes involving two parties (OR=2.98).
- Victims were more likely to have severe injuries in crashes involved with an object (OR=3.02), and non-collision crashes <sup>o</sup> (OR=2.99) when compared to crashes involving another motor vehicle.
- Victims in alcohol-involved crashes were nearly three times as likely to have severe injuries (OR=2.92); and those in drug-involved crashes were nearly four times as likely (OR=3.78).

Table 2. Crash Characteristics of Motor Vehicle Crashes Involving Passenger Cars Resulting in Injured Occupants, California, 2009-2013.

Crash Characteristics	Number of Injured Occupants (%)	Odds Ratio of Victim Severe Injury (95% CI) *
Number of Parties Involved		
One	110,235 (15%)	2.98 (2.84, 3.14) †
Two	458,194 (62%)	*
Three or more	169,553 (23%)	0.94 (0.88, 1.00)
Crash Involved With		
Other motor vehicle	598,949 (81%)	*
Object	103,404 (14%)	3.02 (2.87, 3.18) †
Non-collision	20,540 (3%)	2.99 (2.73, 3.28) †
Parked motor vehicle	15,069 (2%)	1.65 (1.41, 1.92) †
Alcohol-Involved	47,937 (12%)	2.92 (2.77, 3.08) †
Drug-Involved	4,316 (1%)	3.78 (3.33, 4.29) †

### Driver Factors (Table 3)

- Victims in cars with a driver at fault were three times as likely to have severe injuries (OR=3.08).
- Those in cars with drivers over the age of 65 were more than two times as likely to have severe injuries (OR=2.23); and for those over 85, more than 3 times as likely (OR=3.52).
- Victims in cars with a male driver were also nearly two times as likely to have severe injuries (OR=1.93).

Table 3. Driver Characteristics of Motor Vehicle Crashes Involving Passenger Cars Resulting in Injured Occupants, California, 2009-2013.

Driver Characteristics	Number of Injured Occupants (%)	Odds Ratio of Victim Severe Injury (95% CI) *
Driver Age		
< 15	3,512 (1%)	1.56 (1.24, 1.94) †
16-24	98,561 (24%)	1.35 (1.27, 1.43) †
25-44	162,536 (40%)	*
45-64	107,145 (26%)	1.19 (1.12, 1.27) †
65-84	32,488 (8%)	2.23 (2.07, 2.40) †
85+	3,419 (1%)	3.52 (2.99, 4.13) †
Unknown	1,092 (0.3%)	-
Driver Sex		
Male	182,728 (45%)	1.93 (1.84, 2.02) †
Female	225,062 (55%)	*
Driver at Fault	179,785 (44%)	3.08 (2.93, 3.24) †

<sup>o</sup> A non-collision crash is defined as a collision involving a motor vehicle in-transport which occurred in any manner other than through contact with another vehicle or object (e.g., overturned vehicle).

\* Missings and Unknowns not included in Wald Chi-Square test

† Wald Chi-Square p-value < 0.001

\* Reference Category

#### Victim Factors (Table 4)

- Victims who were not using safety equipment (e.g., safety belts, child passenger seats) were more than four times as likely to have severe injuries (OR=4.59).
- Those who were ejected were nearly fifteen times as likely to have severe injuries (OR=14.9).

Table 4. Victim Characteristics of Motor Vehicle Crashes Involving Passenger Cars Resulting in Injured Occupants, California, 2009-2013.

Victim Characteristics	Number of Injured Occupants (%)	Odds Ratio of Victim Severe Injury (95% CI) *
Victim Role Driver Passenger	297,523 (73%) 111,230 (27%)	1.12 (1.07, 1.19) † *
Victim Sex Male Female	162,306 (40%) 246,447 (60%)	1.89 (1.81, 1.98) † *
Victim Age < 15 16-24 25-44 45-64 65-84 85+	34,586 (9%) 96,430 (24%) 140,632 (34%) 100,065 (25%) 32,979 (8%) 4,061 (1%)	0.86 (0.77, 0.95) ‡ 1.28 (1.21, 1.37) † * 1.23 (1.15, 1.31) † 2.31 (2.15, 2.49) † 3.59 (3.10, 4.16) †
Victim Race/Ethnicity Non-Hispanic white Non-Hispanic black Hispanic Asian Native American	162,332 (40%) 43,970 (11%) 133,519 (33%) 34,425 (8%) 1,074 (0.3%)	* 0.56 (0.51, 0.62) † 0.88 (0.84, 0.93) † 0.81 (0.74, 0.89) † 0.62 (0.37, 1.05)
Seating Position Front Back	364,995 (89%) 40,404 (10%)	0.99 (0.91, 1.06) *
No Safety Equipment Used	26,858 (7%)	4.59 (4.33, 4.87) †
Airbag Deployed	140,055 (34%)	2.55 (2.42, 2.69) †
Victim Ejected	2,514 (0.6%)	14.9 (13.5, 16.5) †

\* Missings and Unknowns not included in Wald Chi-Square test

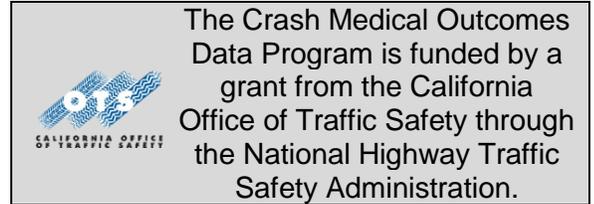
† Wald Chi-Square p-value < 0.001

‡ Wald Chi-Square p-value < 0.05

\* Reference Category

## Conclusion

Traffic safety intervention and prevention efforts now include severe injury measures in addition to fatalities for planning and target setting, however these are usually based on on-scene judgments by law enforcement officers who are typically not medically trained. It has been previously shown that the sensitivity of law enforcement assigned injury severity is low.\* This report uses crash-medical linked data that allows us to look at crash factors associated with injury in a more precise manner. Using a standard medical measure (i.e., Injury Severity Score) provides a more accurate assessment of injury severity. Crashes resulting in severe injuries are substantially different from those resulting in non-severe injuries. There are multiple factors at the crash, driver, and victim levels showing significantly high associations with severe injuries among injured occupants, including rural areas; night hours; single party involved; drug and alcohol involved; male, older, and at fault drivers; male, older, and white victims; and especially safety equipment usage. These findings may assist in traffic safety planning and interventions.



---

\* *Exploratory Analysis of Injury Classification of Crash Victims Using Crash-Medical Linked Data in California.* Crash Medical Outcomes Data Project, California Department of Public Health. December 2015.