Preliminary Estimates of Frontal Crash Injury Risk in Best Performing Passenger Vehicles

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Introduction and Objective

The longer-term goal of this project is to predict the incidence of crashes and injuries in the United States in a future fleet of the 2025 time-frame after current active and passive safety countermeasures are available in the entire vehicle fleet. Our assumption was that, by 2025, all new vehicles will have passive safety performance equivalent to current U.S. NCAP[1] five star ratings.

The objective of this study was to estimate frontal crash injury risk in vehicles with the best frontal crash performance in the U.S. New Car Assessment Program (NCAP).

Data Sources Selection Criteria

The dataset used for this study is the Crash-worthiness Data System (CDS), a component of the National Automotive Sampling System (NASS), referred to as NASS/CDS[2]. NASS/CDS investigates 4,000 to 5,000 police-reported crashes per year in the United States and includes detailed research of occupant, vehicle, and scene information. Weighting factors are computed for each case which allow conclusions to be made at a national scale.

Case Selection Criteria:

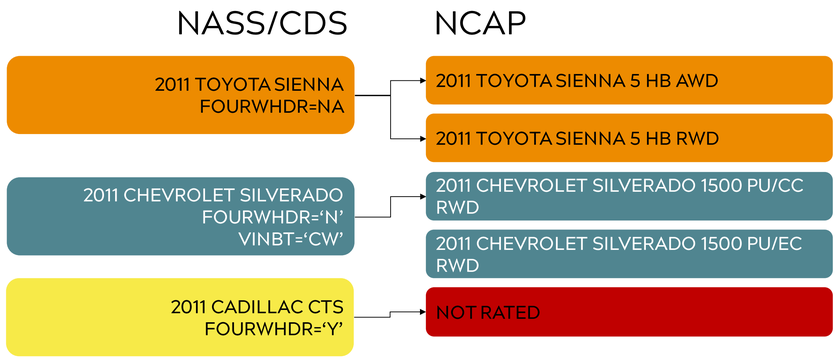
- Two passenger vehicles
- First impact was highest delta-v
- Front-side impact (GAD)
- Front-row occupants over the age of 12
- Cases with weight < 5000
- Model Year 2008 or later
- Vehicle has NCAP Star Rating

Case Exclusion Criteria:

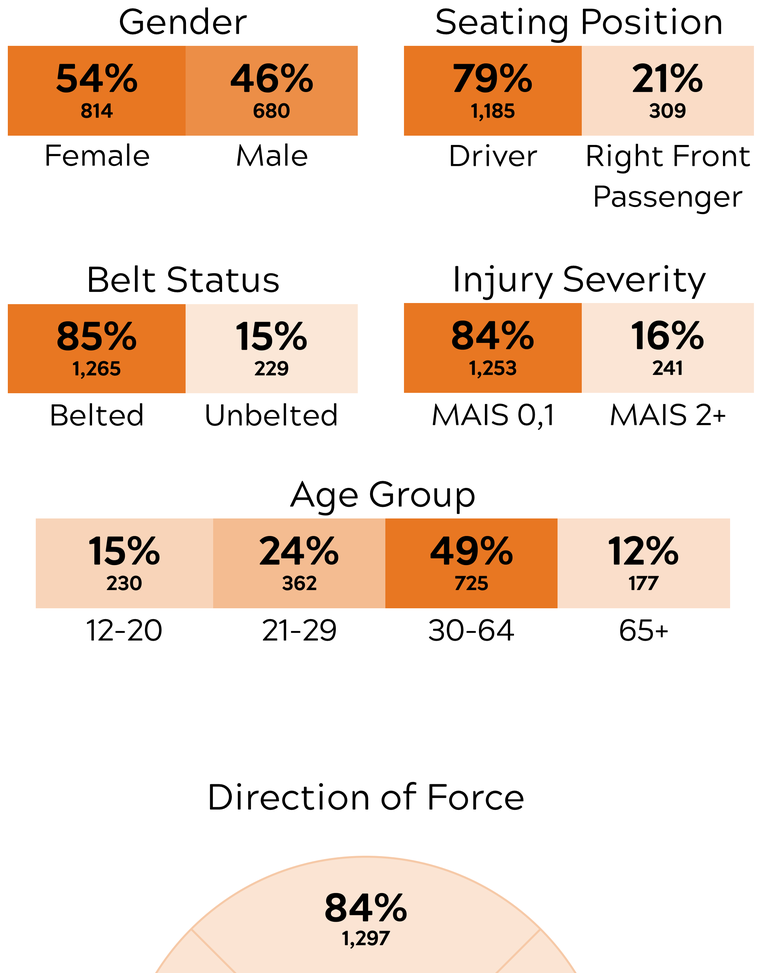
- Rollover cases excluded
- Ejection cases excluded
- Pole impact cases excluded

Merging NCAP with NASS/CDS

Each vehicle in the NASS/CDS dataset was assigned its U.S. NCAP frontal barrier test. Vehicles in the NASS/CDS database and the NCAP database do not have the same naming scheme and not all vehicles are rated, requiring a complicated mapping process[3].



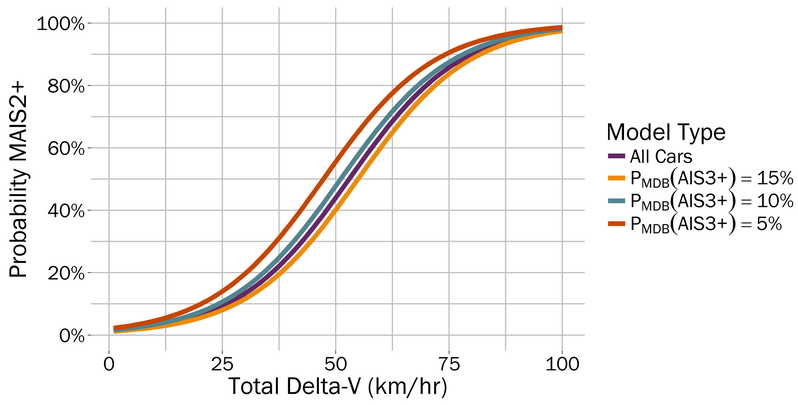
Dataset Composition 1,494 Cases



Injury Risk Model

Injury risk was modeled using logistic regression to predict the incidence of MAIS2+ injury to a front row occupant. The complex NASS/CDS sampling scheme was accounted for using the `survey`[4] package in R.

20% of the samples were withheld from training and used for validation. The AUC ROC of the model on the validation set was 0.775.



Coefficient	Value	χ^2	P-Value
β_0 – Intercept	-2.605	-	-
β_1 – Delta-V (km/h)	0.081	27.23	<0.001*
β_2 – Belted?	-0.934	4.81	0.028*
β_3 – Over 65?	1.428	9.18	0.002*
β_4 – Male?	-1.221	22.63	<0.001*
β_5 – NCAP Risk	-6.224	1.07	0.301

Discussion and Conclusion

We did not find a significant link between NCAP frontal test performance and frontal crash injury risk. This may be because the NCAP frontal test is performed at a very high delta-v of 56 km/h, more severe than 99.1% of crashes included in this dataset, but this requires further analysis.

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References

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