

Estimates of Frontal Crash Injury Risk in Best Performing Passenger Vehicles

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Objective

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

Dataset

The dataset used for this study is the Crashworthiness Data System (CDS), a component of the National Automotive Sampling System (NASS), referred to as NASS/CDS. 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. This study used 908 frontal crash occupants from NASS/CDS years 2010 to 2015. Occupants were included in the dataset if the crash involved exactly two passenger vehicles, and the occupant's vehicle was Model Year 2011 or newer.

Methodology

A logistic regression model was used to model the risk of MAIS2+ injury to a front row occupant in a frontal crash. "MAIS2+" refers to an injury severity of at least Abbreviated Injury Scale level 2 to any body region of the occupant. The predictor variables used in the logistic regression were Δv , belt status, age, gender, and probability of MAIS3+ injury in the NCAP Frontal test for the driver dummy (referred to as $P_{Frontal}(MAIS3+)$). The assignment of $P_{Frontal}(MAIS3+)$ to each vehicle is non-trivial and used the method in [1], adapted to $P_{Frontal}(MAIS3+)$ from $P_{MDB}(MAIS3+)$.

Results

The preliminary risk curve for a belted female front row occupant between 12 and 64 years old is shown in Figure 1. This preliminary risk model does not include $P_{Frontal}(MAIS3+)$ as a predictor variable. Table 1 shows the logistic regression coefficients of the model. A Wald-test was performed to test the hypothesis that each predictor variable coefficient was zero.

Table 1. Logistic Regression Coefficients for the frontal injury model. A Wald-test was performed for each predictor variable to show significance. P-Values under 0.05 are marked with a * to show significance.

Coefficient	Value	χ^2	P-Value
Intercept	-2.704	--	--
Δv	0.078	17.53	<0.001*
Belt Status – Belted	-1.303	5.83	0.015*
Age – > 65 years old	1.054	4.20	0.040*
Gender – male	-1.079	15.19	<0.001*