Development of an Injury Risk Curve for Child Pedestrians in the U.S.

Samantha H. Haus, Hampton C. Gabler

Virginia Tech, 325 Stanger St., Blacksburg, VA, 24061

Objective: In 2017, 214 children under the age of 15 were struck and fatally injured in vehicle-pedestrian collisions. Children interact with vehicles differently than adults due to their smaller stature and differing biomechanics [1]. We expect that children will likewise have different injury risk curves than adults. However, little has been published on the injury risk curves for children pedestrians. The objective of this study is to develop an injury risk curve for children using U.S. vehicle-pedestrian crash data.

Methods: The data sources used in this study were the Pedestrian Crash Data Study (PCDS) and the General Estimates System (GES). PCDS contains crash reconstructions and detailed pedestrian injury information which makes it well suited for injury curve development [2]. PCDS is not, however, a nationally representative sample. To correct for this bias GES was used to develop weights for PCDS cases based on frequency of injury severity and type of striking vehicle (cars or light truck and vans). A logistic model was fit to the data based on impact speed and the height of the child using equation 1 in which $P_{MAIS3+F}$ represents the probability of MAIS3+F injury, v represents the impact speed in km/h, $height$ represents the child's height in cm and A,B,C represent the coefficients shown in Table 1.

$$P_{MAIS3+F}(v, height) = \frac{1}{1 + \exp(-A_{MAIS3+F} - B_{MAIS3+F} * v - C_{MAIS3+F} * height)} \quad (1)$$

Results: Of the 549 PCDS cases, 126 pedestrians were children under the age of 15. A total of 25 cases were missing impact speed or injury severity, 10 cases were missing height information, and 1 case had incorrect height information. Of the 93 remaining cases, 5 were fatalities and 23 were MAIS3+F injuries. As shown in Figure 1, the risk increased with impact speed and risk to a child with a height of 138cm was not significantly different from a 30 year old adult.

Table 1. Logistic model coefficients

	A	*B*	*C*
MAIS3+F Injury Risk	-3.382	0.1069	-0.007984

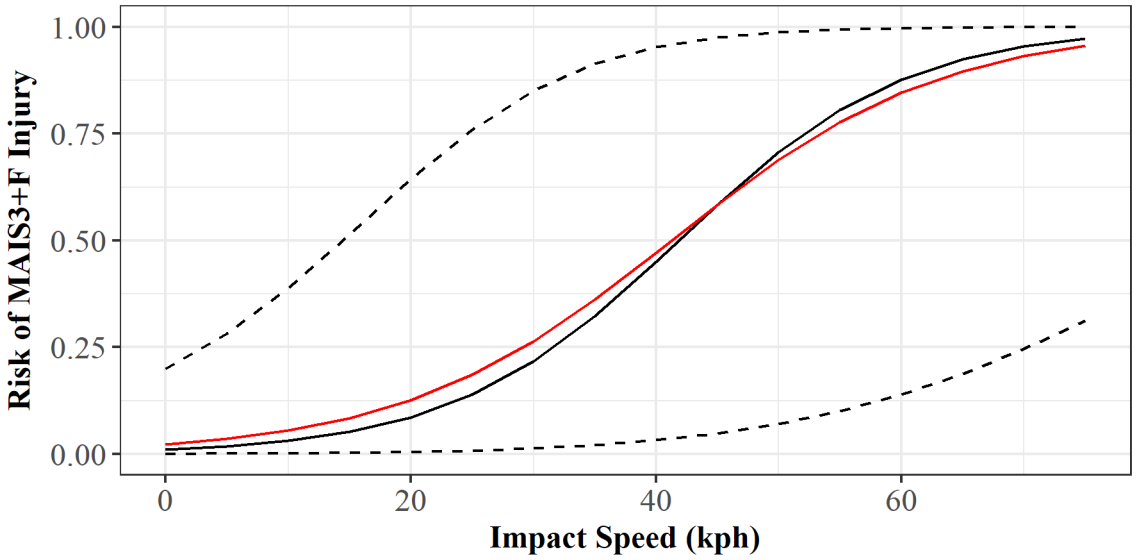

Figure 1. MAIS3+F injury risk curve assuming child height (138cm) and varying impact speed (black) compared to MAIS3+F injury risk curve for a 30 year old adult (red).

Discussion and Conclusion: This study was limited by the small sample size and age of the dataset. Vehicle geometry may play a role in injury severity, but that analysis could not be done with the limited sample size. PCDS was collected in the 1990s which means that the vehicles in the study are different than the vehicles on the road today. Due to the height difference of children, injuries to specific body regions, like the head, may be more common. In the future, we would like to create risk curves by body region.

Despite these limitations, these curves provide an early look at child injury risk in vehicle-pedestrian collisions and may help inform pedestrian cognizant vehicle design and regulatory tests parameters.

References:

[1] C. Tarriére, "Children are not miniature adults," in *International IRCOBI conferen ce on the Biomechanics of Impact*, Brunnen, Switzerland, 1995, pp. 15-26.

[2] NHTSA, "Pedestrian Crash Data Study 1996 Data Collection, Coding, and Editing Manual," Washington1996.