

Modeling Safety Effects of Horizontal Curve Design on Injury Severity of Single-Motorcycle Crashes with Mixed-Effects Logistic Model

Abstract

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Horizontal curves have been of great interest to transportation researchers because of expected safety hazards for motorcyclists. The impacts of horizontal curve design on motorcycle crash injuries are not well documented in previous studies. The current study aimed to investigate and to quantify the effects of horizontal curve design and associated factors on the injury severity of single-motorcycle crashes with consideration of the issue of unobserved heterogeneity.

A mixed-effects logistic model was developed on the basis of 2,168 single-motorcycle crashes, which were collected on 8,597 horizontal curves in Florida for a period of 11 years (2005 to 2015). Four normally distributed random parameters (moderate curves, reverse curves, older riders, and male riders) were identified.

The modeling results showed that sharp curves (radius $<1,500$ ft) compared with flat curves (radius $\geq 4,000$ ft) tended to increase significantly the probability of severe injury (fatal or incapacitating injury) by 7.7%. In total, 63.8% of single-motorcycle crashes occurring on reverse curves are more likely to result in severe injury, and the remaining 26.2% are less likely to result in severe injury.

Motorcyclist safety compensation behaviors (psychologically feeling safe, and then riding aggressively or vice versa) may result in counterintuitive effects (e.g., vegetation and paved medians, full-access-controlled roads, and pavement conditions) or random parameters (e.g., moderate curve and reverse curve). Other significant factors include lighting conditions (darkness and darkness with lights), weekends, speed or speeding, collision type, alcohol or drug impairment, rider age, and helmet use.