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Differences between pedestrian injury severity determinants at school and non-school zones: new findings from streetscape quality factors

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In response to the high rates of pedestrian fatalities near schools, numerous efforts have been made to address these tragic incidents over time. This study seeks to explore potential variations in the impact of factors affecting pedestrian injury severity across different time periods in both school and non-school zone pedestrian-involved crashes. Additionally, it aims to analyze the overall differences in pedestrian injury severity between these zones and over time. The research utilized four years of police-reported pedestrian-vehicle crash data from Seoul, South Korea, incorporating key crash-risk factors. This dataset was supplemented by factors derived from pedestrian eye-level street view imagery obtained through semantic segmentation techniques using deep learning and 360-degree Google Street View imagery captured at the crash scenes. Before model estimation, likelihood ratio tests were conducted to evaluate the applicability of the model estimations across school and non-school zone locations and different years. Subsequently, various econometric models, including traditional multinomial logit models and random parameters multinomial logit models with heterogeneity in means and variances, were estimated to account for potential unobserved heterogeneity in the crash data. Marginal effects were computed for explanatory variables to assess their impact on injury severity probabilities across different time and location combinations. Preliminary analysis revealed instability in the factors used in the models, necessitating the estimation of separate models for school zones and non-school zones during different periods (2018-2021). The results highlighted significant temporal instabilities in the effects of certain factors, such as drivers aged 56-65, evening periods (20-23 hours), male drivers, low building density, low sidewalk proportion, and low vegetation proportion, particularly in school zones. Specifically, these indicators increased the probability of fatal/severe pedestrian injury severity outcomes in school zones in recent years (2021). Through extensive out-of-sample prediction simulations, the study identified potential benefits of implementing safety policies related to school zones. The insights gained from the model structure, particularly regarding random parameters and factors influencing their means, provide valuable information for enhancing pedestrian safety in both school and non-school zones. Based on these findings, detailed recommendations encompassing enforcement, education, encouragement, and engineering measures are proposed for adoption in local and international contexts.

Keywords: *school zone, injury severity, deep learning, pedestrian, multinomial logit*