Pedestrians are considered the most vulnerable road users who are directly exposed to traffic crashes. In 2014, there were 4,884 pedestrians killed and 65,000 injured in the United States. Pedestrian safety is a growing concern in the development of sustainable transportation system. But often it is found that safety analysis suffers from lack of accurate pedestrian trip information. In such cases, determining effective exposure measures is the most appropriate safety analysis approach. Also it is very important to clearly understand the relationship between pedestrian injury severity and the factors contributing to higher injury severity. Accurate safety analysis can play a vital role in the development of appropriate safety countermeasures and policies for pedestrians.

Since pedestrian volume data is the most important information in safety analysis but rarely available, the first part of the study aims at identifying surrogate measures for pedestrian exposure at intersections. A two-step process is implemented: the first step is the development of Tobit and generalized linear models for predicting pedestrian trips (i.e., exposure models). In the second step, negative binomial and zero inflated negative binomial crash models were developed using the predicted pedestrian trips. The results indicate that among various exposure models the Tobit model performs the best in describing pedestrian exposure. The identified exposure-relevant factors are the presence of schools, car-ownership, pavement condition, sidewalk width, bus ridership, intersection control type and presence of sidewalk barrier. The t-test and Wilcoxon signed-rank test results show that there is no significant difference between the observed and the predicted pedestrian trips. The process implemented can help in estimating reliable safety performance functions even when pedestrian trip data is unavailable.

The second part of the study focuses on analyzing pedestrian injury severity for the nine counties in Central Florida. The study region covers the Orlando area which has the second-worst pedestrian death rate in the country. Since the dependent variable 'Injury' is ordinal, an Ordered Logit model was developed to identify the factors of pedestrian crashes. The explanatory variables can be classified as pedestrian/driver characteristics (e.g., age, gender, etc.), roadway traffic and geometric condition (e.g., shoulder presence, roadway speed etc.) and crash environment (e.g., light, road surface, work zone, etc.) characteristics. The results show that the presence of intersections, local roads, drug/alcohol involvement, pedestrians in a hurry, roadway speed limit more than 40 mph, dark condition (lighted and unlighted) and presence of elder pedestrians are the primary contributing factors of severe pedestrian crashes in Central Florida. The area under the ROC (Receiver Operating Characteristic) curve has a value of 0.75 that indicates the model performs reasonably well. Finally the study validated the model using k-fold cross validation method. The results could be useful for transportation officials for further pedestrian safety analysis and taking the appropriate safety interventions.

Walking is cost-effective, environmentally friendly and possesses significant health benefits. In order to get these benefits from walking, the most important task is to ensure safer roads for pedestrians.