Incorporating safety into the transportation planning stage, which is often termed as transportation safety planning (TSP), relies on the vital interplay between zone characteristics and zonal traffic crashes. Although a few safety studies had made some effort towards integrating safety and planning, several unresolved problems and a complete framework of TSP are still absent in the literature. This research aims at examining the suitability of the current traffic-related zoning planning process in a new suggested planning method which incorporates safety measures. In order to accomplish this broader research goal, the study defined its research objectives in the following directions towards establishing a framework of TSP: exploring the existing key determinants in traditional transportation planning in order to develop an effective and efficient TSP framework; investigation of the Modifiable Aerial Unit Problem in the context of macro-level crash modeling to investigate the effect of the zone's size and boundary; understanding neighborhood influence of the crashes at or near zonal boundaries; and development of crash-specific safety measure in the four-step transportation planning process.

This research was conducted using spatial data from the counties of West Central Florida. Analysis of different crash data per spatial unit was performed using a wide range of statistical techniques and Geographic Information System based application tools.

It was found that significant differences are present between the predictor sets for various crash types (pedestrian, bicycle, total and severe crashes) and models with spatial correlation (hierarchical Bayesian) performed better than the models that did not account for spatial correlation among Traffic Analysis Zones (TAZs). Based on various goodness-of-fit measures it was evident that the total, severe and pedestrian crash models for TAZs and block groups had similar fits, and better than the ones developed for census tracts. This indicated that the total, severe and pedestrian crash models are being affected by the size of the spatial units rather than their zoning configurations. A novel approach was proposed to account for the spatial influence of the neighboring zones on pedestrian and bicycle crashes which specifically occur on or near the zonal boundaries. It was found that crash models (that account for boundary and interior crashes separately) had better goodness-of-fit measures compared to the models which had no specific consideration for crashes located at/near the zone boundaries. Additionally, the models were able to capture some unique predictors associated explicitly with interior and boundary-related crashes. Motor vehicle crashes (total and severe) were classified as 'on-system' and 'off-system' crashes and two sub-models were fitted in order to calibrate the safety performance function for these crashes. It was evident by comparing this on- and off-system sub-model-framework to the other candidate models that it provided superior goodness-of-fit for both total and severe crashes. Based on the safety performance functions developed for pedestrian, bicycle, total and severe crashes, the study proposed a novel and complete framework for assessing safety (of these crash types) simultaneously in parallel with the four-step transportation planning process with no need of any additional data requirements from the practitioners' side.

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