Development of Multinomial Logistic Model and Ordinal Model for Bicyclist and Pedestrian Crashes across Highway Divisions 13 and 14 of North Carolina

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MOTIVATION

Figure 1: Pedestrian and Bicyclist

- The North Carolina Department of Transportation (NCDOT) is responsible for all modes of transportation in the state, including highways, rail, aviation, ferries, public transit and bicycle and pedestrian.
- The NCDOT is divided into fourteen local division offices under the Division of Highways for responsibilities such as construction, maintenance, roadside environmental programs and traffic services.
- The Alliance for Biking and Walking listed North Carolina 41st lowest in its ranking of pedestrian safety by state and 44th lowest for bicyclist safety

Pedestrian Crashes, 2007-2016 Bicyclist Crashes, 2007-2016

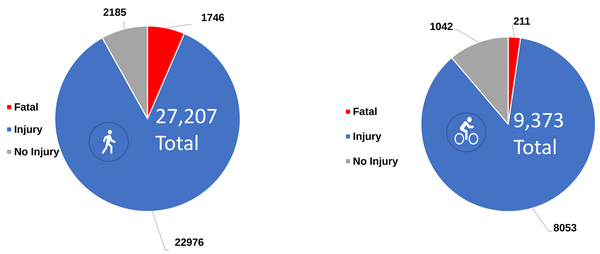


Figure 2: Pedestrian and Bicyclist Crashes in North Carolina

OBJECTIVES

- To perform exploratory analysis for pedestrian and bicyclist crashes in two divisions of the State of North Carolina.
- To determine which locations record high concentration of pedestrian and bicyclist crashes using optimized hotspot analysis tool in Geographic Information System.
- To develop Ordinal logistic and multinomial logit models to examine the contribution of several environment factors to the injury severity of bicyclists.
- To propose counter measures that will help reduce the number and severity of pedestrian and bicyclist crashes.

METHODS

Exploratory Analysis for Pedestrian and Bicyclist Crashes for Highway Divisions 13 and 14

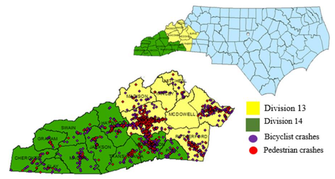


Figure 3: Map of North Carolina showing Highway Divisions 13 and 14

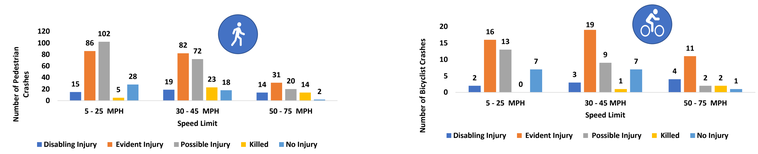


Figure 4: Distribution of Pedestrian and Bicyclist Crashes by Speed limit (mph) and Injury Severity Division 14

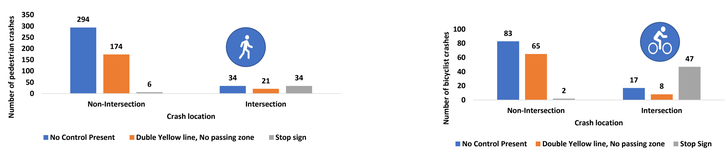


Figure 5: Pedestrian and Bicyclist crashes by Location and Traffic control Division 13

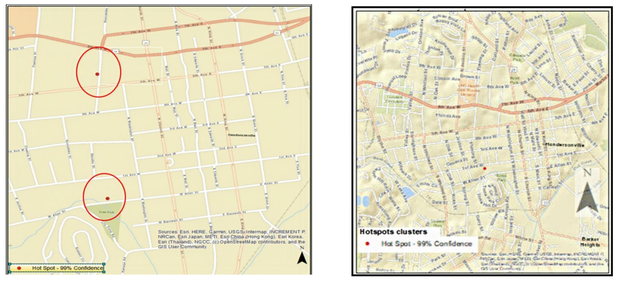
Figure 6: Pedestrian and Bicyclist crashes by speed limit and injury severity Division 13

The Optimized Hotspot Analysis

Pedestrian Hotspots Location Division 13

- 53 crashes around Intersection of Patton Ave and College St
- 30 crashes along Merrimon Ave
- 22 crashes along N. market St
- 13 crashes along Biltmore Ave

Figure 7: Pedestrian and Bicyclist Hotspot Locations in Division 13



Pedestrian Hotspots Location Division 14

- 29 crashes along the W Allen St
- 25 crashes along the road connecting Buncombe St to the 5th Ave W
- 15 crashes along the Clairmont Dr
- 12 crashes along the N. Oak St

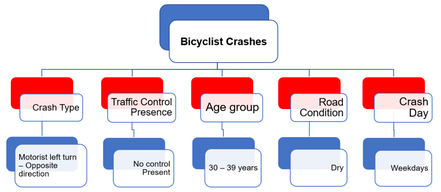
Figure 6 Pedestrian and Bicyclist Hotspot Locations in Division 14

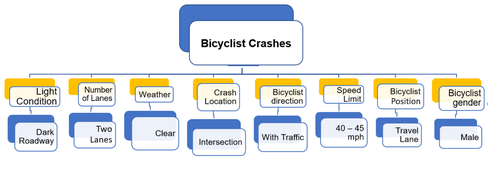
RESULTS

Multinomial and Ordinal Logistic model estimation results

Variable	Coefficient	Odds Ratio	P-Value	Standard Error
Crash Location (Intersection)	-0.0112	0.9889	0.0016	0.4171
Crash Type (Motorist Left Turn - Opposite Direction)	0.2801	1.3232	0.9786	0.4854
Traffic Control Presence (No control present)	0.0463	1.0474	0.5639	0.4098
Number of Lanes (Two Lanes)	-0.0502	0.9510	0.9099	0.3647
Weather	-0.1849	0.8312	0.8905	0.4142
Light Condition (Dark Roadway)	-1.4109	0.2439	0.0092	0.5418
Bicyclist Direction (With Traffic)	-0.3450	0.7082	0.4189	0.4268
Speed Limit (40-45) mph	-0.0817	0.9216	0.8546	0.4455
Bicyclist Age Group (30-39)	0.1826	1.2003	0.7249	0.5187
Bicyclist Position (Travel Lane)	-0.2002	0.8185	0.6282	0.4135
Crash Day (Weekdays)	0.0345	1.0351	0.9326	0.4080
Bicyclist Gender (Male)	-0.0324	0.9681	0.9398	0.4298
Road Condition (Dry)	0.2225	1.2492	0.6782	0.5362

Summary of Factors with +ve and –ve coefficient for Ordinal Logistic model





CONCLUSION

- 12% and 9% of the pedestrian crashes in Division 13 and 14 respectively occurred as a result of pedestrians failing to yield.
- Division 13 and 14 recorded 61.6% and 58.6% respectively of pedestrian crashes that occurred because there was no control present.
- The multinomial logit model results suggest that motorist left turn – opposite direction crash type, intersections, weekdays, traffic control, clear weather and dry road condition are more likely to result in possible and evident injuries relative to fatal and disabling injury crashes.
- The ordinal logistic regression model the most critical environment crash type variable to be factor Motorist left turn – opposite direction.
- The proposed countermeasure for the motorist left turn – opposite direction crash type is to provide left turn restriction and construct roundabout at intersections to improve safety.
- The key findings of this study can aid making countermeasures for the policymakers to reduce the frequency and severity of bicyclist and pedestrian crashes and improve safety.

KEY REFERENCES

- Alliance for Biking and Walking. Biking and Walking in the United States: 2014 Benchmarking Report. (2014).
- WalkBikeNC North Carolina Statewide Pedestrian and Bicycle Plan Summary Document 2013
- NCDOT Division of Bicycle and Pedestrian Transportation. 2007-2016 Bicycle and pedestrian Crash Data.
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