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Original Research Paper

Factors associated with crash severities in built-up areas along rural highways of Nevada: A case study of 11 towns

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HIGHLIGHTS

- The study found that speeding was a major factor associated with injury crashes in built-up areas of rural highways.
- The crashes that occurred during midnight until 4 a.m. were found to be more injury crashes than the property damage crashes.
- The likelihood of occurring injury crashes on weekdays are three times more than that of weekends.

ARTICLE INFO

Article history:
Received 18 January 2016
Received in revised form
8 June 2016
Accepted 18 August 2016
Available online 5 January 2017

Keywords:
Speed-zone guideline
Crash severity
Binary logistic regression model
Rural highway
Nevada department of transportation

ABSTRACT

In 2014, 32,675 deaths were recorded in vehicle crashes within the United States. Out of these, 51% of the fatalities occurred in rural highways compared to 49% in urban highways. No specific crash data are available for the built-up areas along rural highways. Due to high fatalities in rural highways, it is important to identify the factors that cause the vehicle crashes. The main objective of this study is to determine the factors associated with severities of crashes that occurred in built-up areas along the rural highways of Nevada. Those factors could aid in making informed decisions while setting up speed zones in these built-up areas. Using descriptive statistics and binary logistic regression model, 337 crashes that occurred in 11 towns along the rural highways from 2002 to 2010 were analyzed. The results showed that more crashes occurred during favorable driving conditions, e.g., 87% crashes on dry roads and 70% crashes in clear weather. The binary logistic regression model showed that crashes occurred from midnight until 4 a.m. were 58.3% likely to be injury crashes rather than property damage only crashes, when other factors were kept at their mean values. Crashes on weekdays were three times more likely to be injury crashes than that occurred on weekends. When other factors were kept at their mean value, crashes involving motorcycles had an 80.2% probability of being injury crashes. Speeding was found to be 17 times more responsible for injury crashes than mechanical defects of

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Peer review under responsibility of Periodical Offices of Chang'an University.
http://dx.doi.org/10.1016/j.jtte.2016.08.003

the vehicle. As a result of this study, the Nevada Department of Transportation now can take various steps to improve public safety, including steps to reduce speeding and encourage the use of helmets for motorcycle riders.

1. Introduction

Half a century back, the number of traffic fatalities in United States (U.S.) was increasing rapidly (NHTSA, 2012). However, the number of such fatalities has been decreasing since 2005. In 2014, the number of fatalities was 32,675 compared to 43,510 in 2005 (IIHS, 2016). During this period, the fatality rate also decreased from 14.7 to 10.2 per 100,000. In Nevada, the number of fatalities had been decreasing from 2006 to 2014. In 2006, the total number of motor vehicle crash deaths was 432, yielding a fatality rate of 17.3. However, in 2014, the number of motor vehicle crash deaths was 290, yielding the fatality rate of 10.2. Despite the decrease, the number of fatal crashes per 100 million vehicle miles traveled (VMT) in Nevada still was higher than the national average in 2014 (1.15 versus 1.08).

In 2010, 51,664 crashes occurred in Nevada. Out of those crashes, property damage only (PDO), injury, and fatal crashes were 63.40%, 36.15%, and 0.45% respectively (Nevada Department of Transportation (2012)). Among all these categories of crashes that occurred in Nevada, 10% of PDO crashes, 8% of injury crashes, and 41% of fatal crashes occurred in rural areas of the state. While fewer crashes occurred in the rural areas, much higher portion of fatal crashes occurred in the rural areas. In 2014, about 31% of fatal crashes occurred in rural areas of the state. In the national context, 49% and 51% of the fatalities occurred in urban and rural areas, respectively (IIHS, 2016). Since people are traveling 1.8 times more in urban roads than rural roads, this higher number of fatalities in the rural roads is alarming (NHTSA, 2016). All these statistics about the crashes in rural areas occurred along the entire section of the rural highways. No study had been conducted to identify the number of crashes and factors affecting the crashes in built-up areas of rural highways. In order to decrease more severe crashes in these built-up areas along rural highways, factors associated with severe crashes in built-up areas should be identified.

Many studies conducted to identify the factors affecting the crash severities focus on the geometric factors, such as lane width, number of lanes, and the presence of a median and personal factors, such as age, sex, disability, and alcohol usage (Evans and Wasielewski, 1983; Jonah, 1986; Lee and Mannering, 2002; NHTSA, 2015a, b). However, in this study, the geometrics of the road sections in built-up areas along rural highways were not considered, because all the built-up areas along these rural highways had similar road geometrics. Also, the data related to drivers who were involved in the crashes were not collected. Therefore, factors such as weather, lighting, vehicle action, time, day, month, vehicle factor, and vehicle speed were analyzed for their association with crashes. One of the major reasons for not collecting the characteristics of the person involved in crashes and the road geometric was that this research aimed to investigate crashes within a certain number of miles of each town along rural highways in order to determine whether speed limits along the town played a role in the crashes. This crash analysis was a part of research conducted for Nevada Department of Transportation (NDOT) to prepare the speed limit guidelines for built-up areas along the state's rural highways (Shrestha and Shrestha, 2016). Identification of these factors, along with curtailing speeding, is expected to aid decision makers at NDOT to prepare speed limit guidelines to reduce crashes in towns along rural highways. It will help NDOT head towards their "zero fatality" goals (Nevada Department of Transportation (2015)).

In reviewing some of the studies conducted to identify various factors affecting crash severities, the focus mostly was on factors related to weather, lightning conditions, vehicle actions, the number of vehicles involved, timing, the drivers' conditions, and vehicle speed.

Xie et al. (2012) analyzed severities of crashes (no injury, possible injury, non-incapacitating injury, and fatal injury) involving a single-vehicle. The study found that 31 out of 53 predictor variables have significant correlations with crash severities. Some of the factors found to be significant were those under investigation in this study, e.g., lighting condition, speed, and the first and second harmful events. Similarly, Chen et al. (2012) analyzed the effect of various driver characteristics, vehicle features, environmental and road factors, and crash characteristics on the severity of intersection crashes (fatal or non-fatal). The study found that speed zone, time of crash, and crash type all have a significant effect on the severity of intersection crashes.

Chang and Wang (2006) studied crash data to analyze the relationship between crash severities and various temporal characteristics (e.g., time of crash) and highway/environmental characteristics (e.g., lighting condition or speed limit). The study could not find any relationship between these factors and the severity of crash injuries. Li et al. (2012) analyzed the crash data from freeways diverge areas in Florida to analyze the factors affecting crash severities in five levels – no injury, possible injury, non-incapacitating injury, incapacitating injury, and fatal injury. The study used 37 explanatory variables, e.g., speed, light condition, weather, road surface, and crash type. They found that the freeway pavement surface conditions, lighting conditions, weather conditions, and alcohol/drug involvement significantly affected the crash severities.