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Roadside elements and single-vehicle crash severity in Iceland

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Introduction, research aim and objectives: Run-off-road crashes are among the most common and serious crashes on rural state roads in Iceland. In such crashes, roadside hazards can significantly contribute to greater severity of the crash. Many existing roads were built years ago when safety standards were different, and the need to improve roadsides is enormous. However, the funds available for the improvements are limited. Therefore, it is crucial to prioritize the improvements of roadsides to work on the most significant roadside hazards. Understanding the roadside elements that significantly contribute to high severity of single-vehicle injury crashes occurring in rural roadways is therefore essential.

The main objective of this research is to identify the roadside elements that most significantly contribute to high severity of single-vehicle injury crashes occurring in rural surroundings in Iceland.

Research methods: Original police records on 712 single-vehicle injury crashes[1] on rural state roads in Iceland in the period 2016-2018 were reviewed and additional data were coded. This was necessary as factors within the roadside, which are expected to influence the consequences of the crash, are not included in the standard digital crash data. This information, where available, was derived from written text descriptions and or photos in police reports.

In injury crashes, severity is classified into fatal, serious, and minor injury crashes. There were few fatal injury crashes, making a separate statistical analysis of that category impossible. Thus, fatal and serious injury crashes were combined into one category of high severity. The high severity crashes are defined as crashes where at least one vehicle occupant was fatally or seriously injured. Minor injury crashes are defined as crashes where the most serious consequence in the crash, across all occupants, was a minor injury.

[1] Crashes involving motorcyclists, bicyclists, and pedestrians are excluded.

A binary logit model, conditional on crash occurrence, was developed to investigate roadside elements significantly contributing to the high severity crashes on rural roads. The roadside hazards tested were road equipment in the roadside, culvert, steep main road slope, ditch, rock in the roadside, steep transverse slope, lava field, sea or water, tunnel wall. Additionally, several other variables were used to control for other factors such as location and season, along with driver, vehicle, environment, and other road characteristics. A total of fifty-five independent variables were thus tested in the model. The hypothesis of no significant difference from zero was tested for each coefficient on each variable using the Student's t-test. Coefficients that were not statistically significantly different from zero at the 90% level were constrained to zero.

Since the dependent variable is based on the most severe injury in the vehicle, the number of vehicle occupants matters for the analysis. The effects of the number of vehicle occupants were tested for non-linearity. The results revealed that it was statistically sufficient, at the 95% significance level, to include a linear variable on the number of vehicle occupants in the model. The average pseudo-elasticity was calculated to measure the change in severity probabilities when each explanatory variable was changed from 0 to 1.

Results: The resulting crash severity model identified 15 statistically significant factors. Of the tested roadside hazards, a rock within the roadside and a steep transverse slope, both more than double the probability of high severity of single-vehicle crashes on rural roads. The other tested roadside hazards were not statistically significant at the 90% level of significance. Of the other included variables, several also doubled the probability of high severity in a single-vehicle injury crash. These were: Driver is (or is suspected to be) intoxicated, heavy truck involved, a gust of wind or strong wind, location on the Ring Road along the south coast of Iceland, and location on the road Reykjanesbraut (connecting the capital area and the international airport in Iceland).

Discussion and conclusions: These findings help prioritize projects on improving roadsides to make them more forgiving, by highlighting which roadside hazards are significant and have a large impact on the probability of high severity. Roadside improvements by removing rocks from the roadside or reducing the transverse slope, have a further benefit in that road users are not likely to notice such improvements. Therefore, it is unlikely that road users adapt their behavior, e.g., increase their driving speed, and thereby outweigh the safety benefits of the measures.