This study is concerned with the safety risk of reduction of visibility on roadways. One way to improve safety under reduced visibility conditions (i.e., reduce the risk of visibility related crashes) is to improve drivers’ behavior under such adverse weather conditions. However, there is lack of studies that attempted to better understand drivers’ behavior at different traffic and visibility conditions. One of the objectives of this research was to investigate the factors affecting drivers’ stated behavior in adverse visibility conditions, and examines whether drivers rely on and follow advisory or warning messages displayed on portable changeable message signs (CMS) and/or variable speed limit (VSL) signs in different visibility, traffic conditions, and at two types of roadways; freeways and two-lane roads. The data used for the analyses were obtained from multi-approach self-reported questionnaire survey carried out among 566 drivers in Central Florida, USA. The results revealed that gender, age, road type, visibility condition, and familiarity with VSL signs were the significant factors affecting the likelihood of reducing speed following the instructions of CMS/VSL signs in reduced visibility conditions.

In addition, this research aimed to thoroughly examine and quantify the impacts and values of various factors found to be related to drivers’ compliance and drivers’ satisfaction with VSL and CMS instructions in different visibility and traffic conditions. To achieve these goals, Exploratory Factor Analysis (EFA) and Structural Equation Modeling (SEM) approaches were adopted. The results revealed that drivers’ satisfaction with VSL/CMS was the most significant factor that positively affected drivers’ compliance with advice or warning messages displayed on VSL/CMS under different fog conditions followed by human factors. Furthermore, drivers’ familiarity with VSL and human factors were the significant factors affecting drivers’ satisfaction with VSL/CMS advice under reduced visibility conditions. Based on the findings of the present study, several recommendations are suggested as guidelines to improve drivers’ behavior in such reduced visibility conditions by enhancing drivers’ compliance with VSL/CMS instructions.

Additionally, there is a lack of good understanding of the relationship between real-time traffic flow variables collected from LDs and crashes that occur under reduced visibility (VR crashes). Thus, this research explores the occurrence of reduced visibility related (VR) crashes on freeways using real-time traffic surveillance data collected from loop detectors (LDs) and radar sensors. In addition, it examines the difference between VR crashes to those occurring at clear visibility conditions (CV crashes). To achieve these objectives, Random Forests (RF) and matched case-control logistic regression model were estimated. The results indicated that traffic flow variables leading to VR crashes are slightly different from those variables leading to CV crashes.

Moreover, two issues that have not explicitly been addressed in prior studies are; (1) the possibility of predicting VR crashes using traffic data collected from the Automatic Vehicle Identification (AVI) sensors installed on Expressways and (2) which traffic data is advantageous for predicting VR crashes; LDs or AVIs. Thus, this research attempts to examine the relationships between VR crash risk and real-time traffic data collected from LDs installed on two Freeways in Central Florida (I-4 and I-95) and from AVI sensors installed on two Expressways (SR 408 and SR 417). Also, it investigates which data is better for predicting VR crashes.

The approach adopted here involves developing Bayesian matched case-control logistic regression models using the historical crashes, LDs and AVI data. The results as well as an argument concerning which traffic data (LDs or AVI) is better for predicting VR crashes are also provided and discussed.

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