Modeling to assess gender and age influence on traffic injury severities in Brazil: urban vs. rural environment

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BACKGROUND

The growth of the road transportation system has brought some externalities, including a significant increase in traffic accidents. Therefore, safety of the system users became one of the main objectives to be addressed during road transport planning and management.

Traffic accidents represent high socio-economic costs to the developing countries. In Brazil, a survey conducted by the Ministry of Transport, Ports and Civil Aviation (MTPA) shows more than 1,134,800 accidents on federal highways supervised by the Federal Highway Police (PRF) between 2010 and 2016, resulting in more than 55,850 deaths. These data stresses that measures to improve road safety are urgently needed on both type of road environment - rural and urban.

In general, engineering actions of road safety are focused on the reduction of accidents and their severity through the implementation of reactive measures at hotspots (locals with a high concentration of accidents). However, the adoption of preventive strategies also contribute to improve safety by decreasing accidents and/or reducing the consequent severity.

It is worth noting, among the proactive strategies, the importance of road safety modeling as a tool for road safety management (RSM). Usually, models are developed and applied to study the relationship between road infrastructure and operation features, and the accidents frequency and/or severity. However, the analysis of the relationship between road user characteristics and accidents is also important, enabling to guide actions focused on road user such as the promotion of targeted educational campaigns and thus enlarging the scope of RSM actions.

AIM

In this context, the aim of the present study is to investigate the influence of road users characteristics on traffic accident severity modeling data of Brazilian highways provided by the Federal Highway Police. Due to the scarce and/or incomplete accident data usually available the analyzed characteristics are gender and age data of the users involved in the accident, reflecting in some way, the heterogeneity of users behavior.

METHODOLOGICAL APPROACH

Data from PRF, which is the agency responsible for traffic accident records on Brazilian federal highways, will be used. The database consists of records throughout the country's road network, between the years of 2010 and 2017, corresponding to a total of 1,224,233 accidents. In order to consider the type of road environment (urban vs. rural) where accidents occurred, a previous analysis was conducted to identify the local of the accidents.

Statistical modeling techniques have been traditionally employed for accident prediction and severity analysis, using appropriate models to the data’s specificities. Nevertheless, limitations are recognized in this type of approach, since each statistical model has its own assumptions and a pre-defined relationship between dependent and independent variables.
On the other hand, considering that Artificial Neural Networks (ANN) has shown on past studies similar or superior performance compared to traditional modeling and overcoming the need of a pre-defined relationship between variables, this technique was adopted for modeling the described data.

In this sense, ANN modeling will allow the analysis of the influence of the included variables on each level of accident severity (without victims, with injuries, with fatalities). Firstly, two datasets are created and analyzed by separating rural and urban accidents and aggregating by each user. Secondly, each dataset (rural and urban) are subdivided into three subsets, each one associated with a level of severity (without victims, with injuries, with fatalities), providing the association of users characteristics depending on the type or road environment and accident severity.

EXPECTED RESULTS

At the final of the modeling process, it is expected to be possible to establish the relationship between age and gender and the accident severity under two distinct road environments. Through the study results, it will be possible to infer about the impact of the behavior of each age or gender group on accident severity. In addition, the results will allow the comparison between rural and urban roads, which may reveal how the user behavior diverges depending on the road environments.