Accident Prediction Modeling and Analysis for Vulnerable Road Users – A review of Recent Studies

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Abstract:
Transportation is essential for overall development of any country but in India it is very critical problem. It is because every year traffic volume and VRUs are also increase on road. Haryana is experiencing a fast growth of road network through NHDP and PMGSY. In absence of proper safety measures and design of crossings traffic from various roads merging with the VRU traffic in a very dangerous manner resulting a large number of traffic accidents and fatalities. The accidents of VRUs are mainly due to improper interactions between vehicles, road user and or highway geometric features. The main cause of such problem is the use of mix vehicular traffic including two wheelers and cyclists, that creates social problems due to loss of lives. In this study frequent elements which are accountable for accident study in India are studied for developing different modelling techniques to suggest solution.

The various studies stated in the past years and various roads (S.H. and N.H.) and their outcomes with different approaches adopted have been reported in this paper. The researchers have also tried to explain important explanatory variables and their significance. Researchers are assuming various methods and many independent variables are being tried into accident prediction modelling. Comparative impact of variables to predict VRU accidents and effectiveness of different modelling techniques also essentials to be tested for various roads data. Through this paper the researcher had collected all the relevant studies and found out the various reasons for the road accidents. The paper will lead to the figuring our various significant factors which are responsible for road accidents in India.

Key words: NHDP, PMGSY, VRU, Accident Prediction model.

INTRODUCTION
Road accidents are the 9th main reason for death in 2004 and it will be predicted that by 2030 it will be the fifth primary reason of death by this increasing rate. As per the National Crime Records Bureau, Law commission of India, Ministry of Road Transport and Highway, Global status report on road safety 2015, there is one serious road accident in the country in every minute and every hour 16 dies on Indian roads. The increase in the persons injured in road accidents during 2015 was about 2.9% from previous years. On an average Road accident kill approximately 382 persons daily which are more than even terrorism. The studies states the maximum 53% people got killed in these accidents are VRUs, then trucks (20.1%), cars (12.1%) and buses (8.8%). Mumbai has the maximum number of 23,468 road accidents in 2015 while in Delhi the highest number of 1622 deaths. Indian national highways recorded about 35% of accidents out of which persons killed and 29% injuries. India has already crossed China for highest number of people killed in 2008 due to road accidents and it is around 1.2 lakh people. Goa met 267 accidental deaths in state per lakh population in 2010. The maximum no. of persons killed on highways found to be in Tamil Nadu i.e. 23 as per lakh of population, than in Goa i.e. 19.1 than in Haryana i.e. 18.9 per lakh population in the year 2010. Initial step is to be taken that actual data has to be collected with real crashes on road accident sites. Then we have to recognize the variability of the data and what are the reasons behind the fatalities and injuries. What would be the possible steps to outcome to avoid these accidents? The main focus of this study is to find relation with various parameters and accidents and to develop a model to predict accidents.
LITERATURE REVIEW

(Knuiman, Council et al. 1993) et al. examined the effect of the mean value of highway width for four-lane roads on accident prediction models. For data distribution a negative binominal function was used. The results presented that the accident rate reduced when roadway width increased reaching minimal crash-rate values when the carriage way dimensions are more.

(Kolhar 2012) Studied and analysed the various parameters responsible for all types of accidents. For analysis of accident prone Tumkur Road at Bangalore was identified as the testing area. By collecting significant amount of data, it is used for further analyses. Mixed type of non-linear regression analysis was used then a statistical and practical significant model was selected. The mean speed of the traffic flow formed a critical factor in any type of the accident analysis but here average speed of traffic flow showed very less R2 value with the dependent variable. He explained that the land use, road condition, shoulder type, carriageway width, and composition of trucks were the most noteworthy parameters affecting VRUs accidents on various roads.

(Persaud and Dzbik 1992) stated the first crash prediction model for multilane roads. The model shows relationships of number of accidents and traffic flow expressed as average daily traffic (ADT) and hourly volume. The analysis was based on generalized linear models. The finding demonstrated the accident rate increased with traffic flow.

(Abdel-Aty and Wang 2006) established that accident prediction models (APMs) had been broadly used in classification of accident sites with the aim of identifying accident black spots. Before this study black spots had been reached by using a uni-variate count data or a multivariate count data model for modeling the number of accidents at different severity levels simultaneously. Therefore, the two-stage mixed multivariate model used as an encouraging tool in predicting accident frequency according to their severity levels.

(Golob and Recker 2004) discussed linear and non-linear multi-variable regression analysis for comparison of the correlations between traffic flow with crashes, weather conditions and lighting. They evaluated the effects on road safety with changes of traffic flow.

(Hauer 2004) from University of Toronto studied about established statistical regression equations to predict the number of crashes per year in relation to geometric roadway features and traffic flow. The crash data collected and analysed using binominal negative distribution. This study introduced an encouraging tool to measure the adequacy of accident prediction models, called the Cu.Re method (Cumulative Residuals method).

(Hauer, Harwood et al. 2002) calibrated other models to predict crash frequency i.e. number of crashes per year on multilane urban roads by using variables listed as AADT (Annual Average Daily Traffic), roadway width, slope danger levels of road shoulders, the percentage of trucks, horizontal curve length, points of access, speed limits, type and width of clear zones and the presence and nature of parking areas. The result confirmed that AADT, the point of roadway access, and the speed limits were the significant variables for predicting crash frequency. Statistical tests were developed by the same author to test the statistical significance of the obtained results.

(Fridström, Ifver et al. 1995) et al. correlated the number of crashes with four variables: traffic flow, speed limits, weather and light conditions in his study. The study stated the relationship and interdependency of these variables with accidents.

(Kibar, Celik et al. 2013) stated that accidents in Turkey were growing every year. The key objective for their study was to explore the issues that cause accidents and to develop an accident prediction model of factors caused accidents. With that the probable number of accidents at divided highways was predicted. The method of generalized linear models was applied to the collected accident data. This model showed that the vehicle kilometres of travel, number of vehicles crossing the road and average speed of vehicles are significant variables for road accidents.

(Persaud, Retting et al. 2000) presented accident prediction models which established different regression equations for circular curves and tangent elements entirely dedicated on two-lane roads. Crash frequency was predicted by using traffic flow and roadway features.
Gaps and Need of study

From the literature review it is very clear that VRU accident study and model development is urgent required area of study and to evaluate the effect of various contributing factors. These factors causing accidents should be further removed to minimize VRUs Road accidents. The main parameters of VRUs accidents are driver condition, vehicle condition, road condition, road users, type of traffic flow, shoulder, median other than the motorist. So the purpose of this study is to control the various identified parameters that causes overall accidents on Indian roads. The needs to study non-urban and urban section of roads are very essential. The researcher tried to identify the significant factors of various types of accident especially VRUs on Indian roads and to develop a predictive model for the same. The study would also assess the traffic safety of Indian roads and recommend suitable improvement.

The accident data and road geometry data used for development of predicting accident models to be collected over a number of urban and non-urban sections of roads in Haryana. The detailed data collection of accident along with causes from record of traffic police, NHAI, PWDs, toll booths, FIRs of police stations and other concerned agencies will be collected. This data will be categorized and analyzed for various significant factors leading to accidents on Indian roads. Using Factor analysis the most critical parameters leading to accidents would be derived. Further multiple linear regressions would be used to develop quantitative relationship between the various significant variables. Various suggestions based on study can be elaborated on the bases of prediction model to reduce the VRU accidents in the study area.
Conclusion

The research paper presents a thorough review on vulnerable road users safety standard and various related accident prediction models. Lot of factors, variables and data collection is discussed while describing critical factors about the importance of this study.

This research works the proposal of an experimental or analytical study on statistical tools and technique and expressive analysis to determine the various factors. These factors will help the researcher to determine the important variables leading to accidents and formulate scientific model to predict the vulnerable road users accident.

References