

Abstract

Traffic safety and mobility are crucial parameters of a transportation system. Maintaining a balance between these two factors is essential for the long-term sustainability of a transportation system. To realize an efficient transportation system, efforts aimed at improving mobility are indispensable. However, measures aimed at improving mobility should also ensure that the measures do not increase the traffic risk. This study is aimed at exploring the crucial relationship between mobility and traffic safety at a region-wide level for India, a middle-income country. For low- and middle-income countries, which contribute a major share to the global traffic fatalities, this study provides some valuable insights on the efforts to be undertaken for reducing the traffic risk.

Lack of availability of reliable traffic safety data in low- and middle-income countries is a major issue. In India, due to lack of data collection mechanisms for collection of data related to traffic crashes, the total number of traffic fatalities is the only reliable data. Hence, in this study, traffic safety has been quantified by considering the total number of fatal crashes only. The main objective of this research was to study the relationship between mobility and traffic safety at a region-wide level. To fulfill the primary objective, a number of sub-objectives with the common aim of determining the relationship between mobility and traffic safety were considered.

In the first study, mobility was related to traffic safety by considering data from 30 states and union territories of India. In this study, suitable indices representative of mobility at a region-wide level were considered. Mainly two categories of variables were considered to quantify mobility in this study. These categories include the length of high-speed roads such

as national highways, state highways, and other surfaced roads and the total number of motor vehicles present in a region. The proportion of the length of each category of high-speed roads present in a region to the total roads present in the region was considered as mobility index. Moreover, with respect to vehicle population, the proportions of the total number of registered motor vehicles per unit population and per unit total road length present in a region were considered to be mobility indices. Traffic safety was quantified in terms of the total number of fatal crashes per hundred thousand population. Seasonal autoregressive moving average models were used in this study. The major finding of this study was that except for national highways, all the other surfaced roads were detrimental to traffic safety. Moreover, an increase in vehicle population was adversely related to traffic safety, consistent with the findings of existing literature.

In the second study, the relationship between mobility and pedestrian traffic safety was studied. The variables considered in this study were similar to the ones considered in the first study. Results obtained from this study showed that all the considered mobility measures were detrimental to pedestrian traffic fatality.

In the third study, the relationship between economic growth and traffic safety was studied. Both mobility and traffic safety are outcomes of economic growth. Although economic growth is indispensable for the progress of a country, increase in traffic fatality is not at all desirable. However, the scenario in low- and middle-income countries is that both the total number of traffic fatalities and economy are growing at a rapid pace. One novelty of this study is that it suggests a new economic indicator suitable for studying traffic safety in low- and middle-income countries. The household Consumer Expenditure Survey was used in this study. The primary finding of this study was that economic growth was found to have an inverse relationship with traffic safety for

less developed regions and a direct relationship with traffic safety for regions that were comparatively more developed.

The fourth study was aimed at addressing some of the gaps in literature with respect to traffic safety studies for rural and urban areas. Rural and urban areas have significantly different characteristics; therefore, the risk of traffic fatality in these areas also varies significantly. Rural areas account for higher number of road traffic fatalities than urban areas. However, certain gaps have been observed in literature. The economic growth of a region influences the traffic fatality of the region. However, literature does not present any study exploring the relationship between economic growth and traffic fatality for rural and urban areas. Moreover, vehicle population influences traffic fatality. However, the relationship between various personal modes of travel such as bicycle, two-wheeler, and four-wheeler and traffic fatality has not been explored for rural and urban areas. Literature also does not present studies showing how non-personal modes of travel influence traffic fatality in rural and urban areas. The main reason for these gaps in literature might be due to lack of data availability at an international level. This study aims at addressing these gaps in literature by considering the Consumer Expenditure Survey data. The variables considered in this study were primarily expenditure variables that were used as a proxy. The main finding of this study was that economic growth was found to be associated with a decrease in traffic safety in rural areas and an improvement in traffic safety in urban areas. Similarly, variables such as expenditure on fuel and expenditure on conveyance were found to be detrimental to traffic safety in rural areas and were vice versa in urban areas.

Another study was conducted to relate mobility and traffic safety for urban regions. A total of 50 Indian cities were considered as the regions of interest in this study. Literature presents speed and traffic-safety-related studies. However, the results of most of these studies are found to be

inconclusive. Literature presents a few of the most cited works (Quddus 2013; Kockelman & Ma, 2007; Baruya, 1998) which show the nature of relationship to be different from those identified by some of the previous studies (Solomon, 1964; Nilsson, 1981). A reason for this might be that speed-related studies are mostly location-specific. Hence, the obtained results would mostly be true for a set of controlled factors pertaining to the specific location. In this study, the relationship between mobility and traffic safety was studied by considering similar travel-time-based mobility measures at a city-wide level. One important objective of this study was to determine if the relationship between mobility and traffic safety at the city-wide level remains similar to the location-specific speed related studies by considering similar mobility measures. In this study, travel time information was extracted using Google Maps. Mixed linear modeling was used in this study.

In the last part of this study, certain fatality prediction models were developed at nation- and state-wide levels. The relationship between various independent variables and traffic fatality was considered, as discussed in the previous chapters. Autoregressive moving average model with exogenous input (ARMAX) was used for developing the fatality prediction models. The net state domestic product per capita was found to be a significant variable that was considered in 67.7 percent of the prediction models.

Thus, the research work studied the relationship between mobility and traffic safety. A number of sub-studies with the common aim of establishing the relationship between mobility and traffic safety were conducted. One novelty of this study is that it employs a number of alternate data sources to bridge gaps in related literature. Thus, this research work focuses on the usefulness of alternative data sources to study traffic safety. The findings of this study are especially useful in low- and middle-income countries, where data availability and credibility are major problems.