2. RESEARCH METHODOLOGY

This chapter describes the research method we adopted to project highway crash fatalities involving older drivers. First, we surveyed the literature pertaining to elderly driving and crashes to identify issues and relationships that influence crashes involving the elderly. The U.S. Census Bureau has projected the number of elderly persons in the future. These estimates comprise elderly population that are potentially at risk to traffic fatalities. Much has been written about the population over 65 years of age – for example, health, social characteristics, and the impact of physical and cognitive impairments on driving behavior. Changing income levels brought on by changes in retirement ages and by the economy have also been studied. Travel habits and trip patterns of the elderly have been documented in national transportation surveys. Existing longitudinal studies have examined health issues. In addition, the U.S. DOT has collected a significant body of data on crashes and casualties. Currently, safety on the highway is being improved partially with increased seat belt use and usage of other in-vehicle devices. Furthermore, it is anticipated that deployments of Intelligent Transportation System (ITS) technologies, both within the vehicle and on the highway, will further improve highway safety. Our literature review (Chapter 3) concentrated on the U.S. population over 65 years of age and specifically on the driving behavior of this population.

After a review of the existing literature, we examined various data sources for potential use in the model. A number of criteria were used to determine the feasibility of these data sources. First, because the projections would be for years 2000 through 2025, it was desirable to have as much historical data as possible. Second, it was desirable to have a *single* data source that contains all necessary information on individual older drivers that is pertinent to crash involvement such as household characteristics, demographics, health status with respect to physical and functional limitations, chronic conditions (e.g. Parkinson's disease, glaucoma, etc.), driving patterns, and medication use.

Finally, data sets should contain, at a minimum, information categorized by age, gender, and regional designations.

Unfortunately, no single data source contained all necessary information. Some data sets were compiled for only a few years, and the data sets were not totally compatible. Sufficient data were available that allow us to estimate the probability of an older driver's decision to drive and the average number of miles driven per year. However, that was not the case for estimating crash risk. Data were inadequate to estimate crash risk on an individual driver basis. Consequently, the crash risk model had to be based on the typical characteristics of subgroups of older drivers specified by age, gender and Census region combination. Chapter 4 discusses the data sources that were examined and the rationale for selecting and using a specific data source.

To project the future, one needs first to acquire a comprehensive understanding of what conditions have influenced current and past trends. In the example of older drivers' decisions to drive, we rely on historical data to identify what influences an older driver's decision to drive. The next challenge is to identify the future directions that are likely to "alter" historical trends. Again, in the example of older drivers' decisions to drive, we speculate that the future older population will be healthier, more financially secure, more accustomed to driving, and enjoy longer life expectancy than their counterparts today. All of these trends suggest that the future older population is likely to continue to drive well into their advanced years and will drive more miles and more frequently than the older population today.

To project the future based on the past, we were constrained to predictors (e.g., driving determinants) for which reliable projections are possible. This constraint is consequential in that the *explanatory* power of our empirical models is less than desirable because only selected explanatory variables, for which reliable projections are possible, are included in the model. Consequently, the *predictive* power of our crash model is seriously reduced. For example, vision impairment from cataracts or glaucoma has been suggested in the literature to be a significant crash risk factor. However, without reliable projections on the percentage of older drivers who will suffer from vision impairment, we had to omit that factor in our empirical models.

Using historical data, we developed a series of empirical models: (1) a model to estimate the probability of an older driver's decision to drive; (2) a model to estimate the average number of miles driven in a year by an older driver; and (3) a model to estimate the crash risk of a group of older drivers categorized by age, gender and Census region. The crash risk is defined in two ways: as the total number of driver fatalities from crashes involving older drivers per one million miles driven, and as the total number of fatalities, regardless of age, associated with a crash in which an older driver is involved. The rationale for developing this series of models is that:

- Given the projections of future older population, we can estimate the number of older drivers in the future by multiplying population projections and the estimated probability of an older driver's decision to drive,
- Applying the estimated number of older drivers in the future (from the previous step) to the average number of miles driven annually by an older driver, we can estimate the **total** annual vehicle miles of travel (VMT) by each age group of older drivers,
- Multiplying the crash risk (fatalities per one million VMT) and the total annual VMT by older drivers, we can estimate the two measures of fatalities involving older drivers.

These models are described in greater detail in Chapters 5 through 9.

In summary, ORNL's approach to developing a logical, transparent, and defensible model was as follows:

- Review the literature to ascertain the current state of the research and to identify issues.

- Examine data sources to determine compatibility between modeling issues and data.
- Build a mathematical link between two national surveys so that the minimal information on health status could be included in the model.
- Develop three empirical models based on historical data.
- Formulate assumptions on the projections of independent variables in the empirical models for the years 2000-2025.
- Adjust some empirically estimated parameter values in the models, primarily time trends, to ensure logical projections (e.g. percentages of the population that drives between 0 and 1)
- For the years 2000-2025, project (1) the number of older drivers, (2) the average VMT per older driver, and (3) crash rates and highway traffic fatalities. Projections are generated by age group, gender, and Census region.
- Analyze the projections in terms of the extent to which various factors contribute to the increased fatalities. This type of analysis is crucial for policy makers to help them identify and prioritize areas where actions can be taken to improve older driver safety.