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Volume II Appendices

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16. Abstract

The National Highway Traffic Safety Administration is concerned about highway safety issues for older adults and is interested in understanding what contributes to seat belt use or nonuse among people 65 and older. This background report details the information gathered from a variety of sources addressing the older adult population and those factors that might affect seat belt use.

The research included a review of literature, including experimental and quasi-experimental studies as well as qualitative documents on the cognitive, attitudinal, and physical factors that might influence the use of seat belts among older adults. Design features and the interaction between user capabilities and technology were also explored. Additionally, experts in the fields of aging, vehicle design, law enforcement, physical mobility and human factors were contacted. These individuals provided contextual information to help explain nonuse of seat belts among older adults. Analyses of several national databases, including survey, observational, and crash data addressing key issues regarding aging and seat belt use were conducted. The analyses included runs of frequencies, cross tabs of selected variables, and logistic regressions to explore the relationship between key factors and seat belt use among older adults.

The information gathered in this process was synthesized in order to identify the gaps in knowledge, and to inform and support the development of strategies to increase seat belt use among older adults.

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Executive Summary

The number of older adults in the United States is projected to grow significantly over the next several decades. Driving is currently the primary mode of transportation for older people in the United States, followed by riding as a passenger, and the numbers of drivers 65 and older are expected to at least double over the next 30 years. Older occupants are at increased risk of injury in a crash due to their fragility and as older people begin to drive and ride in passenger vehicles for many more miles crash-related fatalities and injuries are expected to rise.

Research indicates that correct use of a seat belt is the most effective means of preventing serious or fatal injury in a motor vehicle crash. The National Highway Traffic Safety Administration (NHTSA) is concerned about highway safety issues for older adults and is interested in understanding what contributes to seat belt use or nonuse among people 65 and older. In order to fully comprehend the dynamics behind the decision to use or not use a seat belt, the physical conditions experienced by older adults, design features of seat belts, the weaknesses and strengths of various social marketing strategies, differences in the effectiveness of primary and secondary seat belt laws, enforcement levels and techniques, and other issues that may influence seat belt use among older adults must be explored. This background report was originally developed in 2004 and details the information gathered from a variety of sources addressing the older adult population and factors that might affect seat belt use.

The research included a review of literature, including experimental and quasi-experimental studies as well as qualitative documents on the cognitive, attitudinal, and physical factors that might influence the use of seat belts among older adults. Design features and the interaction between user capabilities and technology were explored. Additionally, experts in the fields of aging, vehicle design, law enforcement, physical mobility, and human factors were contacted. These individuals provided contextual information to help explain nonuse of seat belts among older adults. Analyses of several national databases, including survey, observational, and crash data addressing key issues regarding aging and seat belt use were conducted. The analyses included runs of frequencies, cross tabs of selected variables, and logistic regressions to explore the relationship between key factors and seat belt use.

The information gathered in this process was synthesized to identify the gaps in knowledge, and to inform and support the development of strategies to increase seat belt use among older adults. This background research also laid the foundation for additional tasks related to the topic of occupant restraint use among older adults, including a series of focus groups with older adults and a field data collection project on the relationship of seat belt system characteristics and the comfort, convenience, and usability of the belts for older drivers and passengers.

1.0 Introduction

The number of older people in the United States is projected to grow dramatically over the next several decades. According to the Census Bureau, 35 million people 65 and older constituted 12.4% of the total U.S. population in 2000, a figure that will rise to 16.3% by 2020. By 2030, older adults are projected to constitute 71.5 million out of 364 million people, or 19.6% of the U.S. population (www.agingstats.gov/default.htm).

Driving is currently the predominant mode of transportation for older people in the United States. Older Americans depend on private vehicles for the majority of their travel, and it is estimated that the numbers of drivers 65 and older will at least double over the next 30 years. In addition, relative to previous generations, more women are licensed drivers and are holding on to their licenses as they age. Thus, if the older women driver population grows as expected, the number of older drivers could exceed 2.5 times current levels within 30 years.

While fatality rates from motor vehicle crashes have declined significantly for all age groups over the past 20 years, the fatality rates for vehicle occupants over 65 have experienced more moderate reductions (Eberhard et al., 2003). Moreover, as older people begin to drive many more miles and become more of a presence on our streets, they are at increased risk of fatalities from crashes (Lyman et al., 2001). This increase in fatalities among older adults is viewed by policymakers and the public as cause for serious concern.

One factor contributing to older adult fatalities in passenger vehicle crashes may be an increased fragility. Using the Fatal Analysis Reporting System (FARS), the General Estimates System (GES), and the Nationwide Personal Transportation Survey (NPTS) Li et al. (2003) examined the roles of fragility and crash involvement in fatality risk for older drivers relative to their younger counterparts. Fragility begins to increase at 60 to 64 years old and continues to increase steadily with advancing age. In turn, the increase in older driver deaths grows sharply, and for 80 and older the fatality rate is over four times that of drivers between 30 and 59 (Eberhard et al., 2003). Unless significant countermeasures are employed, traffic fatalities for older adults are projected to increase substantially; projections indicate that fatal crashes for drivers over 65 may double or even triple during the next 20 years (Eberhard et al., 2003). Adults over 85 are of particular interest because these individuals experience dramatic rises in frailty levels and increased risk for injuries, and they comprise the fastest growing demographic group in the United States (Older Americans, 2004).

Research indicates that correct use of a seat belt is the most effective means in preventing serious or fatal injury in a motor vehicle crash. From 1975 to 2003 seat belts are estimated to have saved 179,756 occupants of motor vehicles (NHTSA, DOT HS 809-775, 2005). Although older adults are reported to use seat belts more than any other age groups,[1] much of what we know about the reasons older adults do not use a seat belt is anecdotal. Reasons for nonuse include comfort and convenience, the presence of chronic health conditions such as arthritis, and resistance or refusal to use a seat belt. Other presumed factors attributed to nonuse of seat belts include obesity, low education level, and low socioeconomic status (Carr,

[1] Refer to Motor Vehicle Occupant Safety Survey (MVOSS), National Observational Protection Use Survey (NOPUS), and the Behavioral Risk Factor Surveillance System (BRFSS).

2000). Race and ethnicity factors have also been associated with lower seat belt use (Vivoda et al. 2004, Baker et al. 1998).

The older adult population is heterogeneous by nature, with varying demographic and physical characteristics. This requires that research on any given topic related to this population must focus on the many distinct groups that comprise the 65-and-older population in this country. Variability among this age group can be found in general health and physical activity as well as physical and financial independence. Individuals between 65 and 74 generally continue to be physically active, healthy, and financially independent, much like their younger counterparts 30 to 59 years old. Conversely, individuals who are 85 and older experience an increased incidence of disease, disability, and cognitive impairment, often requiring the need for assistance with instrumental activities of daily life, such as handling medications, managing personal finances, shopping, doing laundry, cleaning house, and preparing meals.

In addition to distinct variations among the different age cohorts within the older adult population, patterns of driving and seat belt use will vary according to many of the same socioeconomic and demographic factors that characterize differences in other age groups. For example, lower use of seat belts have been reported among men, African-Americans and Hispanics, people with lower income levels, and overweight people, whereas people with higher education were more likely to wear seat belts. Accordingly, any public policy effort to understand and influence the use of seat belts by older adults must look beyond the summary patterns in the data and document the distinctions by age, income, sex, race/ethnicity, and location of residence (including States with different seat belt laws and levels of enforcement).

It is also recognized that seat belt use patterns may be influenced by design features. In particular, adjustable shoulder belts were found to be more comfortable and used more frequently than nonadjustable belts. Discomfort, due to body pressure/pain, is a reason why drivers dislike seat belts or find them annoying (Freedman, De Leonardis, & Irani; 2000). Documenting these use patterns according to such design features is an important part of understanding the factors that contribute to use and nonuse among any driving population.

The objective of the current study is to understand what contributes to seat belt use or nonuse among people 65 and older, and identify what can be done to increase seat belt use among older adults, now, and in the future, thereby reducing injuries and fatalities among this segment of the population. In order to fully comprehend the dynamics behind the decision to use or not use a seat belt, one must explore factors such as the physical conditions experienced by older adults, design features of seat belts, the weaknesses and strengths of various social marketing strategies, differences in the effectiveness of primary and secondary seat belt laws, enforcement levels and techniques, and other issues that may influence seat belt use among older adults. In order to facilitate such an understanding Westat has conducted a comprehensive review of the current literature addressing the older adult population and all factors that might affect seat belt use. In addition, we have conducted informal interviews with experts in the fields of aging, vehicle design and instrument technology, law enforcement, physical mobility and human factors, as well as completed analyses on several databases that address key issues regarding aging and seat belt use. The following chapters outline the methodology used for this information-gathering task, and provide results concerning issues in occupant protection for the 65 and older age group. This report also discusses the implications of the findings for developing strategic approaches to increase seat belt use among the older adult population.

2.0 Methodology

2.1 Identify Available Information Sources

The first goal was the identification of a comprehensive list of relevant journal articles, studies, databases, surveys, and organizations or individuals working in the fields of seat belt use, older drivers, gerontology, vehicle restraint design, and traffic safety research in order to obtain information regarding seat belt use among older adults 65 and older. Sources identifying frequency data of seat belt use among older adults as well as the cognitive, attitudinal, and physical factors that might influence the use of seat belts were compiled. Literature on design features and the interaction between user capabilities and technology were identified as well. Last, experts in the fields of seat belt use, older drivers, gerontology, vehicle restraint design, and traffic safety research were contacted to identify additional documents and people that might provide contextual information to help explain nonuse of seat belts among the older adult population. The complete list was intended to identify a wide variety of data sources, including national databases, experimental and quasi-experimental studies, and qualitative research. Using these data sources, Westat would then synthesize the literature, identify the gaps in knowledge, and inform and support the development of strategies to increase seat belt use among older adults.

2.2 Research Questions

Research questions concerning the factors affecting the nonuse of seat belts among older adults framed the search for relevant resources as well as the guide for expert interviews:

- To what extent does seat belt use differ among age cohorts within the 65 and older age group?
- What is the distribution of seat belt use by demographic variables within the cohort of older people?
- Does the distribution of seat belt use among older adults vary according to geographic regions, levels of regulation (primary versus secondary enforcement states), and urbanicity?
- Is there any research examining differences in seat belt use among the different racial and ethnic groups? And are there any programs that have specifically striven to increase seat belt use among older drivers in the different racial and ethnic groups?
- To what extent do older people use seat belts in comparison to younger age groups? What are the patterns of seat belt use among Baby Boomers? How does their seat belt use differ from that of older people?
- To what extent does risk perception play a role in seat belt nonuse among older adults?

- To what extent do trip purpose, length, and other driving factors (e.g., road type, weather) affect seat belt use among older adults? How do comfort and convenience affect the use of seat belts among older adults?

- How do developmental factors, physical conditions, and physical characteristics affect the use of seat belts among older adults and how do they interact with other factors?

- What occupant restraint and other vehicle design features (e.g., reminder systems) affect the use or nonuse of seat belts among older adults?

- What effect do media campaigns to increase seat belt use have on increasing the use of occupant restraints?

- What are the implications for seat belt use of future changes in the older adult population (health, mobility, demographics)?

2.3 Analysis of the Literature

Synthesis of the literature on seat belt use among older people included new analysis of the literature with more intensive types of review. The objective was to integrate information from many different resources, to cogently summarize what is known about seat belt use, and identify the most important gaps in the literature. The inquiry identified links between seat belt use and the following:

- Age and sex;
- Other demographic characteristics (e.g., ethnicity, income level);
- Physical limitation;
- Anthropometric characteristics;
- Limitations to dexterity;
- Normal belt use and seating practice;
- Risk perception; and
- Comfort and convenience.

Westat conducted a literature search to identify resources on aging and mobility, seat belt use, older drivers and occupants, and seat belt design. These resources included the results of experimental and quasi-experimental research, focus groups, and theoretical articles on the reasons for nonuse of seat belts among older people. Searches were conducted in Westat's in-house library catalog (WesCat), on-line databases systems, and on the Internet. The research team accessed a variety of information databases, including MEDLINE, library catalogs, and other resource files available on the Internet and accessible through desktop computers. Many of the expert contacts sent additional literature and references as well as media and educational material, including brochures, Web links, videos, and presentation material.

Relevant material was downloaded from the Internet or obtained via the Westat library. Each piece of literature was then catalogued and reviewed. Westat prepared written summaries

for each of the relevant articles that served as the basis for the literature synthesis. Over 140 articles and literature pieces were reviewed (see Section 8.1.A Literature Sources).

2.4 Analysis of Information from Human Resources

Contacts with human resources in the field provided a means to obtain unpublished data, clinical information, and identify sources that might fill current data gaps. Prior to contacting any experts, a contact information form was developed. The form included the name and affiliation of the contact person, reason for contacting the person, a list of key questions, and the disposition of the call, including a list of material and any resources that were obtained from the contact.

Through contacts with experts, Westat made a concerted effort to fill in the information gaps that were identified during the course of the literature review. The focus of each interview was tailored to the professional's area of expertise and its relationship to seat belt use/nonuse among older adults, but also probed for information that might fill in the information gaps. Each completed contact information form was summarized in a one- or two-page report so that information could be synthesized with the results of the other phases of the information search.

Discussions with experts on the initial list often led to the identification of additional recommended specialists. Contacts were also made with a number of societies, professional organizations, and universities involved in the field of seat belt use, older drivers, and medicine. Westat completed discussions with 77 individuals.

2.5 Analysis of National Databases

The research questions listed above provided a framework for the data collection and analysis. The approach taken to addressing the research question concerning the correlation between seat belt use and demographic variables is a good example of how the analysis of the national databases was conducted. Two major questions concerning seat belt use are:

- To what extent does seat belt use differ among age groups within the 65-and-older cohort?
- What is the distribution of seat belt use by demographic variables within the cohort of older people?

Westat used three types of data to respond to the questions regarding seat belt use among older adults: observational, survey, and crash data. Each of these kinds of data provides different perspectives as to the influencers and reasons behind use or nonuse of occupant restraints by older adults. In addition, researchers are often critical of survey data, asserting that respondents feel compelled to offer the most socially desirable answer to a given question. Using survey data as well as observational and crash data allows comparisons between what respondents are saying and what is objectively observed in the real world. See Section 8.1.B for a description of all the data sources.

Table 1 presents several of the databases and the key demographic variables that are contained in them that address these questions.

Table 1: Examples of databases to address research questions related to the rate of seat belt use among older people

Examples of Databases to Answer the Research Question	Variables of Interest
Behavioral Risk Factor Surveillance System (CDC)	Frequency of seat belt use Sex Income Education Physical limitations Perception of risk Race/Ethnicity
Motor Vehicle Occupant Safety Survey (NHTSA)	Frequency of seat belt use Sex Race Age Type of vehicle Presence of air bag Past history of vehicle-related injury
The Fatal Analysis Reporting System (NHTSA)	Safety belt use Type of belt/bag system Injury type and severity Age Sex Driver/passenger Seating position (front seat/back seat)

Westat reviewed the questionnaires and codebooks for each of the databases in order to select appropriate variables for analysis. The research team read SAS data sets or created SAS data sets from flat data files, and ran frequencies and statistics on the relevant data elements. Additional analyses included cross tabs of selected variables, and logistic regressions to explore the relationship between key factors and seat belt use.

The results of analysis of national databases were used to examine several other key research questions that contributed to synthesizing the knowledge base of seat belt use among older people as well as their travel behavior and patterns. In addition, the results of national studies also provided information on the comfort and convenience of seat belt use (MVOSS), how nonuse of seat belts may contribute to fatalities in motor vehicle crashes (FARS), and so forth. Section 8.2 provides detailed descriptions and tables of the various types of analyses and data sources.

2.6 Integration of the Data Collection Methods

Data from multiple types of sources were synthesized to promote understanding about preferences for seat belt use, and the specific conditions in which older people are more likely to wear seat belts. Although the data do not lend themselves to a statistical meta-analysis, Westat conducted a comparative review. In this review, analyses of secondary data sets as well as information obtained from articles, organizations, experts, and other sources were synthesized to advance the understanding of seat belt use among older people.

3.0 Demographic Groups among Older Adults

It is well established that belt use varies across different demographic groups among the motoring public. To illustrate, men have been observed to wear their seat belts less often than women, and older motorists have been observed to wear their seat belts more often than younger motorists (Glassbrenner, 2003; Eby et al., 2002, Wagner, 2003). In addition, some researchers have found that Hispanics and Blacks use seat belts less often than White motorists (Braver, 2003; Glassbrenner, 2003; Lerner et al., 2001), while others found little difference based on race and ethnicity (Wells et al., 2002). If seat belt use does differ among vehicle occupants from different demographic groups, it is critical to understand these interactions. Understanding which demographic groups are less likely to use seat belts will assist in the development of seat belt promotion programs specifically focused on those individuals who are not restraining themselves.

3.1 Young-Old, Middle-Old, and Old-Old

While most people universally accept the term aging as a reference to growing older, the terms *senior* or *older person* are more difficult to define. Much of the confusion regarding who belongs in this category comes from the researchers themselves. Researchers often use different criteria when classifying individuals. While some classify individuals based on chronological age, others might use social factors (age of retirement), physical capabilities (level of flexibility or physical activity), cognitive ability, or a combination of any of these criteria (Crandall, 1991).

In the United States the traditional definition of *old* was institutionalized by the Social Securities Act of 1935 which made the primary worker of a household eligible to collect full retirement benefits at 65 (Uhlenberg, 1987). In 1935 the average life expectancy for a white male was 60 years and for white females it was 64; the figures were 51 and 55 for Black males and females, respectively. However, with the onset of health and medical advances as well as social security and private pension plans, many individuals are living healthy and financially independent lives as they age. In 2001, the average life expectancy for a white male was 75 years and for white females it was 80; the figures for Black males and females were 69 and 76 (Older Americans, 2004). This relatively new phenomenon has necessitated the separation of older adults into three categories: Young-Old, Middle-Old, and Old-Old.

The category of Young-Old typically refers to those individuals who are between 65 and 74 and who continue to lead physically active, healthy, and financially independent lives. People who are 85 and older are now being called the Old-Old age group, and represent the fastest-growing segment of the U.S. population. Their advancing age is often associated with an increased incidence of disease, disability, and cognitive impairment. In addition, these individuals begin to need assistance with instrumental activities of daily life, such as managing medications and personal finances, shopping, doing laundry, cleaning house, and preparing meals. Middle-Old includes those individuals between 75 and 85 years and appears to be a grey area between the two extremes of Young-Old and Old-Old. Overall, many of these individuals continue to live healthy independent lives; however, they begin to show signs of physical and cognitive frailty.

While physiological changes associated with aging are well recognized, changes in seat belt use behavior associated with aging is less documented. Do Old–Old adults differ in their

behavior regarding seat belt use when compared to Young-Old adults or Middle-Old adults? It is generally accepted that, as a group, older adults (70 and older) have higher seat belt usage rates than any other age group. According to the National Occupant Protection Use Survey (NOPUS) conducted in 2002 by NHTSA, older vehicle occupants had a higher usage rate (82%) relative to occupants 25 to 69 (76%) (Glassbrenner et al., 2004). Using 2003 FARS data, 57% of older drivers between 65 and 74 and 62% of drivers over 74 who were fatally injured in crashes were using seat belts. These numbers increase to 89% (65 to 74) and 87% (75 and older) when examining vehicle occupants who were injured (NHTSA, HS 809 766, 2004).

The Motor Vehicle Occupant Safety Survey (MVOSS) is a national telephone survey conducted by NHTSA approximately every two years to monitor attitudes about seat belts, child restraints, reasons for belt use and nonuse, knowledge of seat belt laws, experience with law enforcement, and attitudes about risk perception. The survey also collects information on various demographic characteristics including age, race, sex, income, education, and employment status. Using the 2003 MVOSS data set, Westat examined the relationship between seat belt use and various demographic factors. The MVOSS questionnaire asks two separate questions regarding seat belt use, one addressing lap belts and the other focusing on shoulder belts. To conduct the analyses on overall belt use, a distinct variable was created and defined as the highest of lap/shoulder belt use. This measure of seat belt use was used for any analyses conducted by Westat on the 2003 MVOSS except when otherwise stated. Overall, older adults reported high belt use rates, and there were no statistically significant differences among the Young-Old, Middle-Old, and Old-Old ($p=.26$). Among MVOSS respondents 65 and older, the rate of seat belt use was significantly associated with sex. Older women reported statistically a higher usage rate than did older men ($p=.00$). See Section 8.2.D for a more detailed description of the analyses.

The Behavioral Risk Factor Surveillance System (BRFSS) is the world's largest telephone survey. The survey tracks health risks in the United States, and information from the survey is used to improve the health of the American people. The 2002 questionnaire included 51,082 records for adults 65 and older and includes a question regarding seat belt use. Data from the BRFSS corroborate the findings of the most recent MVOSS. Older men (65 and older) were more likely than older women to indicate that they did not *always* use their seat belts ($p=.00$). There were no statistically significant differences in seat belt use rates ($p>.05$) among the different age cohorts (Young-Old, Middle-Old, Old-Old). See Section 8.2.B for a more detailed description of the analyses.

Using police crash reports, Kostyniuk et al. (2003) examined trends of older adult motor vehicle crashes in Michigan over a five-year period (1998-2002). Over the five-year period, the proportion of older drivers involved in crashes and their rate of seat belt use remained relatively constant. Relative to older passengers, seat belt use was consistently higher for older drivers.

When data were examined for differences between the sexes, belt use for women was always higher than for men. Seventy percent of the drivers who were nonusers were men. Among male drivers, the highest percentage of nonusers vacillated over several years. The highest proportion of male nonusers was in the 70 to 74 age range from 1998-2000. Data from 2000 indicated that the highest proportion of male nonusers were 80 and older. Unlike drivers, the highest percentage of passengers who were unbelted at the time of the crash was women. In turn, the highest proportion of women nonusers was 80 and older. Finally, seat belt use was

inversely related to injury severity, with the lowest usage rate among passengers or drivers fatally injured as a result of the crash.

NHTSA estimates that seat belts saved 14,903 lives in the year 2003 alone (NHTSA, 809-775, 2005). Research indicates that, when used properly, seat belts reduce the risk of fatal injury to front-seat passenger car occupants by 45% and the risk of moderate-to-critical injury by 50% (NHTSA, Report to Congress, 2001). While unbelted vehicle occupants are always at greater risk for injuries and fatalities, evidence suggests that physiological changes associated with aging produce greater susceptibility to injuries caused by seat belts. Chest injury tolerance for belt loading force reduces with age (Augenstien, 2001). Relative to younger adults, older adults are at higher risk for fractures and chest injuries (Augenstein, 2001; Coley et al., 2002; Wang, 2001) and have poorer prognoses (Evans et al., 2001).

Li et al. found fragility, or susceptibility to injury, to be the most important measure for explaining increased fatality risk per vehicle mile of travel (VMT) for older drivers. Using the FARS, GES, and NPTS data, Li et al. (2003) examined the roles of fragility and excessive crash involvement in fatality risk for older drivers relative to their younger counterparts. While crash over-involvement was highest among the youngest age group (16-19 years), fragility accounted for about 60-95% of the increased fatality rates per VMT in older drivers. Fragility increased steadily from 60, with greater increases at 80 and older. Death rates per VMT, for men from 70 to 74 were more than double that of men 30 to 59. Among women this increase started at an earlier age, 60 to 64. Extremely high death rates per VMT were recorded for men and women 80 and older involved in side-impact crashes, at a rate 13 times higher than that of drivers 30 to 59.

Braver et al. (2004) examined the relationship between driver characteristics and the risk they pose to themselves and others on the road. When older adults were involved in a crash the risk of death for the older adult were significantly higher when compared to vehicle occupants in the other vehicle involved in the crash. Older adults suffered the most serious injuries in crashes, where most often the fatal victims were the older driver or an older passenger.

As a group, older adults (70 and older) have higher seat belt usage rates than any other age group. However, research points to no clear difference in self-reported seat belt usage rates across the age cohorts between 65 and 85. Conversely, seat belt usage is clearly associated with sex. Older men both reported and were observed to have lower seat belt use relative to older women. In addition, age differences among older men were identified in some cases. Among passengers involved in crashes, women were more likely to be unbelted at the time of the crash. With regard to the outcomes associated with crashes, there are clear differences between the age cohorts. The oldest age group is more frail and vulnerable to the seat belt and belt-induced injuries. In addition, women are more fragile than men and the risks of death in a crash rise for women at a younger age. Women may be at a higher risk from 60 and older while men only reach that risk level 10 years later. Due to the fatal nature of thoracic injuries and rib fractures for older adults, seat belts present both a risk and protective factor to this population group. Seat belt use and risk of serious or fatal injury to older adults will be discussed in more detail later in this report.

3.2 Racial and Ethnic Groups

Studies have examined the different rates of seat belt use for various racial and ethnic groups (Braver, 2003; Cordy et al., 2002; Glassbrenner, 2002; Lerner et al., 2001; Vivoda et al., 2004; Wells et al., 2002). However, when examining for differences, most did not address differences across age groups within the respective racial or ethnic groups. According to current studies there are some discrepancies in the findings regarding belt use. Some researchers have found that seat belt use for Blacks and Hispanic occupants differs from White vehicle occupants (Braver, 2003; Eby et al., 2002; Glassbrenner, 2003; Lerner et al., 2001), while others find little difference (Wells et al., 2002).

In 2002, NHTSA conducted its annual National Occupant Protection Use Survey (NOPUS) and observed little variability between seat belt use rates for vehicle occupants described as Black or Other relative to those identified as White. This difference was not statistically significant (Glassbrenner, 2002). The 2003 MVOSS results support the NOPUS findings. Little variability was found among the different racial groups: White, Black, and Other (see Section 8.2.D), and the differences were not statistically significant ($p > .05$).

The Insurance Institute for Highway Safety conducted an observational survey of seat belt use in four metropolitan areas in order to examine the effects of primary versus secondary enforcement seat belt laws. Two cities were located in States with primary laws (New York, Texas) and two were located in secondary law States (Massachusetts, Illinois). In the primary enforcement States no clear differences associated with race or ethnicity were observed; however, in the secondary States vehicle occupants identified as Black were less likely to wear seat belts relative to White or Hispanic occupants (Wells et al., 2002).

An observational study recently conducted in Michigan found that a motor vehicle occupant identified as Black was less likely to wear a seat belt regardless of age, sex, vehicle type, or seating position compared to a vehicle occupant identified as White or Other (Vivoda et al., 2004). Consistent with results from previous studies, Vivoda found that sex, type of vehicle, and seating position were also strong predictors of nonuse. With regard to age, Vivoda found that while seat belt use generally increased with age, there were no significant differences in seat belt use between vehicle occupants over 65 and those between 30 and 64. Interactions between age and race were only significant with regard to occupants between 16 and 22 and 23 to 29, and in both cases Blacks were less likely to wear seat belts when compared to White vehicle occupants of the same age.

Three separate studies (Braver, May 2003; Cosby et al., 2003, Lerner et al., 2001) examined belt use among crash victims. Using the Fatality Analysis Reporting System (FARS), Braver examined seat belt use of crash victims and found, relative to White and Hispanic vehicle occupants, Blacks were less likely to have been reported as being restrained. Lerner et al., analyzed the influence of certain demographic characteristics on seat belt use by occupants injured in a crash and found being White was a significant predictor of belt use. Using FARS data collected for 2000, Cosby et al. found lower usage rates for Blacks 65 and older relative to White occupants in the same age group. This difference was not evident within the middle age group (30 to 64) where seat belt use was almost the same.

Cosby et al. also used the Behavioral Risk Factor Surveillance System (BRFSS), and Motor Vehicle Occupant Safety Survey (MVOSS) to assess differences in self-reported seat belt use among the different racial groups. Results from the BRFSS (1997) indicated that Blacks report lower belt use when compared to Whites in the following demographic categories: females, 65 and older, college education, and obese. Older females who were calculated to be extremely obese were over 2.5 times as likely to report low belt use than those of normal weight (body mass index was calculated based on respondents' reported height and weight). Finally, data from the 2000 MVOSS indicated that Blacks are more likely than Whites to believe that they would receive a ticket for not wearing a belt (also see Preusser et al., 1997), and seat belts are as likely to harm you as to help you. On the other hand, Black respondents favored a front seat primary seat belt law.

In order to better understand the traffic safety needs of the Black community and to determine an effective means of directing media messages to this population Cordy et al. (2002) conducted a series of focus groups. One focus group at each of six sites was for older adults 60 to 79 years old. They ranked nonuse of seat belts as the second most serious traffic safety problem in the Black community. In each of the focus groups a substantial number of participants indicated they did not use seat belts on a fulltime basis. Reasons for nonuse included wrinkled clothes, uncomfortable fit (particularly among women), short rides, forgetting to use it, and not in the habit of using it. Negative associations concerning seat belts included possible risk to personal safety and an aversion to law-enforced seat belt use. One participant felt that "Black people have not been taught the value of seat belts."

Participants in the Cordy study indicated that part-time usage is common within the community. Most decide to wear seat belts on a trip-by-trip basis. The decision to use a seat belt often depends on factors such as perceived skill of the driver; distance traveled, and type of roadway (highway versus local). Focus group participants questioned MVOSS survey results that showed support for seat belt laws in Black communities. Nonprofit organizations, churches, and schools were considered most likely to be effective in exposing their community to traffic safety. The most trusted sources of information were doctors, hospitals, and churches; however, politicians and law enforcement were not trusted. Participants noted that ads reflecting real-life situations and ordinary people make the most significant impressions on them because they are believable and connected to the community. Older adults believed the emphasis should be on developing media campaigns that portray real life situations. Interestingly, an issue raised on several occasions during focus groups in Mississippi was that literacy may be an issue in understanding laws and issues, particularly among the older adult population.

Hispanic drivers have lower seat belt use rates than White non-Hispanics (Parada et al., 2001; Harper et al., 2000), and higher fatality rates in crashes (Baker et al., 1998; Harper et al., 2000). Using FARS data Harper et al. (2000) examined fatal crashes for Hispanic and non-Hispanic vehicle occupants in Colorado. Eighty-four percent of Hispanic drivers who were fatally injured were reported not to be wearing a seat belt compared to 70% of White non-Hispanic drivers.

Racial differences were also found in a study conducted by the Florida Department of Transportation (Sapolsky, 2001). While seat belt use was observed to be similar for White and Hispanic women, seat belt use for Black women was substantially lower. In addition, Hispanic and Black men were less likely to use their belts relative to White men. When age was introduced as a factor, Black and Hispanic front-seat vehicle occupants older than 59 were less

likely to wear their seat belts when compared to White front-seat vehicle occupants of the same age. Conversely, using self-reported and observational data, several studies have found that Hispanics have higher seat belt usage rates compared to White or Black occupants (Nelson et al., 1998: Oguntoyinbo, 2001). Analyses of the BRFSS data (2002) show that Hispanics were only 39% as likely as Whites, and Blacks were 84% as likely as Whites, to say that they wear their seat belts *sometimes, seldom* or *never;* inferring that Hispanics and Blacks were more likely to wear their belts than White occupants.

Research on seat belt use among Hispanics may be inconclusive for a variety of reasons. Mexicans are known to have lower belt use rates while other Hispanic groups have higher belt use rates (Arce et al., 2004). Thus, seat belt use among Hispanic demographic groups is difficult to determine, and is strongly influenced by country of origin and current place of residence. In focus groups with Mexican immigrants Arce et al. (2004) found that time in the United States has a greater relationship to seat belt use than education level. In a study of Hispanic migrant farm workers in California, Stiles et al. (1999) found that although 86% of the workers said they wore their seat belt all the time during face to face interviews only 37% actually wore their seat belts in an observational survey conducted at that same location.

In a 1995 NHTSA study, male Hispanic focus group participants cited law enforcement as the primary reason for their wearing a seat belt. Some participants were currently driving without a license because the Spanish translation of the driver's manual was too difficult to comprehend and the cost of obtaining a driver's license, vehicle registration, and insurance was too expensive. None wanted to be targeted by the police and risk losing their main mode of transportation for not wearing a seat belt (Mueller et al., 2004). On the other hand, Hispanics may not wear seat belts because they believe that seat belts are uncomfortable, not safe, unnecessary for short trips and unnecessary for passengers in the back seat. Some of the male participants stated that good drivers don't need to wear seat belts and others seemed to embrace the idea that an individual's time to die has been preordained and there is nothing one can do to prevent or change it (Mueller et al., 2004). Additionally, Hispanics were more likely to be driving older vehicles which are less likely to have functioning seat belts (Ucles, 2001).

Although there is inconsistency in the findings with regard to the relationship between race and ethnicity and seat belt usage, there is a general understanding that there are differences among Whites, Blacks, and Hispanics. Evidence from studies, surveys, and focus groups suggests that the decision to use a seat belt is driven by different factors. Black and Hispanic vehicle occupants express concerns regarding law enforcement for differing reasons. Blacks feel that the importance of using a seat belt for safety has not been effectively communicated to the Black community; that they may be targeted, and they are more likely to receive a ticket for not wearing a seat belt compared to White occupants. Hispanics' decision to use seat belts is somewhat more complex. It might be a reflection of their country of origin, time in the United States, status in the United States, as well as other beliefs. Regardless, programs to increase seat belt use within the communities must consider the different customs, perceptions, and attitudes of the communities. An effective message must be communicated in a manner that will address any misconception, and in a way that will be fully understood and trusted by the community. Effective media campaigns must be specifically tailored to the community of interest.

3.3 Socioeconomic Status

Level of education and socioeconomic status have also been linked to seat belt use (Cosby et al., 2003; Lerner et al., 2001; Mueller et al., 2004; Shinar et al., 2001; Wells et al., 2002). Studies examining the relationship between education or income and seat belt use have not usually explored age differences. In general, studies have found that belt use is directly and positively related to level of education and income.

Shinar et al. (2001) used data from annual telephone surveys conducted by Prevention Magazine from 1983 to 1995 to examine trends in driver health-related and safety-related reported behaviors and attitudes over a decade. The annual surveys were conducted by phone using a random sample of 1,250 adults representative of the U.S. adult population. The analysis focused on four demographic variables: age, sex, education, and income in relation to questions on seat belt use, speeding, and drinking and driving. Shinar et al. found that although seat belt use appears to be unrelated to both speeding and to drinking and driving, there was a direct relationship between seat belt use and sex, age, and education. That is, women reported higher belt use than men; older adults reported higher belt use than younger adults; and higher educated participants reported more frequent use than lower educated participants. There was no significant interaction of age with income or education.

In a four-city seat belt use observation study conducted at gas stations by the Insurance Institute for Highway Safety, education levels were determined through short interviews with the observed subjects. Results confirmed earlier findings that drivers with higher educational attainment were more likely to use belts. This finding was consistent for Blacks, Hispanics, and Whites. However, Black drivers without college degrees in secondary law states had belt use rates that were significantly less than either White or Hispanic drivers having the same level of education (Wells et al., 2002).

Lerner et al. (2001) studied the records of injured adults admitted to a trauma center as a result of motor vehicle crashes to better understand the influence of various demographic factors on seat belt use by adults. The demographics examined included age, sex, race, and the residence ZIP code. ZIP code served as a proxy for income based on geographic location as identified in the 1990 U.S. Census. Data were available for 1,366 patients admitted to the trauma center following motor vehicle crashes. The results of a logistic regression analysis indicated that age, sex, race, socioeconomic status, and position in the vehicle were all significant predictors of seat belt use in the crash. Those individuals with a higher socioeconomic background were more likely to wear seat belts at the time of the crash. Seat belt use was also higher for women, Whites, drivers, and adults older than 60.

Using 1995 data from FARS and the Nationwide Personal Transportation Survey, Braver (2003) identified socioeconomic status (based on educational level) as the strongest determinant of occupant death based on miles traveled; stronger than race or Hispanic origin. Seat belt use rates for fatally injured drivers were lower among those drivers with lower levels of education.

The 2003 MVOSS survey results indicated that reported belt use increases in conjunction with higher education and is significantly related to income levels. Reported *all the time* use by older drivers (65 and older) tended to be lower for individuals with fewer years of education

when compared to those with some college education and above. While it appeared that income was significantly related to lap/shoulder belt use (p=.01) the relationship was not monotonic. That is, higher income was not necessarily related to higher lap/shoulder belt use rates. To illustrate, 93% of older adults with an annual income of $50,000 to $74,999 reported wearing their seat belts *all the time* while 87% of older adults with an annual income of $100,000 or more reported wearing their seat belts *all the time*.

An additional survey that gathers information on belt use and various demographics including education and income is the Behavioral Risk Factor Surveillance System (BRFSS 2002). Data from this survey indicated that people reporting different levels of education also report different levels of belt use (p=.00). People reporting less than an 8th grade level of education were 40% more likely to indicate that they wear their seat belts *sometimes, seldom*, or *never* when compared to those individuals with some college education. Those with a 9th to11th grade level of education were 33% more likely to report part-time or nonuse when compared to those individuals with some college education. Reported seat belt usage rates were also related to level of income. People at the lowest end of the income spectrum were 39% more likely to report part-time or nonuse when compared to those in the mid-range of the income spectrum (p=.01). In turn, those at the highest end of the spectrum were less likely to indicate part-time or nonuse (p=.01), suggesting that people in the highest income level use their seat belts regularly.

Evidence from the different studies, surveys, and focus groups suggests that the decision to use a seat belt varies according to economic status and level of education. Generally, older adults at higher income and education levels use their seat belts more frequently than older adults at lower income and education levels.

3.4 Baby Boomers

Baby Boomers are the 78 million people born from 1946 to 1965. The generation preceding the Baby Boomers, those born from 1909 to 1945, comprise much of the present-day older population. Increased life expectancy and the increased growth of the older adult population point to a heightened need for advances in all types of transportation as the Baby Boomer generation begins to age. In addition, generational differences between these two groups indicate that any adjustments to transportation needs must consider differences in the level of education, lifestyles, and the importance placed on automobiles as a main source of transportation. To illustrate, higher education is typically associated with better health, higher economic status, and increased travel. In terms of years of formal education, Baby Boomers are more educated than their older counterparts.

Opinions regarding future seat belt use of aging Baby Boomers are conflicted. A number of experts interviewed indicated that belt use is a socially conditioned habit in this cohort, and their belt use will therefore be higher than that of current older-age cohorts. They buttress their argument by noting that lap belts were required as standard equipment in all new vehicles for all passenger positions beginning in 1968, and in 1990 a Federal mandate required lap/shoulder belts for all outboard positions in all new-model vehicles. In addition, during the mid 80s States began requiring that all front passengers in passenger cars, pickups, SUVs, and vans wear seat belts. Thus, many Baby Boomers were exposed to seat belts and seat belt laws beginning at a much younger age compared to the current older adult population. Baby Boomers have also

been faced with caring for their own aging parents, and this fact has made them more aware of various frailty and safety issues than their older counterparts.

Other experts believe that a driving force in determining whether a seat belt is used by an older adult is comfort and convenience. If there are no changes to the current seat belt design, it is the experts' belief that this issue will exist in the future as well. In other words, there is no strong evidence that the Baby Boomer generation is aging differently than the current older adult population. Baby Boomers are still exhibiting the normal physiological and mental signs of aging. The average American female 60 to 69 is 63.1 inches tall, and is expected lose at least 2 inches by the time she is 80 years old. The average adult male 60 to 69 is 68.6 inches tall, and will lose 2 inches by the time he is 80 years old (Center for Disease Control). This muscular-skeletal degeneration may contribute to older adults complaining about seat belts cutting across their necks or the belts putting pressure on their skin and chest. Furthermore, 31.3% of men and 39.3% of women over 65 report having arthritis that may contribute to their having difficulty reaching for or buckling seat belts (Older Americans 2004). These numbers increase for adults over 70, reportedly 58.1% of men and 63.8% of women (Centers for Disease Control). According to these experts, without adjustments and improvements to current seat belt design, a percentage of older adults will either continue to not wear their seat belts or stop wearing them as seat belts become more difficult or uncomfortable to use.

A third group considers the rise in belt use with age to be a common phenomenon that will occur as the Baby Boomer generation ages, just as it did with the current older population. The only difference will be that Baby Boomers will be driving longer, farther distances, and in greater numbers than any other previous older population.

Bush (2001) examined various forecasts for future older populations. Bush believes that Baby Boomers differ from the current generation of older drivers and we need to understand the differences in their lifestyles to predict future transportation needs. Baby Boomers started driving at younger ages and will have more experience behind the wheel that may lead to a reduction in crash rates. As stated earlier, Baby Boomers are better educated, and education correlates with improved health and economic status, and increased travel. Female Baby Boomers are more active in the workforce, make more trips, and will have more demand for travel than current older women. Baby Boomers are more used to owning vehicles and are more reliant on them for personal travel. All the above factors may increase exposure (Bush, 2001). An additional factor to consider is that the Baby Boomer generation may have different alcohol use patterns than previous generations of older adults, which may have an additional effect on crash risk for Baby Boomers when compared to the current older adult population (Waller, 1996). Predictors of future crash rates or behaviors are difficult to analyze as they may be specific to a generation.

Using 2002 BRFSS data, Westat conducted preliminary analyses on how seat belt use varies across different demographic groups of the Baby Boomer population. Findings were consistent with findings from both younger and older age groups. Women reported higher belt use rates than men. When asked about frequency of belt use, 90% of women Baby Boomers said they *always* wore their belts, compared to 83% of the men. Income was directly related to belt use. Individuals reporting an annual salary of less than $15,000 reported *always* using a seat belt less frequently (83%) than did those in any other income group (Lower Middle: 85%; Upper Middle: 88%; and Upper: 91%). Contrary to findings from other surveys, both Blacks (89%) and Hispanics (92%) reported higher use than White respondents (87%).

Vehicle designers are taking a great interest in the Baby Boomer generation as they are consumer-oriented and are interested in designing for both current older drivers as well as for the future old. Vehicle manufacturers believe that the Baby Boomers, in a youth-oriented society, are much less likely to purchase automobiles designed for older drivers (Ford, 2000). That is, consumers are not apt to purchase vehicles solely based on comfort of seat belts, or ease of entry and egress. With that in mind, manufacturers have begun to introduce features commonly referred to as “transparent enablers.” These unobtrusive features take into account physical and cognitive changes that often accompany aging and help drivers to overcome them. Vehicle manufacturers stand in the middle of a great tug of war. Their challenge is to develop vehicles that can be sold to people born after 1979 (“Generation Y”) as well as to a fast-growing older adult population. A more in-depth discussion of vehicle designers’ response to the growth of the older-driver population is presented later in this report.

4.0 Reasons for Nonuse

4.1 Risk Perception

It is commonly accepted that younger adults, due to immaturity, lack of knowledge, and inexperience, engage in many risky behaviors (Jonah 1990, NHTSA, Occupant Protection Facts, 2004; Williams et al. 2002). Numerous studies have found that younger drivers are more likely to take risks while driving to make driving more fun. These risks can include tailgating, driving over the speed limit, passing other vehicles in a no passing zone, and entering an intersection when a signal light is about to turn red. Little is known about the risk-taking behavior of the older adult community. However, conventional wisdom suggests that with increased knowledge and maturity, voluntary risky behavior should be inversely related to age. That is, as one ages voluntary risky behavior should decrease.

Among the experts talked to for this review, there are differing beliefs as to the level risk perception plays in decisions among older adults. When working with older adults, some of the experts have detected attitudes and behavior patterns denoting awareness among older adults of special safety concerns and their vulnerability in motor vehicle crashes. Others see no difference between older adults and any other age group with regard to their perceptions of risk and decisions regarding whether or not to use a seat belt. A number of occupational therapists mentioned that within the older age group there are those drivers and passengers who pre-date seat belts; and have a different attitude as to the need for a seat belt. For the oldest-old, who drove for many years without belts, the belts often seem superfluous. Safety belts may even be perceived as a burden since the laws were passed well after they initiated independent driving.

Jonah analyzed the results of a Canadian national telephone survey on drinking and driving, conducted by Statistics Canada for Health and Welfare Canada, to better understand the correlation between age and risky behavior and driving. The results of the survey indicated that adults over 65 were the least likely to report that they never use a seat belt. Older adults inclined to consume alcohol, drink and drive, or drive aggressively were more inclined to drive without seat belts (Jonah, 1990).

With this in mind, Westat examined responses to key questions in the 2002 BRFSS and 2003 MVOSS to assess the relationship between certain behaviors considered to be health risks (e.g., smoking, nonuse of a seat belt in a vehicle with an air bag, and missing annual health exams) and the likelihood of seat belt use among older adults. The following paragraphs outline some of the findings and Section 8.2 includes tables and a description of the analyses for each of the data sets.

Older adults who admitted to being regular smokers were more likely to report part-time or nonuse of seat belts when compared to those who never smoked (p=.00). However, those older adults who began smoking before the age of 12 were less likely to report part-time or nonuse than those who started smoking as adults (16-60 years) (p=.04) (BRFSS, 2002).

Older adults who were single were more likely to report part-time or nonuse of seat belts (*sometimes, seldom*, or *never*) when compared to those who were currently married (p=.00) (BRFSS, 2002). In addition, when compared to retired older adults, those who were currently in

the labor force were more likely to indicate that they wore their seat belts *sometimes, seldom* or *never* (p=.00).

Considering the overall physiological weakening associated with age, one might assume that any older adult who does not undergo a routine annual checkup might be engaging in a pattern of risky behavior. With that in mind, Westat examined the association between activities indicative of someone who is conscientious about health and patterns of seat belt use. Behaviors of interest included annual checkups, mammograms (for women), and PSA tests (for men). Older women who had a mammogram within the past year were less likely to report *sometimes, seldom* or *never* using a seat belt when compared to older women who never had a mammogram. In addition, those who had a mammogram within the past 5 years were also less likely to report *sometimes, seldom* or *never* using a seat belt when compared to older women who never had a mammogram. With regard to men, those men who had PSA tests were less likely to report *sometimes, seldom* or *never* using a seat belt compared to men who had never had the test (see Section 8.2.B). While these are simple examples, the findings might offer some insight into how seat belt use relates to an overall pattern of health-conscious behavior. That is, those older adults who are more likely to track their own health are more likely to use a seat belt.

Using the MVOSS 2003 data Westat examined the relationship between the presence of an air bag in the vehicle and seat belt use among older vehicle drivers. Older drivers were more likely to report that they would use a seat belt when the vehicle they were in was equipped with an air bag. Ninety percent of older drivers using vehicles with an air bag used a seat belt *all the time* compared to 88% of the older adults driving vehicles without an air bag (p=.02).

The 2003 MVOSS included a question to assess people's beliefs concerning their chances of surviving a crash. Interestingly, 93% of the people who did not have a fatalistic attitude towards life indicated that they wore their seat belts *all the time* compared to 88% of the individuals who felt that if it is your time to die, you will die, regardless of whether or not a seat belt is used during a crash (p=.00).

There are those experts who suggest that seat belt use has nothing to do with perceived risk and believe that it is related to habit. Therefore, once older adults are taught to use the belt regularly they will do so. The 2003 MVOSS asked individuals their reasons for seat belt use. Ninety-five percent of the individuals who gave "habit" as a reason for their belt use indicated that they wore the belt *all the time* compared to 68% who did not give habit as a reason for their belt use (p=.00). In addition, 97% who felt uncomfortable when not wearing a seat belt reported they wore theirs *all the time* compared to 83% who felt that this was not a reason why they wore their seat belts (p=.00). Interestingly, 93% of the people who indicated that they wore a seat belt because they wanted to prevent serious injury also indicated that they wore their seat belt *all the time*.

In recent focus groups with older adults on licensing regulations, AARP discerned recognition by older adults that they need to be conscious of their safety and vulnerability. Older adults were willing to accept regulations if they are fair, linked to specific problems, and not prejudicial based only on age. In fact, older drivers have a general awareness of their diminishing capabilities and make numerous strategic and tactical adaptations to compensate (Smiley, 2002). Many older adults create self-imposed restrictions on driving patterns including reduced travel at night, in rush hour, and on high-speed roads. Older drivers can be assisted in making

appropriate adaptations through driver education. Strategic advice to older adults would include promoting the use of seat belts as well as other appropriate changes to driver behavior.

4.2 Trip Purpose, Length, Driving Factors

The 2001 National Household Travel Survey (NHTS) provides nationally representative data on trip type, purpose, and other characteristics of travel for the U.S population. The NHTS 2001 included approximately 9,000 respondents older than 65. Collia et al. (2003) summarized information regarding the travel patterns of older Americans as presented in the NHTS. Relative to the younger population, older adults take fewer trips. Although older adults represented 12.6% of the population in 2001, they took only 10% of the daily trips and 8% of the long distance trips.

Travel by personal vehicle is the leading form of transportation for all age groups in the United States. However, relative to younger adults, a higher percentage of older adults take trips in vehicles as a passenger rather than the driver. This is especially true for older women. Overall, 80% of older adults report to be drivers as compared to 93% of younger adults; older women trail older men by 18 percentage points. Older drivers prefer to travel in sedans (77%) over trucks (10%), vans (8%), or SUVs (4%). Data analyses from the 2003 MVOSS indicate that vehicle type is directly related to lap/shoulder belt use for older adults. Consistent with findings for the younger age groups, pick-up truck occupants (82%) reported *all the time* use less frequently than occupants in any other vehicle type (sedans: 92%; vans: 88%; other: 90%) (p=00).

NHTS provides detailed characteristics of daily trips. Older adults take a lower number of daily trips and travel shorter distances than their younger counterparts. Older women take the least number of daily trips and travel the shortest distance of all the age and sex groups. When providing reasons for their daily trips, older adults often cited social or recreational activities (19%), family and personal reasons (18%), and shopping (18%). Compared to younger adults, a much smaller percentage of daily travel for older adults is for work (3% versus 16%). Most daily trips are made in the middle of the day; over 60% of travel by older adults is between 9 a.m. and 4 p.m. It seems that older adults are avoiding peak commuter hours. Approximately 66% of the older respondents expressed concern regarding traffic congestion.

NHTS also provides characteristics of long-distance trips. When taking long-distance trips, both younger (89%) and older adults (89%) prefer the personal vehicle over other modes of travel such as public transportation. Most long-distance trips taken by older adults are for pleasure. Older adults tend to take fewer long-distance trips (Collia et al., 2003).

The Academy for Educational Development conducted a series of focus groups with older drivers in Florida and Pennsylvania. Participants indicated that they are less inclined to use seat belts in the case of short trips (AED, 2002). Some States have conducted studies of travel patterns and belt use at the local level. While experts did not provide Westat with hard data for each State, they suggested that older drivers, like the general public in their State, are more likely to use seat belts on longer trips that involve freeways and are less likely to use them on shorter trips or when in pickups. Belt use is lower for rural travel, and in trips that are for farming, or involve completing errands and visiting neighbors. Drivers and passengers are more likely to buckle up for trips “into town” or on higher speed highways.

4.3 Passengers

There are two ways to examine passenger travel with regard to the older adult population. The first is the difference in seat belt use when older adults are sitting in the passenger position compared to the driver position, and the second is the effects of the presence of other passengers on the belt use of an older driver.

Across all age groups, belt use rates are consistently lower for passengers (77%) relative to drivers (80%) (NOPUS, 2003). Evidence from the National Household Travel Survey (2001) demonstrates that when traveling in passenger vehicles, older adults (26%) take a higher percentage of their daily trips as passengers than do younger adults (18%). Furthermore, the observed differences in seating position can largely be attributed to older women. When taking a trip, older men (88%) tend to assume the driver position as much as their younger counterparts (90%). Alternatively, younger women (76%) tend to drive more often relative to older women (62%) when taking daily trips (Collia et al., 2003).

In a variety of focus groups older adults mentioned the influence of grandchildren in the vehicle. When grandchildren are in the vehicle, older adults will make a point of wearing their seat belts. Focus group participants emphasized that they are interested in serving as role models for their grandchildren and that there should be more public information on this issue (AED, 2002).

It is common knowledge that crash risk for teen drivers increases as the number of teen passengers increases (Williams, 2001; Doherty et al., 1998). Younger drivers are less experienced than their older counterparts (25 to 64 years old), and are distracted from the task of driving when other teenage passengers are present. Although older adults (65 and older) may have more experience driving than teenagers, their elevated crash risks may stem from sensory, motor, and cognitive declines. Many older adults address their diminished skills by practicing compensatory measures. To illustrate, older adults tend to take most of their daily trips during the mid-day hours in order to avoid rush hour traffic that can be confusing for them, and travel when daylight is at its peak and visibility is optimal. Few researchers have examined the effects of passengers on the safety of older drivers. The presence of a passenger in the vehicle might distract the older driver and increase the likelihood of an at-fault crash.

Hing et al. studied four years of crash data from Kentucky State police reports, 1995-1998. Overall, older drivers (75 and older) showed a higher tendency to be involved in single-vehicle and multiple-vehicle at-fault crashes when compared to Young-Old adults (65 to 74). This problem was exacerbated when two or more passengers were riding along in the vehicle. In addition, vehicles with all-male occupants were particularly prone to be involved in at-fault crashes. The negative impact for these older drivers was greater on less-ideal road conditions, roads with curves. Hing et al. (2000) suggest that possibly the presence of passengers raises the level of distraction in the non-ideal driving environment.

4.4 Comfort and Convenience

Two of the major reasons individuals choose not to use seat belts are the lack of comfort and convenience of occupant restraints. Many experts from various backgrounds state that in their work with older adults the comfort issue factors heavily in lack of belt use.

Complaints related to comfort have been voiced by older adults in a variety of settings including focus groups (Steinfeld et al., 1999), meetings with physicians and occupational therapists, and in response to surveys (Balci et al., 2001; Steinfeld et al., 1999). In some cases comfort and a physical condition are interrelated. That is, individuals of extreme stature (smaller or taller) or weight often had more comfort-related issues when discussing seat belts. Common issues related to comfort and convenience identified in numerous studies and discussions with experts were:

- Difficulty reaching the seat belt;
- Difficulty buckling the seat belt;
- Girth or height;
- Desire not to wrinkle clothing;
- The belt cuts across the neck or chokes the occupant;
- The belt puts pressure on the skin and chest;
- Release method can be confusing;
- Passive shoulder belt system startled the occupant; and
- Buckles were difficult to locate.

The Delphi Corporation, a manufacturer of occupant restraint systems, looked at the comfort and usability of seat belts via questionnaires administered to 194 participants (Balci et al., 2001). Among those who reported part-time use, the primary reason offered was forgetting, followed by discomfort. Older respondents reported having more difficulty using the seat belt because of the location of the shoulder belt, the belt pulling force, and inappropriate and loose fitting of the belt on the body. Shorter-statured drivers reported needing two hands to pull and secure the belt. Participants who were above the 66^{th} percentile with regard to their weight had complaints about the belt twisting and the sensation of suffocating, and women drivers had more complaints than men.

An additional study conducted by Delphi examined factors associated with seat belt comfort and convenience. The goals of the study were to better understand how the geometric designs of seat belts work with the anatomical characteristics of occupants, and improve designs to achieve higher usage rates. Results of the previous survey suggested that a primary reason many people have for not wearing seat belts is that they are inconvenient to fasten and unfasten and uncomfortable to wear, especially for specific stature groups (small females and large males). Delphi tested 54 experimental scenarios with 15 volunteers who gave subjective ratings on seat belt pressure and fit. They found that the seat back angle and the D-ring location for the fore-aft and inboard-outboard directions were statistically significant for contact pressure and fit. Height adjustment is also significant in achieving a better fit and helps reduce the risk of the belt rubbing the neck or slipping off the shoulder. While analysis showed no impact of height and body mass index on seat belt pressure in the normal driving condition, these factors did affect the comfort rating of the seat belt fit and routing (Chen et al., 2003). Discomfort associated with belt use may be alleviated by simply using the height adjuster located along the B-pillar.

Unfortunately, many older adults may be unaware of the height adjustor, which allows the driver to reposition the shoulder belt to a more comfortable height. For those individuals who cite discomfort as the primary reason for part-time or nonuse, increasing their awareness of the different design options available in their vehicles might contribute to increased levels of belt use.

NHTSA has encouraged manufacturers to incorporate various systems that will offer improvements to the fit and accessibility in vehicles of seat belts. The FMVSS No. 208 includes requirements regarding adjustments to lap/shoulder belts for all seating positions including: hooks, tension relieving devices, seat belt contact force, latch plate location and access, and retraction of seat belts when doors are open (NHTSA Initiatives, 2003).

Unfortunately, a number of experts mentioned that older adults are unaware of any existing adaptive equipment that may improve the comfort of seat belts (Silverstein et al., 2005). Several occupational therapists mentioned that one of the first actions they take with an older adult behind the wheel is to reposition their seat and restraint so that they will be both safer and more comfortable. In most cases this is the older adult's first introduction to these capabilities in the vehicle. Many dealerships do not take the time to familiarize older adult consumers with many of the additional features that newer vehicles offer. In turn many older adults show little or no interest in the technological advances, they simply use the vehicle as a mode of transportation. Additionally, many older drivers do not buy new vehicles as frequently as other consumers, and thus, their vehicles may not have some of the features that are now required on newer vehicles to promote comfort and convenience.

The Consumer Assessment Survey (CAS) conducted by the Rehabilitation Engineering Research Center on Aging is a longitudinal study of older adults with disabilities. In the sixth year respondents were asked a series of questions on vehicles, including difficulties encountered when driving or riding in a vehicle. There were a total of 639 respondents over 65 who reported they had, at one time, driven a car. Of these, 45.5% indicated that they were still driving while 54.5% no longer drove. About three quarters (76.2%) reported that they had driven or ridden in a personal vehicle in the last month. Nineteen percent of individuals who were in a car within the past month reported that fastening seat belts is one of the problems they encounter when driving and riding in a vehicle. Additional related problems included reaching the door (10.8%), using the handle (3.6%), and bending at the waist (8%). Individuals older than 85 (n=106) reported increased difficulties with fastening seat belts (27%), reaching the door (11.3%), using the handle (4.7%), and bending at the waist (14.2%). Steinfeld et al. conducted a series of focus groups that addressed the CAS results. Participants overwhelmingly disliked seat belts. Many reported not using belts, and pointed out that the belts do not fit well and cause discomfort and bruising, especially after surgery. Some participants complained that shoulder belts choke them and that the belts may cause injuries to older people. Many reported that the shoulder belts are difficult to reach, fasten, or unfasten (Steinfeld et al., 1999).

According to results of the 2003 MVOSS, 97% of those individuals who felt they would be uncomfortable without a seat belt on wore their seat belts *all the time* compared to 83% who did not think they would be uncomfortable without it ($p<.00$).

4.5 Physical Conditions

Research indicates health generally deteriorates with age. Using data from the 2002 BRFSS, Westat used self-reported health assessments to examine the relationship between seat belt use and an occupant's general health. Those who reported their health as *poor* were more likely to report part-time or nonuse of seat belts when compared to those individuals reporting *good* health (p=.00).

A variety of physical conditions that may impede belt use by older adults are described in the research literature (Bodenmiller et al., 2002; Braver, 2003; Carr, 2000; Hogan, 1999; Hunt, 1996; Mackay, 1988). As we age, stiffness in joints and changes in the structure of bones may cause reduction in height, stooped posture, and sometimes limitation in mobility. These physiological changes can, either singularly or in combination, impair older adults' ability to properly and comfortably use safety restraints when riding in motor vehicles. To illustrate, changes in the musculoskeletal system sometimes make routine tasks more difficult and tend to affect one's ability to turn and reach around for the belt buckle, grasp the buckle, and then turn in the opposite direction to secure it. Arthritis of the cervical spine can reduce neck movement, limiting head turning or the reaching motion involved in buckling a seat belt. Arthritis and other hand deformities can affect an older adult's physical ability or willingness to apply full strength when reaching for or grasping the belt buckle (Hogan, 1999). The most common conditions mentioned in the literature and by gerontologists and occupational therapists we contacted include:

- Arthritis
- Joint deformity
- Osteoporosis
- Obesity
- Peripheral neuropathy
- Inability to twist the neck and torso
- Shoulder injury
- Parkinson's disease
- Visual and tactical sensory loss
- Kyphosis (curvature of the spine)
- Recent surgery
- Pacemaker
- General lack of flexibility
- Fragility

These physical conditions are an impediment to seat belt use and can lead to misuse or nonuse by older adults. Often the shoulder belt is incorrectly positioned across the neck or is placed behind the back altogether. Many older adults report that the belts did not fit them well and caused discomfort, bruising, and pain after surgery to the chest or abdomen. In focus groups older people with disabilities reported that they place the shoulder belts behind their shoulders because the belt is uncomfortable and causes pain. Individuals who had recent surgery or chronic health problems in their torso areas reported the most discomfort with seat belts. Those with arthritis or limitations in range of motion reported difficulty with buckling the belt and reaching for the shoulder belt (Steinfeld, 1999). These conditions may be more prominent in the nondriving older adult population. Carr (2000) found that nondrivers were more likely to have

decreases in muscle strength, range of motion, and mobility. However, results from the BRFSS survey suggest that older adults who reported having arthritis were less likely to use their seat belts *sometimes, rarely,* or *never* than older adults without arthritis (p=.01). This suggests that older adults with arthritis were more likely to wear their seat belts.

Cushman et al. (1990) found that older people had a much higher incidence of inappropriate use of seat belts than their younger counterparts. Although the percentage of adults using seat belts was greater among older vehicle occupants relative to the younger age group, a greater number of older drivers appeared to have used their restraints improperly. Misuse often resulted in a number of belt-related injuries during a crash, such as abrasions under the arm, across the lower chest, and upper abdomen, as well as lacerations of the diaphragm, fractures of the spine, and face lacerations (Cushman et al., 1990). Failure to properly secure the seat belt can put the older adult at greater risk for injury in a crash. The effectiveness of the air bag (front or side) relies on correct use of the restraint system.

Some experts feel that certain physiological conditions increase older adults' potential for injury from the force exerted by seat belts during a crash which may lead to a lower rate of belt use. With age, bone density and muscle mass decrease and there is increased cartilage ossification. This fragility results in a higher rate of rib fractures and other chest injuries. The Crash Injury Research and Engineering Network (CIREN) facilities have noted a much higher chest injury pattern for older adults involved in fatal crashes (Wang, 2001; Augenstein, 2001). In fact, many studies of motor vehicle crashes and crash data files indicate that there is a higher propensity to severe injuries from seat belts among fragile older adults (Cook et al., 2000; Li et al., 2003; Morris et al., 2002; Transport Canada, 2003; Wang 2001; Zhou et al., 1996).

Cook et al. (2000) compared crash characteristics and medical outcomes of motor vehicle crashes for older (70 and older) and younger drivers (30 to 39) using State motor vehicle crash records and hospital discharge records in Utah. Compared to younger drivers, significantly more of the older drivers were involved in fatal crashes or crashes resulting in serious injuries. Older drivers were more likely to be killed or hospitalized than younger drivers when each of the following conditions was met: wearing seat belts, high-speed crash, nighttime, and male. While younger drivers were typically discharged to home, older drivers tended to have longer recovery periods and were more likely to be discharged from the hospital to another health care facility (See also Mackay, 1988).

Technological advances enable those individuals whose physical limitations might compromise their safety to continue to travel safely as drivers or passengers in many vehicles. To illustrate, an older adult with decreased right-shoulder range of motion from arthritis, bone fracture, or stroke, might be able to use a grip attachment in order to reach the seat belt. This device minimizes the reaching angle for the occupant with limited range of motion. If the occupant has diminished height as a result of osteoporosis, a built-up seat would help in positioning the shoulder belt so that the belt does not scrape along the occupant's neck or clavicle. Additional information on vehicle design features that may improve seat belt use is discussed further in this report.

Physicians have an important role in assessing and reducing risk for older drivers. Recently NHTSA worked with the American Medical Association on the *Physician's Guide to Assessing and Counseling Older Drivers* which provides guidelines to physicians on how to evaluate the ability of an older adult to continue driving. The guide discusses the various difficulties

older adults may encounter in using a seat belt. Physicians are asked to encourage better vehicle designs that address the physiological changes in older adults. There is also some explanation of adaptive features that may improve vehicle comfort and safety such as depowered air bags, inflatable seat belts, pretensioners, and side air bags that are beginning to enter the U.S. vehicle fleet (Wang, 2003). Carr (2000) discusses the importance of a physician's involvement in the assessment of older drivers. The physician needs to know about an older driver's history, assess medical conditions that may affect the older driver's safety in a vehicle, and make referrals to occupational therapists or physical therapists as needed. Family physicians should encourage seat belt use and give advice regarding the crashworthiness of vehicle models.

In the United States, obesity has risen at an epidemic rate during the past 20 years. Results of the National Health and Nutrition Examination Survey (NHANES) 1999–2000 indicate that an estimated 64% of U.S. adults are either overweight or obese, defined as having a body mass index (BMI) of 25 or more. BMI is an objective scientific measure used to calculate body weight adjusted for height. The BMI ranges are based on the effect body weight has on disease and death. As BMI increases, the risk for various diseases increases. BMI is calculated by dividing weight in kilograms by the square of height in meters. Westat examined the relationship between BMI and seat belt use for adults over 65. Using self-reported weight and height data from the 2002 BRFSS, Westat calculated a BMI for each respondent. Interestingly, those individuals who were underweight (BMI under 18.5) were 24% more likely to report wearing their seat belt *sometimes, seldom*, or *never* when compared to older adults who were average weight (BMI:18.5 – 24.9) (p=.00). In addition, older adults who were calculated to be overweight (BMI:25.0 – 29.9) were 31% more likely to report wearing their seat belt *sometimes, seldom*, or *never*; and older adults who were obese (BMI: 30.0 and above) were 83% more likely to report part-time or nonuse. These findings suggest that there might be something about the seat belt design and fabric that make use uncomfortable with any body type except for those who are considered to be average. Hypothetically, underweight individuals might be irritated by the rubbing of the restraints along their clavicles or hip bones. Conversely, overweight occupants might feel that the belts are too snug or suffocating.

Westat also calculated a BMI for each respondent in the 2003 MVOSS using self-reported height and weight measures. However, the data from the MVOSS suggest a slightly different use pattern for individuals in the different BMI categories (p=.00). Large percentages of individuals who were calculated as underweight/average (93%), overweight (94%), and obese (84%) reported using their seat belts *all the time*. However, significantly fewer obese older occupants indicated that they always wore their seat belts. Again, these findings suggest that there might be something about the seat belt design and fabric that make use uncomfortable for obese individuals.

Another common phenomenon associated with aging is shrinking. It is a common misconception that age-related bone loss is a disease that only affects women. After age 60 the average older adult is expected to lose 1 inch in stature every 10 years (Center for Disease Control). As stated earlier, this muscular-skeletal degeneration may contribute to older adults commonly complaining about seat belts cutting across the neck or the belt putting pressure on their skin and chest. According to the experts, without adjustments and improvements to current seat belt design, a percentage of older adults will either continue to not wear their seat belts or stop wearing them as seat belts become more difficult or uncomfortable to use.

4.6 Logistic Regression

From a practical standpoint, logistic regression produces prediction equations where the regression coefficients measure the predictive capability of the independent variables. With logistic regression, the response variable is an indicator of some characteristic, that is, a 0/1 variable. Logistic regression is used to determine whether other measures are related to the presence of some characteristic, in this case, whether certain descriptive factors are predictive of older occupant seat belt use.

Motor Vehicle Occupant Safety Survey

Analyses of the 2003 MVOSS combined data set used stepwise regression to predict two-way restraint use (*all the time* and *most of the time* vs. *some of the time, rarely,* and *never*) probability as a function of the following characteristics: sex, education, previous crash injury, age, vehicle type, race, driving frequency, restraint type, and presence of an air bag in the vehicle. Income was not included among the potential predictors because it had too many missing values (N=458). Because of the way the questions were designed in the 2003 MVOSS, results were analyzed and presented for the use of lap belts, shoulder belts, and any belt in Section 8.2.D Final models passed the Hosmer-Lemeshow test of model fit for lap belt use and the use of any belts, but the model fit was rejected by the chi-square statistic for shoulder belt use near the threshold level, p~ 0.04.

Results from the analyses suggest that both sex and education are positively related to the probability of reporting *all the time/ most of the time* seat belt use (any belt). That is, being female and having a higher level of education are associated with increased likelihood of indicating belt use all/most of the time (p=.00). Conversely, having a prior crash injury appears to be negatively associated with belt use (p=.05). This can be interpreted in several ways. Two possible explanations are that those who were injured may not have been using a belt at the time, thus increasing the likelihood of injury, or those who reported being previously injured as a result of a motor vehicle crash may have attributed the cause of injury to the seat belts and thus no longer use the restraints.

Using a lap belt seems to be positively related to education (p=.00) and presence of an air bag (p=.00). Those individuals reporting the presence of air bags in the vehicle or higher levels of education were more likely to report using lap belts *all the time* or *most of the time*.

Finally, being female (p=.03) and having a higher level of education (p<.00) increased the probability of reporting *all the time or most of the time* shoulder belt use. Prior injury and more frequent driving were negatively related (p=.03). This suggests that, as with the frequency of wearing any belt, being female and having a higher level of education are associated with increased likelihood of reporting *all the time/most of the time* shoulder belt usage. In addition, having a prior crash injury and driving frequently appear to be negatively associated with shoulder belt use. With regard to the results of driving frequency, one might interpret these findings as those who do not drive often are more afraid of or concerned about crash risks and thus wear their seat belts more often. Conversely, those who drive more frequently may have become desensitized to the risks associated with driving and are more likely to take the chance of not using the shoulder belt.

Using the 2003 MVOSS Version A data set, stepwise regression was used to predict 2-way restraint use (*all the time* and *most of the time* vs. *some of the time, rarely,* and *never*) probability as a function of the following characteristics: fatalism, wearing a seat belt as a passenger, favoring seat belt laws, BMI, habitual seat belt use, and various safety issues. Because of the way the questions were designed in the 2003 MVOSS results were analyzed and presented for the use of lap belts, shoulder belts and any belt in Section 8.2.D.

Results from the analyses suggest that habitual seat belt use, and the feeling of being uncomfortable without one are positively related to the probability of reporting *all the time or most of the time* use of any belt, lap belt, and shoulder belt (p=.00). That is, habitually wearing a seat belt and being uncomfortable when not wearing one are associated with increased likelihood of reporting belt use *all the time or most of the time*.

Behavioral Risk Factor Surveillance Survey

Analyses of the 2002 BRFSS data set used stepwise regression to predict two-way restraint use (*always* or *nearly always* versus *sometimes, seldom,* and *never*) probability as a function of the following characteristics: age, sex, race, marital status, current working status, level of education, income, body mass index, smoking habits, general health, and general conscientiousness regarding health. Except for age, all factors were statistically related to seat belt use. The 2002 BRFSS results were analyzed and presented for the use of lap belts, shoulder belts, and any belt in Section 8.2.B.

Overall, older men were at least two times more likely to report part-time or nonuse relative to older women (p=.00). Older adults who were single were more likely than married adults to report that they were part-time or nonusers of seat belts (p=.00). Divorced older adults were more likely than married adults to claim part-time use. Currently employed individuals were more likely not to use their seat belts *always or nearly always* compared to those who were already retired (p=.00). Consistent with findings from previous studies, older adults from lower income levels or education were more likely to indicate part-time or nonuse relative to middle income adults (p=.01).

Analyses of the BRFSS data (2002) show that both Hispanics and Blacks were less likely to report that they wear their seat belts *sometimes, seldom* or *never* compared to Whites, indicating that Hispanics and Blacks were more likely to report wearing their belts than White occupants (p=.00). Given that this finding contradicts a number of observational studies, a possible explanation might be that Black and Hispanic older adults were more likely to give the socially desirable answer relative to White adults.

Using the BRFSS as part of the analyses allowed the Westat research team to explore how seat belt use relates to other health issues among the older adult population. In other words, are older adults who are generally healthy or health conscious more likely than others to use their seat belts? To illustrate, the BRFSS inquires about an individual's overall health. Those older adults who reported poorer health were more likely to report part-time or nonuse than older adults in good health (p=.00). In addition, older adults with body mass indices that differed from the norm were also more likely to report part-time or nonuse (p=.00). Underweight, overweight, and obese individuals were more likely than average weight older adults to report only using their seat belts part-time or never.

Fatal Analysis Reporting System

In order to improve traffic safety, DOT/NHTSA created the Fatality Analysis Reporting System (FARS) in 1975. This data system was conceived, designed, and developed by the National Center for Statistics and Analysis (NCSA) to identify traffic safety problems, guide the development and implementation of vehicle and driver countermeasures, and evaluate motor vehicle safety standards and highway safety initiatives. FARS collects data on motor vehicle crashes that result in the death of an occupant of a vehicle or a non-motorist within 30 days of the crash. FARS contains data on all fatal traffic crashes within the 50 States, the District of Columbia, and Puerto Rico.

Westat explored the relationship between belt use and selected pre- and post-crash variables among vehicle occupants 65 and older. For the analyses, Westat included only passenger vehicle occupants over 65 with known seating positions. Although the data analyses were extremely informative, one must consider the following factors when interpreting results. FARS includes only those people who were involved in a motor vehicle crash in which one or more persons died within 30 days of the crash; people in crashes with no fatal injury are not included in the FARS data set. Excluding crashes without a fatal injury can skew results and affect interpretations. To illustrate, in a crash between two vehicles, belt use in the first vehicle affects the FARS inclusion probabilities of the second vehicle occupants. If the first vehicle's driver is belted, the driver has a better chance of survival than if unbelted. Hence, if all the occupants in the second vehicle survive, the first vehicle occupants will not be included in FARS. Conversely, if one or more of the occupants in the second vehicle are killed, both vehicles will be included. Factors not relevant to a particular vehicle, or to its occupants, can determine whether or not a crash is included in FARS.

A stepwise logistic regression was used to estimate the probability of belt use as a function of potential predictors separately for men and women. Pre-crash predictors included year of crash, day of week when crash took place, vehicle type, age of occupant, weather, lighting conditions, number of occupants, body mass index, air bag availability, vehicle model year, road type, and restraint type. Eleven significant belt use predictors were found for men and 10 for women. The following paragraphs summarize the results of the analyses. See Section 8.2.C for more detailed discussion of analyses and tables.

Overall, a number of vehicle features were positively related to seat belt usage among older vehicle occupants. Men and women were both more likely to use seat belts in cars, SUVs, minivans, and vans compared to light trucks. They were also more likely to wear seat belts in vehicles with more recent model year dates (1997 and newer). The presence of an air bag in the vehicle was associated with higher seat belt usage rates for both men and women.

Two other factors that appeared to be positively related to seat belt use were the number of occupants in the vehicle and an occupant's seating position. Men were more likely to use a seat belt when there were other occupants in the vehicle than when they were alone in the vehicle, the effect was similar for women. In addition, relative to the second- and third-row seating positions, occupants in the front seating positions were more than three times as likely to use a seat belt.

Lower levels of seat belt use were associated with some additional factors for men and for women. Both men and women were half as likely to wear seat belts in single vehicle crashes compared to men and women in crashes with two or more vehicles involved. Vehicle occupants were less likely to use seat belts when traveling along minor roads compared to highways or arterial roadways. Men were also less likely to use belts when traveling along rural roadways compared to those on more urban roads. No difference was found for women by urbanicity of roadway.

A number of post-crash variables were also found to be strong predictors of belt use among older adults, some of which are not surprising. Older adults who were ejected during the crash were less likely to be wearing seat belts. In addition, older adults who were unbelted were more likely to be seriously or fatally injured.

National Automotive Sampling System

NASS was established in 1979 as part of a nationwide effort to reduce motor vehicle crashes, injuries, and deaths on the nation's highways. NASS is composed of two systems - the Crashworthiness Data System (CDS) and the General Estimates System (GES). Both systems are based on cases selected from a sample of police crash reports. CDS data focus on passenger vehicle crashes and are used to investigate injury mechanisms to identify potential improvements in vehicle design. NASS collects crash data to help government scientists and engineers analyze motor vehicle crashes and injuries. Detailed data are gathered for a representative, random sample of hundreds of thousands of minor, serious, and fatal crashes involving passenger cars, pickup trucks, vans, large trucks, motorcycles, and pedestrians.

As with the FARS data, Westat explored the relationship between belt use and selected pre- and post-crash variables among vehicle occupants 65 and older. For the analyses, Westat included only passenger vehicle occupants over 64 with known seating positions. First Westat used pre-crash variables to estimate belt use probability among older vehicle occupants. Factors that predicted seat belt use among older adults seemed to be sex, vehicle type, and seating position (see Section 8.2.E).

Consistent with findings from previous research, older women were more likely to use seat belts compared to older men. In addition, vehicle occupants in the second- or third-row seating positions were more likely not to wear seat belts compared to first-row occupants.

Contradicting previous findings, analyses on vehicle type indicated that older adults in vehicles other than cars (trucks, SUVs, and vans) were more likely to wear seat belts in vehicles involved in a crash. Some possible explanations for this might involve the perceived risk of the older adult when traveling in trucks, SUVs, or vans compared to traveling in cars, or the influence of other occupants. NHTS data indicate that older adults most frequently use cars when traveling; when traveling in an SUV, van or truck, the older adult might be the passenger and thus be instructed to use a seat belt by the driver. Alternatively, because older adults use cars more often than any other passenger vehicle, they may feel less safe in vans, SUVs, and trucks; and therefore, want the additional protection of seat belts.

Injury severity was found to be indirectly related to belt use. The likelihood of not using a seat belt increased substantially as the injury severity rating increased for older adults. This finding was consistent for police-reported injury. According to the police injury rating, those older

occupants who were fatally injured during a crash were over 16 times more likely not to be using seat belts during the crashes.

5.0 Vehicle Design

5.1 Crash Involvement

Older adults experience a higher rate of fatalities and injuries in motor vehicle crashes per mile traveled than all other age groups except for teenagers. The fatality rate for older drivers (70 and older) calculated on the basis of annual miles traveled is nine times higher than that for younger drivers (25 to 69) (NHTSA, 809-328, 2001). Research indicates that older adults are more susceptible to serious injuries relative to their younger counterparts due to their increased fragility. This fragility plays more of a role than excessive crash involvement in explaining elevated deaths per miles traveled among older drivers (Braver, 2003). Programs developed solely to reduce driving exposure of older adults do not necessarily result in reduced injuries or fatalities. These programs may only result in repositioning the older adult in the vehicle and increasing older passenger exposure (Austin, 2003). Results of various studies suggest a need to improve both the crash avoidance techniques of older drivers and the crash worthiness of the vehicles in which they travel.

One of the signs of increased fragility in older adults is a lower level of chest injury tolerance in motor vehicle crashes. Research indicates that chest tolerance to shoulder belt loading decreases with age (Zhou et al., 1996), and the risk of fatality from rib fractures increases with age (Wang, 1998). In a comparison of the characteristics of motor vehicle crashes and medical outcomes for older (70 and older) and younger drivers (30 to 39) it was found that compared to younger drivers, a higher percentage of older drivers were killed or hospitalized. Older belted drivers were nearly seven times more likely to be hospitalized than younger belted drivers (Cook et al., 2000), indicating that older adults receive less protection from their seat belts than their younger counterparts.

The Crash Injury Research and Engineering Network (CIREN) is made up of Level 1 Trauma Centers that conduct in-depth studies of crashes, injuries, and subsequent treatments. CIREN cases are limited to crash victims that received medical care at CIREN facilities. The CIREN database compiles details on severe motor vehicle crashes including crash reconstruction and medical injury profiles. CIREN cases are not statistically representative of all occupants in all model year vehicles due to the narrow case selection criteria; however, they do provide insight into the kinds of injuries sustained in different types of crashes. As of 2002 CIREN cases were limited to restrained occupants protected by air bags and belts. CIREN cases extending back to 1996 are available online for public viewing (nhtsa-nrdapps.nhtsa.dot.gov/bin/cirenfilter.dll).

In order to obtain a better understanding of the types of injuries sustained by older adults, Westat selected all the cases with occupants 55 and older from the CIREN database for the years 1996 to 2001. These 74 cases were examined in-depth. The numbers and percentages of occupants were compared regarding the following data fields: restraint use and nonuse, injury severity by the maximum abbreviated injury scale (MAIS) score, type of impact, and type of collision. The level of injuries sustained by restrained older adults was compared to the level for those who were unrestrained. In addition, injuries for older adults using seat belts were documented in order to gain better understanding of belt-related injuries.

Of the 74 CIREN cases with occupants 55 and older, 76% (56 cases) were using seat belts, and 24% (18 cases) were unbelted during the crashes. Forty-eight percent of belted occupants were female, and 52% were male. Of the 56 cases where vehicle occupants were restrained, 52% (29 cases) suffered severe belt-related injuries including multiple rib fractures, sternum fractures, and contusions to the inner organs such as the lungs or liver; 20% suffered other types of contusions or abrasions in which seat belts were indicated as the source of injuries; and 29% suffered from injuries that were unrelated to the belts.

Frontal impacts represented 67% of the cases for belted occupants. For both the belted and unbelted older occupants, crashes at intersections represented approximately 40% of the collisions. Ninety-two percent (23 cases) of the 29 cases with severe belt-related injuries were sustained in frontal crashes.

The following paragraphs are examples of cases where seat-belt-related injuries and age were specifically mentioned in the CIREN reports evaluated:

- The case of a 55-year-old female driver restrained in a lap/shoulder belt in a frontal crash who suffered rib cage fractures of three ribs on each side with hemopneumothorax (certain) and a sternum fracture (probable) from the belt restraint webbing/ buckle. The injury analysis stated that “the severe delta V and age of this occupant resulted in the fracture patterns to the ribs in the location of the safety belt across the chest.”

- The case of a 63-year-old female driver restrained in a lap/shoulder belt in a frontal crash who suffered clavicle fracture (certain) and rib cage fractures of two or three ribs (probable) from the belt restraint webbing/ buckle. The injury analysis stated that “due to the older age of the driver the safety belt loading on the chest resulted in the injuries.”

- The case of a 69-year-old male driver restrained in a lap/shoulder belt in a frontal crash who suffered chest arteries laceration (probable) and vertebral artery intimal tear (probable) from the belt restraint webbing/ buckle. The injury analysis stated that “as the vehicle rolled onto its side the restrained occupant fell to the right but was held by the safety belt. The inertial load on his neck in conjunction with the occupant’s arthritic changes in his neck, were the cause of the vessel injuries.”

- The case of a 72-year-old female driver restrained in a lap/shoulder belt in a frontal crash who suffered rib cage fractures of more than three ribs on one side and at least three ribs on the other side (possible) from the belt restraint webbing/ buckle. The injury analysis stated that “with this driver being elderly it is common to see the rib fractures due to the significant loading on the safety belt.”

- The case of a 75-year-old female driver restrained in a lap/shoulder belt in a side-impact crash who suffered cervical spine cord damage (certain) from the belt restraint webbing/ buckle. The injury analysis stated that “the occupant was only 5’ 5” tall indicating that the safety belt was rather high. When the occupant’s body moved left toward the door, the safety belt acted as a pivot point, resulting in her neck and head rotation over the safety belt.”

- The case of a 64-year-old male driver who was not restrained in a seat belt in a frontal crash and who sustained several head and brain injuries from contact with the windshield and deploying steering wheel air bag. The injury analysis stated that “this case is an example of a heavy unbelted elderly driver sustaining severe and fatal chest and head injuries in a severe offset frontal crash because of overpowering and getting over a pre-deployed air bag. Had the driver been using the available three-point belt it is very likely that his head would not have contacted the windshield header and his chest would not have loaded through the air bag into the steering wheel, thereby significantly increasing the likelihood that he would have survived this crash. The limited number and decreased severity of injuries sustained by the belt only restrained elderly female in the right front passenger seat provide an interesting comparison with regard to the importance of using a three-point belt in a severe frontal crash.”

In spite of the fact that older adults are more vulnerable to injuries from seat belts in a crash, seat belts have a significant impact on the survivability of crashes regardless of age. A study reviewing the medical charts of 382 older patients involved in motor vehicle crashes from a Level 1 Trauma Center, the Rhode Island Hospital Department of Emergency Medicine, revealed that while belted individuals were more likely to suffer neck strain and chest contusions, unbelted occupants were more likely to suffer more severe injuries such as open head wounds. In addition, the unbelted patients had higher hospital admission rates, higher hospitalization charges, and increased mortality (Coley et al., 2002).

In 2002, Khattak et al. studied crash data from Iowa from 1990 to 1999 to examine the factors that contribute to more-severe traffic injuries among older drivers. Traffic injuries were rated on the KABCO scale: Killed, A-Type (incapacitating), B-Type (visible), C-Type (complaint of pain), and PDO (property damage only). A majority of the crash victims in their sample were between 65 and 75. Their findings indicated that advancing age increases the propensity of more severe injury on the KABCO scale. However, unrestrained older drivers incurred more severe injuries relative to those older drivers that were restrained.

5.2 Vehicle Design Issues

In order to reduce fatality rates it is important to address fragility in older adults via vehicle modifications such as improvements in vehicle crashworthiness and restraint systems. Key issues that affect the usability of vehicles for drivers of any age group are entry/egress, seating position and comfort, perception of the environment, navigation, obtaining external information, and occupant safety (Steinfield, 2001).

Marketing is a high priority in decision-making among vehicle manufacturers. Vehicle designers have begun to take ergonomics and older drivers into account as this population will account for more than half of future car buyers. A recent Wall Street Journal article “Marketing Surprise: Older Consumers Buy Stuff, Too” describes the strength of this fast-growing consumer group. In 2001, the Federal Reserve identified Americans over 50 as controlling 67% of the country’s wealth (Greene, 2004).

As a general rule, manufacturers are focused on safe and comfortable vehicles that may be specifically packaged and marketed to the general population rather than one segment (older adults). Universal design is an approach used by human factors engineers to design vehicles for people who are older as well as for the general population. Illustrations of this approach are larger knobs and instrument panels. Universal design can improve the usability of automobiles for frail older adults and have benefits for other age groups as well (Steinfeld, 2001). Ford is one of the first vehicle manufacturers to adopt this outlook. Ford designers are currently working on models that will be good for all occupants, not just older adults. Marketing strategies also target all age groups, since Baby Boomers are not interested in vehicles marketed as user-friendly for older adults. Ford sees this design and marketing strategy as more useful in the long term. Design requirements for older drivers are not necessarily unique; many people occasionally experience difficulty with the same vehicle features that challenge older adults, especially people with a variety of needs such as pregnant women, small drivers, and those with temporary injuries (Nicolle, 1995).

In collaboration with Loughborough University, Ford developed the “Third-Age Suit” that enables vehicle designers to experience the limitations in performance that are normally associated with aging. By wearing the suit, designers can better understand the decreased mobility, vision, and tactical sensations that come with old age and other physical conditions. This suit adds bulk and restricts movement in the knees, elbow, stomach, and back. The earliest Ford Focus is the first vehicle model to benefit from this research (Broge, 2001). The Focus comes with features such as a higher seating position, extra-wide doors, large controls and nonreflective interior surfaces to reduce glare. In 2002 Ford’s Mobility Motoring Program unveiled a Ford Focus ZX3 with power-swivel driver and passenger seats, and hand controls with simultaneous one-hand control of both throttle and brake. More recently, Ford has also designed the 500, a sedan that will appeal to Baby Boomers. The 500 has some popular SUV features including raised seating for easier ingress and egress, and all-wheel drive. Neither the Focus nor the 500; however, are marketed as vehicles for the aging population because Ford believes that Baby Boomers do not like to hear that they are aging (Greene, 2004).

General Motors has teamed with the Beckman Institute at the University of Illinois for a multiyear study on driver distractions and how older adults interact with in-vehicle technologies. The Cadillac DeVille currently has an optional night vision system that uses infrared technology to provide additional visual information during nighttime driving (Ehrenman, 2003). GM has also incorporated some additional convenience features that are easier for older adults. The Chevrolet Impala has a dashboard ignition switch so that the driver doesn’t have to twist around the steering wheel, oversized knobs for climate control, bigger inside door latches, large outside mirrors, and an inside gauge that reports tire pressure. GM also raised the popular Corvette’s opening height 2 inches to make rising up and out of the low-slung car easier (Ford, 2000).

Lear Corporation also conducted an 18-month study on aging Baby Boomers to understand the physical limitations of this group, and identify how best to meet their needs. Lear polled a panel of men and women 50 to 70 on methods of ingress and egress, four-point seat belts, seating adjustments, controls and display colors. The study consisted of five focus groups and a two-day seminar on “Designing Vehicle Interiors for the Mature Driver.” Based on the results of the study, Lear designed the “TransG” or transgenerational concept vehicle for aging Baby Boomers. The TransG automotive interior is designed so its features can accommodate the needs of any passenger. The vehicle includes a variety of features specially designed to accommodate maturing Baby Boomers (PRNewswire.com, 2000). The powered rotation seats

swivel outwards at a 45-degree angle and were identified by the study participants as the most comfortable for ingress and egress. The TransG incorporates four-point seat belts that are easy to reach and buckle. Occupants slide their arms through the belts positioned on either side of the seat and latch the front buckle using both hands. The belt also includes an air collar that inflates to protect the head and neck in the event of a crash. Lear found that the four-point belt met the consumers' desire for extra safety, was easy to use, and because of the similarity to the race cars, did not make them feel old (Ehrenman, 2003). Additional older-friendly features include high-contrast displays, larger controls, air curtains, and cushion restraints in the seats.

5.3 Seat Belt Designs

In recent years various improvements have been made to the traditional three-point lap/shoulder belt including more comfortable materials, buckles that are easier to use, stronger webbing, and emergency locking retractors that lock the belt in position during a crash, but allow the occupant to sit comfortably in the seat belt. Vehicle and seat belt manufacturers are now working on a variety of innovative seat belt systems. These newer designs have the potential to enhance the safety of older adults, decrease the current level of injuries and fatalities, and increase older adults' use of occupant restraints. These new seat belt designs must be tested both for their ability to prevent injuries and for their acceptability to the consumer.

There are a number of factors that are important when designing an acceptable seat belt (Natalani et al. 2001). Three are described below:

- Ease of use -- Traditional seat belts require that occupants twist their torsos in one direction to reach the belt and then twist their torsos in another direction to fasten the belt. This motion can be difficult for older people with a limited range of motion and may discourage them from using their seat belts.

- Fit -- Differences in torso height and weight can cause the traditional seat belt to fit awkwardly across the necks, stomachs, and chests of some occupants.

- Comfort -- When a belt does not fit correctly it can be uncomfortable, which may cause an occupant to adjust the belt in a way that may compromise safety. For example, a small-statured woman may move the shoulder belt under her arm so that it does not cut across the neck.

The most promising seat belt systems currently in the design phase include four-point seat belts and inflatable restraints (see Section 8.3 for photographs). A number of manufacturers, including Daimler-Chrysler, Ford-Volvo, GM, Lear, Saab, and TRW are developing different versions of four-point seat belts that have the potential to distribute crash forces across more of the body, and thus minimize the impact of the seat belt on the body during a crash.

5.4 Seat Belt Design Acceptability

Since the 1990s both General Motors and Ford have been investigating the safety of Indy race car drivers involved in high-speed frontal crashes using double shoulder harnesses. They found few chest injuries. Based on these studies Ford began to study and design a four-

point seat belt in which the belt system is anchored to the seat or vehicle at four different points (Rouhana, 2003). Researchers examined both the effectiveness of the four-point design in crash tests and its acceptability by the public.

The initial system geometry of the four-point system developed by Ford is based on research conducted by Ford and Lear Corporation. Researchers recruited 44 coworkers of varying height and weight; the participants fit anthropometric extremes that were thought to limit the effectiveness of the belt system. They participated in a 30-minute evaluation in which they were exposed to eight different shoulder belt configurations while sitting in a test seat simulating a driver's position in a vehicle. Participants rated each belt configuration. The results of this study suggested that avoiding interaction between the shoulder belt and the participant's neck improved the overall acceptability of the system. Participants preferred belts that lay flat across their shoulders as long as the belts do not interfere with the neck (Natalani et al., 2001).

In 2001 Ford conducted clinics at the Detroit Auto Show and the Frankfurt Auto Show to gauge customer acceptance of the four-point belt designs. Two thousand people varying in age, size, and demographics tried on three belt systems:

- three-point seat-integrated belt,
- four-point V-belt (V-4), a suspender style with a buckle in the front,
- four-point X-belt (X-4), a criss-cross design with buckles on the side

Researchers used a laser scanner to record body dimensions and also recorded weight, height, and age. The V-4 style was overwhelmingly preferred by about 80% of the participants in the U.S. show and by 75% of the participants in the European show. Older adults especially liked the V-4 because they found it to be comfortable and felt safer. The V-4 is easy to use because it is donned similar to a back pack with occupants leaning sideways (rather than twisting) to pull on each of the suspender like straps, the buckle is easily accessible in front on the abdomen, and the straps rarely cut across the neck.

As mentioned above, the Lear Corporation incorporated integrated seat belts with a four-point V-style design in its Trans G concept vehicle for older drivers. The center positioned buckle is easy to see and latch, making the act of fastening the belt much easier for people with limited dexterity or limited range of head motion. This four-point style is also more comfortable because it does not cut across the chest on a diagonal (Steinfeld, 2001).

At TRW, internal experiments were conducted with employees regarding four-point seat belt designs. The results were somewhat different from those cited above. TRW found that while older adults appreciated visible buckles, they had difficulty donning the belts. Specifically, they had difficulty getting the straps over their shoulders. In recent meetings with NHTSA personnel, GM also indicated that its research shows that people found the four-point belts to be uncomfortable.

5.5 Seat Belt Design Crash Testing

Following the assessments of customer acceptability, Ford conducted comparative crash tests on three designs: the three-point belt, the four-point V-belt (V-4), and the four-point X-belt

(X-4). The crash tests were of frontal impacts using FMVSS 208 procedures to measure the risk of thoracic injury.

In the first stage of crash tests with the V-4 system, the Test Device for Human Occupant Restraint (THOR) dummies showed evidence of negative chest deflection in the lower part of the ribcage, and marked reductions in chest deflection compared to both the X-4 and the three-point belts. These results indicated a reduction in the chances of chest injury to the occupant (Rouhana, 2003). The V-4 system reduced chest deflection by a factor of 2 for both the 50^{th} percentile male and the 5^{th} percentile female dummy. On the other hand, the X-4 increased chest deflection, and the risk of chest injury, for both the 5^{th} percentile and 50^{th} percentile dummies.

Cadaver tests were then run on 79-, 75-, 72-, and 40-year-old bodies for the three-point and V-4 belts. Four of the V-4 cadaver tests resulted in negative chest deflection measurements and the other tests also achieved very low results (lower than for the three-point belt), indicating a zero or very low risk of injury from the V-4 belt in a frontal crash (Rouhana, 2003). The V-4 design is easier on the body due to its use of vertical shoulder belt webbing from shoulders to pelvis. This design allows the belt webbing to behave like a flexible cable, minimizing stress transmitted to the chest. The load from the belt is shifted to the clavicles and pelvis, reducing chest compression. Additional tests are currently underway at Ford assessing the potential for neck injuries in a far-side impact (for occupants seated on the side opposite from the struck side) and the risk of fetal injury in pregnant occupants due to the buckle situated in front of the abdomen.

Current occupant restraint standards are based on the 95^{th} percentile male from the 1960-70s. For new seat belt features and designs to become standard, benefit analyses indicating the positive effect of these designs for a large population will need to be conducted. At this time, four-point seat belts are not within the FMVSS standards and are still considered to be in the research and development phase. Experts believe that if the additional tests for pregnant females and far-side crashes are positive and the new design is shown to have the potential to save many lives, United States, Canadian, and European authorities may be agreeable to changing the standards.

An additional innovative seat belt design that may affect older occupants is the inflatable belt. These belts use sensors similar to those in air bags and would need to be replaced following a crash. The inflatable belt distributes forces more evenly across the chest. Ford is currently working on a prototype for rear-seat passengers, where the frontal air bag is unavailable. The design is especially beneficial to children and older adults. Designing an inflatable belt that will be comfortable to wear is considered a challenge by most manufacturers.

5.6 Additional Design Features

There are a number of additional developments in vehicle design that may affect seat belt use in the older population. Some of these features may be found in many of the new vehicles on the market while others are still in the development phase. These design features should improve safety without impairing comfort or the ability to market the vehicle. Photographs of some of these features are included in Section 8.3.

Belt Force Limiters

The belt force limiter feature is an energy management device, also termed load limiter. It is intended to reduce the risk of rib fractures due to shoulder belt forces. Load limiters were designed to optimize restraining forces while taking into account the broadest possible population, including older adults (Bendjellal, 1998). Load limiters have been shown to benefit a relatively large number of individuals in specific crash scenarios. Data from the New Car Assessment Program (NCAP) crash tests demonstrate that load limiters result in a reduction in chest acceleration and chest deflection scores for right-front passengers (Walz, 2003). NHTSA encourages manufacturers to incorporate load limiters and identifies vehicle models with this feature in the NCAP ratings.

Belt Pretensioners

Belt pretensioners retract the seat belt to remove excess slack in a crash. A pretensioner is a one-time-use device similar to an air bag, and needs to be replaced after a crash. NCAP crash tests show that pretensioners are effective in reducing Head Injury Criterion (HIC) scores for front-seat occupants as well as chest acceleration and chest deflection scores for right-front passengers (Walz, 2003). Numerous vehicle models include pretensioners as standard equipment because they are among the safety features listed in the NCAP crash ratings, but are not required in the FMVSS standards.

While pretensioners have the capability to reduce injuries, reversible “hypertensioners” that retract the seat belt pre-crash and even reposition the occupant prior to impact, may cause rib fractures in older adults. These hypertensioners are part of the Advanced Safety Interior (ASI) portfolio of advanced technologies currently advertised by Delphi Automotive Systems.

Dynamic Optimization

Dynamic optimization systems use sensors to fit the restraint system to the occupant in the event of a crash. They are older-friendly because they minimize forces applied to the body, minimize local forces, and control the kinematics to avoid contact with hard vehicle components such as the B-pillar. Dynamic optimization systems include force limiting (load limiting) and pretensioner components of seat belts, multistage inflators that deploy less forcefully in moderate crashes than in very severe crashes, and additional relevant occupant safety technologies (Fairfax CIREN, 2001).

Identification Technologies

Identification technologies, an additional possibility for sensing, use a type of keyless entry transmitter or fingerprint identification programmed with information about the occupant regarding age, sex, physical conditions, and size. This technology may be difficult to put into practice for reasons of cost, the advanced nature of this type of system, and the issue of privacy of the driver and passengers.

Integrated Seat Belt Systems

This system incorporates the restraint into the body of the seat so that it allows the seat belt to move with the occupant when the seat is moved. The belt is easier to reach relative to belts that are attached to the floor or pillar, but it is more costly to implement.

Seat Belt Height Adjustors

The seat belt height adjustor is a D-ring mechanism located on the B-pillar on the side of the vehicle allowing the occupant to adjust the shoulder belt to a comfortable height. Many older drivers are unaware of this feature although it is now available on many vehicle models. At Delphi they are trying to think of methods to increase awareness of this feature.

Seat Belt Presenters

Ford's work with the Third Age Suit has helped designers better understand how aging can affect various sensory and motor abilities, including the ability to see, reach, and feel seat belts. Some work has been done in the past on belt presenters that use electronics and robotics to automatically present the seat belt when the occupant sits in the vehicle. This type of design would be especially suitable with pivoting seats that are also comfortable for older drivers. Ford consulted on this with an outside design team who conducted tests with older adults, showing positive results. The system was never adopted and tested by Ford, possibly due to the positive results found for the V-4 belts.

Seat Belt Reminder Systems

Safety belt reminder systems are designed to remind drivers (and in some models, passengers) to put on their seat belts. The system usually uses some combination of a lighted display and audio chime. The reminder systems have been found to be most effective for part-time users, and therefore, may be especially effective for older adults. NHTSA, the American Society on Aging, and the Academy for Educational Development conducted a series of focus groups with older adults in 2002. Focus group participants identified seat belt reminder systems as a reason why they use their seat belts.

Sensors

As a result of FMVSS 208, sensors are being installed in new vehicle models as part of the air bag system. The sensors currently are tailored to identify weight and height; and therefore, inflate the air bags in a variable manner for large occupants in high speed crashes or smaller occupants in low speed crashes. Current sensor technologies will identify a 5^{th}, 50^{th}, or 95^{th} percentile adult, but will not identify the age of the driver or the driver's physical condition. It is possible to connect these same systems to the seat belt mechanism.

5.7 Aftermarket Devices

There are a number of aftermarket devices that may increase seat belt use among older adults. These devices offer a better fit or promote ease of use in pulling the seat belt out or in buckling the latch plate. Many of these devices are readily available in auto supply stores, medical supply stores, or catalogues mailed to the general public. NHTSA does not advocate or advertise aftermarket devices. The following aftermarket devices were mentioned by the experts Westat contacted:

- Seat belt pad or sheepskin cover -- provides more padding and comfort for the user.
- Seat cushion -- raises the upper body for a better fit by the belt across the shoulder and hips.
- Pivoting seat -- raised disk that allows for easy egress, raises the upper body, and results in a better fit for the lap/shoulder belt.
- Ribbon or plastic loop- used to pull the seat belt latch plate towards the body.
- Seat belt adjusters -- position the latch plate so that it is easier to reach for fastening (should be installed by dealership).
- Seat belt extender -- extends the buckle so that it is easier to fasten the seat belt (should be installed by dealership, not available in all vehicle models).

The University of Massachusetts Gerontology Institute developed a video, *Keep Moving Longer: Features for Safe Driving*, which models various inexpensive aftermarket devices to increase comfort and safety for older adults in vehicles. The video identifies a number of features that may increase ease and comfort using seat belts:

- Seat belt pad
- Ribbon on seat belt
- Seat cushion
- Seat belt extender
- Seat belt adjuster

In addition, occupational therapists and driver rehabilitation therapists teach older adults about these adaptive devices. They are an inexpensive way for older adults to get a better and more comfortable fit with their seat belts in their currently owned vehicles.

6.0 Media and Education Campaigns

Successful implementation of a safety program will require an effective campaign to inform the public of the program, heighten awareness of the expected benefits, and encourage compliance with the State's seat belt law. The theory is that with a more comprehensive understanding of the rational basis and safety benefits of wearing a seat belt, vehicle occupants will be more likely to comply with the law. The material for such a program must inform the public in a manner that reflects the community's societal goals and objectives. Accomplishing the public information and education objective requires that key public agencies and public figures buy into the program and implement it in an effective manner.

Effective public information and education campaigns focused on safety are often multi-pronged efforts. A number of public information and education campaigns have been developed and successfully implemented in conjunction with strict enforcement. *Buckle Up America* (BUA) is a national campaign to increase the correct use of seat belts and child safety seats in an effort to save lives and prevent injuries. It includes the *Click It or Ticket* campaign which is designed to encourage motorists to fasten seat belts. The *Click It or Ticket* enforcement and awareness campaign is typically conducted in the spring. In addition, NHTSA has developed and implemented national crackdown campaigns to prevent impaired driving crashes and fatalities.

Through discussions with experts and extensive Internet searches, Westat identified a number of media and education campaigns that concern older drivers or seat belts. While none of these programs specifically promote seat belt use among older adults, many of them refer to the importance of seat belt use or offer information that may influence seat belt use by older occupants. The following section identifies these various media and educational programs.

6.1 Media Campaigns

GrandDriver is a media campaign developed by the American Association of Motor Vehicle Administrators (AAMVA) in partnership with AARP, AAA, NHTSA, and other organizations to increase knowledge among older adults about changes in driving ability with age and to promote discussion with their adult children or caretakers. The program was piloted in the greater Washington DC area. Pulitzer-Prize-winning author and gerontologist Dr. Robert Butler served as the GrandDriver spokesperson on radio and television spots. The program includes a speakers' bureau, a Web site, and a toll-free telephone line. The GrandDriver brochure includes basic rules of driving including *Always, always wear a seat belt,* and recommends vehicle features such as height-adjustable seats and seat belt anchors. References to seat belts are also made in the speeches presented by the speakers' bureau. However, there are no tips on how to increase comfort and seat belt use among older vehicle occupants. The GrandDriver program is now being offered to the States in the form of a media kit. Opinions as to the success of this campaign are mixed. Although GrandDriver had a great amount of exposure in the area, the actual percentage of older adults who were affected by the program is unknown. Material from the GrandDriver Campaign is included in Section 8.4.A.

The *Buckle Up America* (BUA) program is a national initiative that began in 1997. Its main focus is to increase the use of seat belts and child restraints. BUA includes four compo-

nents: building partnerships, enacting new legislation, conducting strong enforcement, and expanding public information and education directed at the general public. BUA does not have any component that is directed specifically at older drivers; however, it may be possible to conduct a campaign for older adults under the auspices of BUA similar to current programs that serve other specific demographic groups (see Section 8.4.B and 8.4.C). The BUA contact mailing list is comprised of many entities and individuals who deal with older drivers on a regular basis, including health professionals, hospitals, law enforcement, and fire personnel.

The National Conference of Black Mayors works in cooperation with NHTSA on the Mayors' Challenge to Buckle Up America, specifically geared towards Black communities nationwide. The program provides funding for local communities to conduct traffic safety programs along with a pre- and post-observational seat belt survey. The programs target schools, civic groups, churches, and law enforcement in a campaign to increase seat belt and child restraint use. Currently there are no local programs geared specifically towards older adults; most of the emphasis is on teen drivers and child restraints. It may be possible to conduct public awareness campaigns for older Black adults via faith-based programs or refresher driver courses within the framework of the Mayors' Challenge.

6.2 Driver Assessment

CarFit is a program under development as a partnership between the American Society on Aging (ASA), AAA, AARP, and American Occupational Therapy Association. CarFit is a 20-minute assessment of the older driver in a motor vehicle. The assessment tool is a checklist developed by occupational therapists and experts in the field of older driver research. One item on the checklist is seat belt use. The assessor checks for use versus misuse and ease of use.

Various material will be provided to the older driver after the checklist is completed. This material will be tailored to each community. The draft of the material includes a section on seat belts and can be found under *Follow Safety Procedures.* Topics included in the section are:

- Crash statistics for people over 75 who do not wear seat belts;
- Strategies to remain safe in a car;
- Directions on how to use a seat belt; and
- A Web site for additional information at www.aarp.org/life/drive/safetyissues/Articles/a2004-06-22-carsafety.html

Ten national sites have been selected for the pilot program, commencing in January 2005. CarFit will train volunteers from law enforcement agencies, aging agencies, social service agencies, and other concerned organizations to conduct the assessments. In addition, there will be driving rehabilitation specialists at each site. The driving rehabilitation specialists will not be paid for their time but they will have the opportunity to have their programs referred to in the additional material and a chance to meet with potential clients. The CarFit program will be conducted at public venues such as senior centers. The goal of the CarFit program will be to operate in a variety of community-based settings, and it will be used in the framework of programs such as driver refresher courses. A recent draft of the CarFit checklist is included in Section 8.4.D.

6.3 Brochures

NHTSA has brochures available on its Web site. One brochure specifically targets seat belt use, *How Wearing Seat Belts Can Help You Save Money, Time, and Your Life*. This brochure provides details on correct usage including:

- Adjust the lap belt to fit low and tight across your hips/pelvis, not your stomach area;
- Place the shoulder belt snug across your chest, away from your neck; and
- Never place the shoulder belt behind your back or under your arm.

Another useful source of information on seat belt design and safety features relevant to older adults can be found in NHTSA's brochure and Web site *Buying a Safer Car.* This annual brochure provides the crash test performance results on new vehicle models as well as information on safety features. Older adults who are considering purchasing a new vehicle will be able to learn more about features that will make seat belts easier to use and may provide them with additional protection in the event of a crash. Explanations are provided for the following seat belt features: adjustable upper belts, belt extenders, pretensioners, energy management features (load limiters), and seat belt reminder systems.

AAA has developed a brochure titled *Crash Protection: For People Who Enjoy Living*. This brochure describes the need for crash protection, how to choose a safer vehicle, and provides details on seat belts including the parts of the belt and correct use of the lap and shoulder belt. AAA also has recently updated a brochure series called *Straight Talk for Mature Drivers* geared towards older adults. The series covers topics such as vision, prescriptions, and vehicle maintenance. One brochure in the series titled *Buying a Vehicle* emphasizes the need for seat belts that fit, and encourages use of seat belt adjustors that will allow the belt to fall across the shoulders properly.

The AAA Foundation for Traffic Safety designed two self-administered tests for drivers 55 and older who are interested in evaluating their own driving abilities. These self-assessment tools are titled *Drivers 55 Plus: Test Your Own Performance* and *Roadwise Review.* Both assessment tools are Web-based, and allow drivers to assess their abilities privately from their own homes.

Drivers 55 Plus: Test Your Own Performance is also available as a free brochure. The rating form includes a test question on seat belts. Under suggestions for improvement there is information on seat belts, an explanation of the need for a seat belt to prevent injuries, and a recommendation to consult with a mechanic about adjusting the seat belt if it is uncomfortable. The brochure also includes a diagram to show the correct position of the seat belt on the occupant. The test in its brochure format is included in Section 8.4.E.

6.4 Web Sites - Information Sources

The American Occupational Therapy Association (AOTA) is currently working with NHTSA to increase the involvement of occupational therapists in older driver safety. Under the auspices of the Older Driver Initiative, AOTA recently designed a comprehensive older driver

Web site, www.aota.org/olderdriver. The site is directed toward occupational therapists, older drivers, and caregivers for older adults. The site has a number of helpful tools including a Reading Room with a bibliography that consists of topic areas like occupational therapy, older drivers, motor vehicle crash injuries, and mobility. There are links to various online resources such as AOTA's library and Medline. A section for consumers and caregivers addresses driver safety tips that include information on the correct use of seat belts: "Wear your seat belt – and wear it correctly. (It should go over your shoulder and across your lap.)" The site also has links to a directory for purchasing aftermarket adaptive equipment that can be used to enhance comfort when wearing a belt. At this time there is no link or brochure that is devoted exclusively to older drivers' use of seat belts. Excerpts from the AOTA older driver Web site are in Section 8.4.F.

AOTA's Older Driver Initiative has developed a curriculum on Older Driver Safety for occupational therapy programs. The Older Driver Education Module is in its final stages of revision**.** Preliminary copies have been sent out for review. The curriculum format is a 1- or 2-day module. The module includes information on seat belts and how occupational therapists can teach clients to buckle up appropriately. NHTSA and AOTA are seeking to include the module on older drivers in the requirements for professional licensing so that all the programs will be required to teach the material.

The National Association for Area Agencies on Aging (N4A) is developing a Web site clearinghouse on older driver safety with a grant from NHTSA. The project is being conducted in stages. N4A will be reviewing literature and compiling a list of best practices. Area Offices on Aging will be sent a brochure encouraging them to apply for seed grants to set up local driver safety programs. Based on the success of these programs, and the information collected from other sources, N4A will set up a Web site with information about older drivers. At this time there is no definite plan regarding the material content that will be included on the web site.

The American Medical Association (AMA) completed work on a Physician's Guide to Assessing and Counseling Older Drivers. The Older Drivers Project at AMA did not focus on seat belt use by older adults; however, the project identified various physical conditions that may affect seat belt use. These conditions include arthritis, reduced muscle strength, obesity, and kyphosis (curvature of the spine). The last chapter in the Physician's Guide gives a series of recommendations on research and planning for safe transportation for older people, including a recommendation regarding vehicle design. Vehicle manufacturers are encouraged to explore and implement enhancements in vehicle design that address and compensate for physiological changes that occur in older drivers. In particular, the AMA encourages the development of vehicle designs based on the anthropometric parameters of older people. Certain add on features, such as padded steering wheels and seat adjuster handles could make current vehicle designs safer (Wang 2003).

Additional Web sites with useful information on older driver safety include:

www.seniordrivers.org This Web site is sponsored by the AAA Foundation for Traffic Safety. The Web site design is directed at the older driver. Under the heading "Getting Ready" there is a video and text on mirrors and head restraints. However, no information is presented regarding seat belts, or their proper usage.

www.aarp.org/life/drive/ AARP has devoted a section of its Web site to driving and driving safety. The Web site includes car safety tips for buying a motor vehicle. The first listed

safety feature is seat belts. AARP also provides links to other organizations' Web sites for additional information on safe driving.

6.5 Driver Education

Researchers at the Gerontology Institute of the University of Massachusetts, Boston, are working on a study “Promoting Safe Mobility among Elders by Increasing Awareness of Vehicle Modifications.” This project includes focus groups with older adults, a video demonstrating after market vehicle modifications, and a pre- and post-survey to assess changes in awareness of the vehicle modifications as well as the likelihood of using such features (Silverstein et al., 2005).

The video titled *Keep Moving Longer: Features for Safe Driving* models the use of low-cost modifications designed to increase safe driving among older adults. Specific features that enhance ease and comfort when using seat belts are seat belt pads, ribbons attached to the seat belt, seat belt extenders, and seat belt adjusters. Other features demonstrated in the video include: visor extenders, a seat cushion, convex mirrors, pedal extenders, and support handles. Older adults are also provided with information on the cost of the various features and suggestions on where to find them, Web resources on older drivers, and features to look for in a new car. Copies of these documents are included in Section 8.4.G.

A number of organizations offer Driver Refresher Courses. The most widely available are: AAA Safe Driving for Mature Operators Program, AARP Driver Safety Program (formerly referred to as 55 Alive), and the National Safety Council’s Defensive Driving: Coaching the Mature Driver. All these education programs include information about seat belts. The basic message is to make sure to wear a lap and shoulder belt at all times because a seat belt is the best way to avert injury in the event of a crash.

The AAA program’s Driving Emergencies video (Module 6) includes an explanation about restraint systems. Although the video shows the proper positioning of the seat belt, it does not go into detail about adjustable shoulder restraints. The AARP Driver Safety Program includes a video clip that demonstrates different methods of adjusting the seat and belt so that it will fit properly. AARP conducted a survey of its graduates and 86% reported changing their driving habits following the driver refresher training (Milton, 2002).

6.6 Law Enforcement

NHTSA’s *A Compendium of Law Enforcement Older Driver Programs* documents strategies used by law enforcement agencies across the United States to reduce crashes involving older drivers. This resource guide of older driver programs includes contact information as well as ideas on positive community policing methods. The majority of the local efforts on behalf of older drivers consisted of law enforcement officers teaching or presenting the various drivers’ training courses, such as the AARP or AAA courses. Another common program is TRIAD. TRIAD is a cooperative effort between local law enforcement and older adults in the community to reduce senior victimization.

Law enforcement officers conduct outreach programs that address the use of seat belts, but it is not the focus of any specific program for older adults. For example, Iowa State Patrol education officers and Iowa driver license examiners are available to talk to older adult groups. They include seat belt use in their talks.

NHTSA will be funding a curriculum for law enforcement on how to approach older drivers when they are pulled over for a traffic offense, and in their daily contact with older adults in the community. The training will be developed via the Transportation Safety Institute (TSI). The course will be composed of six to eight modules, each around 30 minutes long, and will include instructor as well as student material. Training will take place at police departments in their States. Otherwise the curriculum will be promoted through the TSI catalog and forwarded as requested to departments as a stand-alone training course. The curriculum will include information on the importance of seat belts and how to react when you pull over an older driver who is not using a seat belt. It is important to ticket older adults but also to teach them about the importance of seat belts.

Some experts believe that laws will not be enough to convince Baby Boomers of the importance of seat belts. Media and education programs will be needed to explain why seat belts are important.

6.7 Local Programs

The Florida Department of Highway Safety and Motor Vehicles received a grant to print a brochure for older adults on driver-vehicle fit. The brochure will include information on how to use a seat belt properly and how to make seat adjustments. The brochure will also contain descriptions of different adaptive equipment. In addition, the Safe Communities Lifelong Mobility Center at Florida Atlantic University developed an assessment program of driver-vehicle fit for healthy older adults in South Florida as part of a local Safe Communities program. One instructor at the Pasco Pinellas Area Agency on Aging in Florida adds an additional component to the National Safety Council Mature Driver course that she teaches in the area. She conducts hands-on “car fit” assessments with the students. Older adults can then model this behavior in their own vehicles. The hands on component includes: correct use of a seat belt, adjusting seat belts, appropriate distance from the seat to the steering wheel, and information on adjusting seats. Seniors enjoy this portion of the course, and in most cases she finds older adults do not know how to adjust the fit in their vehicle. She also informs older drivers about aftermarket adaptive equipment including lambskin covers for the shoulder belt, seat belt adjustors, seat belt extenders, and adjustable gas and brake pedals.

The Iowa DOT Office of Driver Services has a “Choices Not Chances” Iowa-specific video for older drivers. It addresses Iowa licensing and safe driving including use of occupant restraints. Iowa State Patrol education officers and Iowa Driver License examiners are available to talk to older adult groups. Their presentations include information about the importance of seat belt use for crash protection. Generally, they see the most active and competent portion of the older adult population.

Many of the programs and campaigns identified in Chapter 6 have undergone further development and expansion since this report was originally developed in 2004. In order to obtain current information for the various programs and campaigns one may refer to the various websites referred to throughout this chapter as well as the NHTSA Web site

7.0 Key Research Gaps and Recommendations

There are a number of methods that may be used to increase seat belt use among older adults. In consulting with experts and examining existing data and literature Westat has identified a number of key research gaps and identified recommendations for future study. The issues that need to be addressed are examined in detail in this section and include:

- Improved vehicle designs that will result in higher rates of seat belt use by allowing for more comfortable access and fit, and by providing better protection to this fragile population in the case of a motor vehicle crash;
- Media programs developed and tailored to older age groups and subgroups, possibly using existing programs and trusted resources; and
- Additional research examining the seat belt use patterns of older adults and Baby Boomers to forecast future scenarios and develop additional programs.

Although belt use is already very high among the older adult population, a large proportion of older adults continue to be involved in fatal crashes. Increasing occupant protection for older adults can be addressed in a variety of ways. First, for older adults who are currently using their restraint systems properly, design adjustments may be developed that deal with the physiological changes associated with aging. To illustrate, modifications to seat belts such as wider webbing, the introduction of inflatable seat belts, or the development of a four-point harness instead of the current three-point lap/shoulder belt may provide additional protection for this fragile population. Any one of these design features would assist in distributing restraining forces more effectively, and limit seat belt-related injuries to older occupants. Second, efforts must also focus on the remaining portion of the older adult population currently not using a seat belt on a regular basis. Changes in current design, comfort, and usability as well as an increased understanding regarding seat belt effectiveness in reducing injuries may persuade nonusers to use seat belts more often.

Using injury criteria for older adults in motor vehicle crashes would provide more precise data on the effects of seat belts on this more fragile population. NHTSA may consider revising the injury tolerance criteria for existing dummies to replicate features of older motorists as was stated in the NHTSA Vehicle Safety Rulemaking Priorities and Supporting Research: 2003-2006. This data are already available in-house as the cadaver testing that has been conducted over the years was usually on older bodies. Currently, the results from the cadaver tests are scaled down in order to reflect the average-size 35-year-old male and smaller 50-year-old female. It is feasible to use the current data, as is, to establish new injury criteria reflecting what happens to the older age cohort in motor vehicle crashes.

Canada is considering a proposal to make changes parallel to the provisions introduced by NHTSA to FMVSS 208 in May 2000. These changes to Section 208 “Occupant Restraint Systems in Frontal Impact” of the Canadian Motor Vehicle Safety Regulations are similar to the U.S. standards with a few exceptions. In contrast to the U.S. regulations, Canada is proposing more-stringent chest deflection limits in order to prevent and mitigate chest injuries due to the compression by the seat belt and air bag. Transport Canada’s Draft Report *Benefit and Cost Considerations for Improving Chest Protection in Frontal Collisions in Canada* states that one of the central reasons for Canada's proposal is the increase in the number of older drivers and their reduced tolerance to injury. In spite of a high rate of belt use by older adults in Canada, the

United States, and Europe, older adults are experiencing a higher fatality rate per miles driven than their younger counterparts. Canada sees improving chest protection for occupants involved in frontal crashes as a way to protect the growing group of older occupants who display a high rate of seat belt use but a lower tolerance to injury. Transport Canada is concerned that the new U.S. chest deflection limits introduced recently to FMVSS 208 will not provide adequate protection for older occupants.

The current FMVSS rules do not include regulations regarding accommodations for fragile older adults. Vehicle regulations regarding specific population groups are difficult to put in place. Recognizing that the older population is rapidly growing, vehicle manufacturers have begun research on this topic, to a large extent on their own initiative. Collaboration with manufacturers on concepts of universal design that will improve safety for older adults and will still be marketable to the general population may lead to voluntary implementation of many of these safety features. The IDEA Center at SUNY Buffalo houses a universal design program under the auspices of the National Institute of Disability and Rehabilitation Research through the Rehabilitation Engineering Research Center on Universal Design. The IDEA Center has been involved in a study of older adults and passenger vehicles as well as a study on designing more effective automobiles for older adults using the concepts of universal design. The IDEA Center has an interest in developing universal designs for seat belts based on its research with older adults in partnership with recognized safety organizations with crash-testing capabilities.

Given that older adults exhibit decreased range of motion, reduction in stature, and an increased susceptibility to injuries associated with crash forces, manufacturers may be encouraged to explore and implement enhancements in vehicle design that address and compensate for age-related physiological declines in addition to fragility. In particular, manufacturers might want to concentrate on vehicle designs based on the anthropometric parameters of the older adult population such as their physical dimensions, strength, and range of motion. They could specifically design vehicles with easy entry/egress, seating safety and comfort, and comfortable and effective seat belt systems (American Medical Association, 2003). In terms of improving occupant protection, data suggest that efforts to protect the chest region would likely substantially reduce injuries. This might be accomplished with the use of air bags, as well as modifications to seat and restraint system design to reduce belt-related injuries or to redistribute the load absorbed by the older occupant's chest. Safety belt buckles and seating controls could be improved to make it easier for older adults with arthritis, and other mobility problems to adjust. Manufacturers could consider shape, size, location, and visibility of buckles and seating controls.

The European Conference of Ministers of Transport made a recommendation encouraging manufacturers to teach older drivers about adaptive devices that may allow them to compensate for physical problems (arthritis, decreased mobility and flexibility). Public information on these devices may be helpful for the older adult who is unable to purchase a new vehicle.

Current research including focus groups, telephone surveys, and observational surveys indicate that older adults are more likely than their younger counterparts to use seat belts. There is no media campaign or educational program specifically geared towards encouraging higher rates of seat belt use among older adults. In fact, it may be difficult to produce a large-scale campaign to increase seat belt use, such as those that are targeted to other demographic groups, which will produce justifiable results when taking the cost into account.

To date, a large portion of policy makers' attention has focused on older drivers and the potential risk they pose to themselves as well as to others when traveling on roadways. However, the data from the NHTS suggests that older adults do not drive as much as their younger counterparts. Evidence suggests that older adults more often travel as passengers (NHTS, 2001), and further evidence that belt use is lower for passengers compared to drivers (NOPUS, 2003) is alarming. Given that as a Nation the majority of daily trips taken occur in personal vehicles across all age groups (NHTS, 2001), older adults will likely continue to travel in passenger vehicles whether or not they continue driving. Therefore, countermeasures to reduce vulnerability of older adults to injury in motor vehicle crashes should be pursued. These measures can include changes to vehicle design as discussed above and educational programs that inform older adults of the benefits of seat belt use. The development of screening programs that turn older drivers into older passengers will not have an effect on fatality rates for older adults in vehicle crashes since they will still be in the vehicles, just not in the driver seats (Li et al., 2003).

There are many well established large-scale public information and education campaigns focused on increasing restraint use. However, few target the older adult population. As stated earlier, the most effective campaigns are those that combine a strong educational message with enforcement. *Buckle Up America* and *Click It or Ticket* are national campaigns to increase safety on the roadways. However, because older adults already have the highest seat belt usage rate across all age groups, these campaigns might not be reaching locations and resources frequented by older adults. It might be interesting to poll older adults during times when these programs are implemented in order to assess their awareness of them. Educating older adults on the benefits of seat belt use might simply mean adjustments in who is being targeted and how the information is being distributed. To illustrate, *Buckle Up America* has numerous contacts with organizations and people who deal, on a daily basis, with the older adult community. This includes health professionals, hospitals, police, and fire and rescue teams. *Buckle Up America* could conduct a campaign specifically targeted at the older adult community using these professionals as a means of communicating the seat belt message.

While the evidence regarding the relationship of race and ethnicity to seat belt use is conflicted, it is evident that each community may react differently to campaign efforts to increase seat belt use. Any attempt to increase belt use in the different racial/ethnic communities must consider the different customs and perceptions within that community. To illustrate, law enforcement concerns are very evident in both the Hispanic and Black communities. If law enforcement is used in conjunction with a well planned and distributed educational message regarding the benefits of seat belt use, it may result in higher seat belt usage in both the Black and Hispanic communities. If the information campaign is not well thought out and communicated to the public, some communities might feel as if they are targeted because of their race or ethnicity. Older adults overwhelmingly agree that messages are more effective when real-life situations are portrayed, and when the information comes from a trusted source such as a physician, hospital, or church pastor. The most effective way of communicating with older adults might be to adopt more of a grass roots approach to the safety campaign.

Occupational and physical therapists and physicians have an increased opportunity to address driving and transportation issues among older adults. Due to the physiological declines associated with aging, many older adults make frequent and regular visits to physicians and occupational and physical therapists. Conducting assessments, providing information, and designing programs to improve driving skills are all part of the occupational therapist's role in working with the senior community (Pierce, 2003). Physical therapists often work with older adults on

exercises to increase flexibility and assist in the driving task (Hunt, 1996). These exercises are geared towards improving range of motion that will assist older adults in reaching and twisting to secure the seat belt. Motor evaluation by an occupational therapist may include testing for range of motion, muscle strength, grip strength, reaction time, hand dominance, sitting balance, transfer procedures in and out of the vehicle, and interactions with various controls within the vehicle (including seat belts). These interactions provide physicians and therapists with the opportunity to educate older adults on the effectiveness of belt use as well as allow them to provide some insight on the kinds of adaptive equipment or compensatory techniques that permit the older adult to travel safely in a vehicle. AAA has designed a pamphlet that outlines exercises older drivers can perform at home to help improve joint flexibility as it relates to driving (AAA, 1993).

A number of the experts in the field suggested that a brochure, Webpage, and video on seat belts specifically addressing older adults would fulfill the gap in public information on this topic. The brochure may include general information on seat belts, the need for seat belts, possible adaptations, and references to sources for further information such as driver rehabilitation therapists. Such a brochure would be useful for distribution to the general public, and as a link to existing Web sites that are visited frequently by older adults or those who interact regularly with them (e.g, caregivers, physicians, occupational therapists). A video that models correct belt use would also be useful in training sessions, and as an active link on Web sites directed towards older adults. While there is agreement that belt use by older adults is high relative to younger occupants, there are an unknown percentage of older adults who use seat belts incorrectly, or use them only on occasion. It is important to impress upon older adults the benefits of seat belts in injury prevention and provide them with methods that will make seat belt use as comfortable and convenient as possible.

Little is known about the belt use rates for the Baby Boomer generation. When exploring crash data or seat belt use among the adult population in the United States, researchers have typically separated the Baby Boomer group into two groups for any analyses. A percentage of this population is often grouped with younger adults while a percentage is grouped with older adults (Cosby et al., 2003 Draft; Li et al., 2003; Vivoda et al., 2004; NOPUS 2003). For example, NOPUS measures seat belt use nationwide. For the adult population, the ages are grouped accordingly: 16-24 years, 25-69 years, and 70 and older. Thus results are unavailable for the 39 to 64 age group.

Some researchers believe that Baby Boomers are more aware of safety issues and more accustomed to using seat belts, and therefore will continue to use seat belts as they age. Others feel that as occupants' age, their decision to wear belts is driven by comfort and convenience. Without changes to current seating and seat belt designs Baby Boomers will stop using the belts as they become increasingly uncomfortable to wear. In addition, an issue that is not really addressed in the literature or by experts is that the Baby Boomer generation spans a period of at least 15 years. One might need to address the differences that exist between the older and younger Baby Boomers.

The findings of this review suggest that any number of reasons, singularly or in combination with others, can drive an older adult's decision to use or not use a seat belt. As with younger adults, seat belt use is strongly related to socioeconomic status, trip length, seating position, physical capabilities, and comfort and convenience.

Seat belt nonuse by older adults can fall into two categories, those older adults who do not use seat belts for behavioral or attitudinal reasons and those who do not use seat belts because of a variety of physical challenges that prevent them from doing so comfortably. Some older adults might elect not to use seat belts because they never used them as younger drivers. Others might only use seat belts for long-distance trips. Given that older adults tend to make shorter-distance trips, these occupants may spend a large proportion of their time in vehicles unbelted. Alternatively, some older drivers might want to use seat belts, but are prevented from doing so because of some physical limitation. Barriers including difficulty reaching around for the belt or inserting the latch plate into the buckle may be due to a number of issues from simple limitations in mobility that are typically associated with aging, to more serious difficulties with mobility due to severe arthritis, or even severe hip and knee problems.

The findings from various studies in conjunction with the findings from the logistic regressions identify a number of factors related to part-time use or nonuse among the older adult population. Sex, race and ethnicity, level of education and income, body weight, general health, health-related behaviors, vehicle type, and seating position in the vehicle are just a few examples of factors that relate to belt use among older adults. Older men are more likely to report nonuse than older women, individuals on either extreme of normal weight also seem to be less likely to use restraints than older adults who would be considered normal weight, and people who are passengers in the second or third row are less likely to wear seat belts relative to front-row passengers. Comfort and habit also seem to relate to belt use among older adults.

Since there are a variety of factors that might relate to nonuse among older adults, Westat plans to conduct a number of focus groups for NHTSA in order to identify those factors that seem to significantly result in nonuse among older adults. The focus groups will recruit participants from both the general older adult population and representatives from one or two of the target groups (overweight, physical limitations). This method will encourage thorough and detailed discussion of several topics that contribute to the decision to not use seat belts by older adults rather than discussions on a wide variety of factors.

Finally, this project will examine the relationship between seat belts, seating characteristics, and user characteristics in determining comfort and convenience, and in turn relate this to the likelihood of belt use. Westat will select a sample of older adult drivers and passengers to operate seat belts in a variety of vehicles and in different seating positions in each vehicle. The sample of older adults will be selected so that different groups of nonusers and part-time users within the older adult population are represented. Vehicles will be selected to provide a variety of belt configurations, seat types, seat adjustability, and vehicle types. The goal of this study is to relate seat belt features and seat configuration to measures of performance, comfort, convenience, likelihood of belt use, and proper belt/seating positions, as well as to identify problem areas for countermeasure design indicated as most suitable for target groups among the older adult population. Once more detailed reasons for nonuse are identified, interventions can be developed using the information gathered and strategic approaches will be designed for implementation by NHTSA.

It might also be interesting to explore the effect of belt use on outcomes among the older adult population, that is, estimate the effect of belt use on crash outcomes among older adults controlling for differences between drivers who use seat belts and drivers who do not use seat belts. Analyses using NASS data might explore the crash outcome for older adults by type of belt use and by air bag availability.

How many injuries of various types and deaths could be prevented nationwide if all occupants and drivers used the belts available to them in their vehicles?

Limitations for this proposed analysis would include missing belt use information for some of the records and the relatively small number of fatal crashes included in the NASS data-set resulting in large variances in the results for fatal crashes.

Evans (2001) estimated relative fatality risk in motor vehicle crashes as a function of age and sex. Risk of death from the same impact injuries at the age of 70 exceeds the risk at age 20 by 250 percent for men and 190 percent for women. Using FARS data, it might be interesting to use the estimates generated by Evans in combination with other methods to estimate the number of lives that could be saved by 100 percent belt use among older adults.

While older adults most often refer to physicians as respected and trusted sources of information, no research has really examined what type of information physicians currently offer older adults regarding seat belt use. The recently published *Physician's Guide to Assessing and Counseling Older Drivers* does not address seat belt use at all. Was its exclusion an oversight? Is this not considered a relevant issue? Do physicians have the needed information regarding seat belts and do they know what to say to whom? Increasing proper seat belt use among older adults and encouraging them to purchase safe cars are probably the most effective means to reduce fatalities and injuries. It might be interesting to conduct additional interviews with the authors of this guide to discuss this topic with them further and enlist their opinions on the most effective means of communicating its importance to both the medical field and the older adult community. A survey of physicians who are most often in contact with older adults might identify the nature of advice, if any, actually given by physicians to older adults. Additionally, a survey to determine whether or not older adults follow the advice of medical experts might be insightful as well. There are also a host of related studies about training and motivating gerontologists concerning advice on motor vehicle transportation safety, driving, and seat belt use that may be of interest.

Projected increases in numbers and proportions of older adults in the U.S. population indicate that there will be many more older adults on the road in personal vehicles in coming years. In an effort to promote the well-being of this age group and prevent future injuries in motor vehicle crashes this study provides a better understanding of the rate of seat belt use and reasons for nonuse of seat belts among older adults.

8.0 References

8.1 Information Resources

A. Literature Sources

No.	Author	Title	Source
1	AAA Foundation for Traffic Safety	A Summary of Older Driver Research Funded by the AAA Foundation for Traffic Safety	AAA Foundation for Traffic Safety, 1993
2	AAA Foundation for Traffic Safety	Flexibility Fitness Training Package for Improving Older Driver Performance	AAA Foundation for Traffic Safety, 1989
3	AAA Foundation for Traffic Safety	How to Help an Older Driver, A Guide for Planning Safe Transportation	AAA Foundation for Traffic Safety
4	Academy for Educational Development	Findings from Focus Groups with Older Drivers in Baltimore and Orlando	Submitted to American Society on Aging, Feb. 2002
5	Arce, Carlos, and Dinh-Zarr, T. Bella	Seat Belt Use Among Mexican Born Immigrants in the U.S. 2004	AAA Report 2004
6	Augenstein, Jeffrey Miami CIREN	Elderly Occupants and their Clinical Outcomes	Presented at the Seventh Quarterly CIREN meeting - December 6, 2001.
7	Austin, Rory A. and Faigin, Barbara M.	Effect of Vehicle and Crash Factors on Older Occupant Research	Presented at Experimental Safety Vehicle Conference, Paper 102, 2003
8	Baker, Susan P., Elisa R. Braver, Chen Li-Hui, Janella F. Pantula, and Dawn Massie	Motor Vehicle Occupant Deaths Among Hispanic and Black Children and Teenagers	Archives of Pediatrics & Adolescent Medicine, Vol. 152, No. 12, Dec 1998, pp. 1209–1212
9	Baker, Tara Kelley, Falb, Timothy, Voas, Robert and Lacey, John	Older Women Drivers: Fatal Crashes in Good Conditions	Journal of Safety Research Vol. 34 No. 3 2003
10	Balci, Rana, Vertiz, Alicia, and Shen, Wenqi	Comfort and Usability of Seat Belts	In Balci, Rana et.al. Human Factors in Automotive Design papers from the 2001 SAE World Congress.

No.	Author	Title	Source
11	Bandstra, Richard, Meissner, Uwe, Warner, Charles Y., Monoghan, Susan, Mendelsohn, Robert, and MacPherson, Duncan	Seat Belt Injuries in Medical and Statistical Perspectives	Proceedings of the International Technical Conference on the Enhanced Safety of Vehicles, 1998
12	Barnhill, William	On the Road: Older Drivers Under Closer Scrutiny	AARP Bulletin, 1998
13	Bedard, Michel, Stones, Michael J., Guyatt, Gordon H. and Hirdes, John P.	Traffic Related Fatalities Among Older Drivers and Passengers	The Gerontologist 41: 751-756, 2001
14	Bendjellal, Farid, Walfisch, Gilbert, Steyer, Christian, Bruno, Jean-Yves Foret, Trosseille, Xavier	The Combination of a New Air Bag Technology with a Belt Load Limiter	Presented at Experimental Safety Vehicle Conference, Paper 98-S5-O-14, 1998
15	Bodenmiller, F. M.; Hart, J. M.; Bhise, V. D.	Effect of vehicle body style on vehicle entry/exit performance and preferences of older and younger drivers	Human factors in seating and automotive telematics. Warrendale, SAE, 2002. (Michigan University, Dearborn)
16	Braver, E.R. and Trempel, R.E.	Are older drivers at higher risk of involvement in collisions resulting in deaths or nonfatal injuries among their passengers and other road users?	Injury Prevention 2004; 10: 27-32
17	Braver, Elisa R.	Methods of Exploring Crash and Injury Risk Among Older Vehicle Occupants	Presented at MIT AgeLab Meeting: New Transportation Technology for Older People, Sep 2003
18	Braver, Elisa	Race, Hispanic Origin, and Socioeconomic Status in Relation to Motor Vehicle Occupant Death Rates and Risk Factors Among Adults	Accident Analysis and Prevention Vol. 35 No. 3 May 2003 pp. 295-309
19	Broge, Jean	Ford Research Benefits Senior Drivers	Automotive Engineering International 109, no.2, Feb 2001 Pg. 76-78
20	Bryer, Thomas	Characteristics of Motor Vehicle Crashes Related to Aging	In Mobility and Transportation in the Elderly, K. Warner Schaie and Martin Pietrucha, pgs. 157-206, 2000

No.	Author	Title	Source
21	Bush, Sarah	Does Future Elderly Transportation Demand Pose a "Pending Crisis"? Challenges for Research and Policy Making.	Public Policy and Aging Report, Vol. 11, No. 4, Summer 2001
22	Carr, David	The Older Adult Driver	American Family Physician, Jan. 2000
23	Carr, David B	Characteristics of Frail Older Adult Drivers	Presented at MIT AgeLab Meeting: The Driving Decision: Health, Safety, and the Older Driver, May 2003
24	Center for Advancement of Public Health	Study of Driver's License Options for Applicants Age 70 or older in Virginia	George Mason University 1998
25	Chen, Liang, Balci, Rana, and Vertiz, Alicia	Safety Belt Fit, Comfort, and Contact Pressure Based on Upper Anchorage Location and Seat Back Angle	In: Human Factors in Driving, Seating, and Vision. Papers from 2003 World Congress & Exhibition, March 2003
26	Coley, Andrew, Partridge, Robert, Kaylor, Cynthia, Shapiro, Marc	The Effect of Seatbelt Use on Injury Patterns, Disposition, and Hospital Charges for Elders	Academy of Emergency Medicine, Vol. 9, No. 12, December 2002.
27	Collia, Demetra V., Sharp, Joy, and Giesbrecht, Lee	The 2001 NHTS: A look into the travel patterns of older Americans	Journal of Safety Research Vol. 34 No. 3, 2003
28	Cook, Lawrence J., Knight, Stacey, Olson, Lenora M., Nechodom, Patricia J., Dean, J. Michael	Motor Vehicle Crash Characteristics and Medical Outcomes Among Older Drivers in Utah 1992-1995	Injury Prevention, Annals of Emergency Medicine, 35:6 June 2000
29	Cordy, Sylvia, Raines, Kevin, Singletary, Judith, and Tillery-Larkin, Rochelle	Highway Safety in Black/ African American Communities: Issues and Strategies	Report No. DOT HS 809 649, NHTSA, Washington, DC. 2002
30	Cosby, Otis, Moore, Wayne, Haliburton, William, and Briggs, Nathaniel C.	Seat Belt Use Among African Americans: A Descriptive Analysis of Data from U.S. National Health Surveys and Surveillance System	Meharry Medical College Report, DRAFT, 2003
31	Crandall, Richard C.	Gerontology: A behavioral science approach	McGraw-Hill, 1991

No.	Author	Title	Source
32	Cushman, L. Good R., Annechiarico, R. and States, J.	Effect of safety belt usage on injury patterns of hospitalized and fatally injured drivers 55+	34th Annual Proceedings Association for the Advancement of Automotive Medicine, Oct. 1-3 1990, Scottsdale Arizona.
33	Dellinger AM, Langlois JA, Li G.	Fatal crashes among older drivers: decomposition of rates into contributing factors.	American Journal of Epidemiology 155(3):234–41, 2002.
34	Department of Transportation	Improving Transportation for a Maturing Society	Office of the Assistant Secretary for Transportation Policy, 1997
35	Doherty, S.T., Andrey, J.C., and MacGregor, C.	The Situational Risks of Young Drivers: The Influence of Passengers, Time of Day, and Day of Week on Accident Rates	Accident Analysis and Prevention 30:45-52, 1998.
36	Eberhard, John	Safe Mobility for Senior Citizens.	IATSS Research, 20(1): 29-37. 1996
37	Eberhard, John	The Graying of America: Safe Mobility for Life	Presented at CIREN Conference 2001
38	Eberhard, John W. and Trilling, Donald	Safe Mobility for a Maturing Society: Challenges and Opportunities.	Office of the Secretary, DOT, 2003
39	Ebert, Sheila M. and Reed, Mathew P.	Characterization of Driver Seatbelt Donning Behavior	Presented at SAE 2002 World Congress & Exhibition in Session: Human Factors in Seating Comfort
40	Ehrenman, Gayle	New Wheels for Grandma	Mechanical Engineering, April 2003
41	European Conference of Ministers of Transport Recommendations	Report on Transport and Aging of the Population	European Conference of Ministers of Transport Recommendations, 2001
42	Evans, Leonard	Age and Fatality Risk from Similar Severity Impacts	Journal of Traffic Medicine, 29 (1-2): 10-19, 2001
43	Evans, Leonard	Risks older drivers face themselves and threats they pose to other road users	International Journal of Epidemiology 29:315-322; 2000
44	Fairfax CIREN team	Geriatric Trauma Patients: Physiologic and Biomechanical Considerations	Presented at the Seventh Quarterly CIREN meeting - December 6, 2001.
45	Florida At-Risk Driver Council	The Effects of Aging on Driving Ability	Department of Highway Safety and Motor Vehicles, 2004
46	Ford, Royal	Auto Designs for the Ages	Boston Globe, March 5, 2000
47	Freedman, Mark; De Leonardis, Doreen and Irani, Benaaz.	Expert Panel Workshop on Using Technology to Increase Seat Belt Use.	Draft Final Report prepared by Westat, Inc. for the Office of Research and Traffic Records, NHTSA, July 13, 2000.

No.	Author	Title	Source
48	Gantz, Toni, Shaver, Barrett, De La Garza, Enrique J., Cohne, Larry and Ragland, David	Traffic Safety in Communities of Color	Institute of Transportation Studies, U.C. Berkeley Traffic Safety Center, 2003
49	Glassbrenner, Donna	Safety Belt Use in 2002: Demographic Characteristics	NCSA Research Note, DOT HS 809 557, March 2003; NHTSA.
50	Government Accounting Office	Highway Safety: Causes of Injury in Automobile Crashes	GAO Report PEMD 1995 4
51	Greene, Kelly	Marketing surprise: Older Consumers Buy Stuff, Too	Wall Street Journal, April 12, 2004
52	Harper, Jennifer S., Marine, William M., Garrett, Carol J., Lezotte, Dennis, Lowenstein, Steven R.	Motor Vehicle Crash Fatalities: A Comparison of Hispanic and Non-Hispanic Motorists in Colorado	Annals of Emergency Medicine, Vol. 36, No. 6, December 2000, pp. 589–596
53	Hing, Jason Yaw Cheuk, Stamatiadis, Nikiforos, Aultman-Hall, Lisa	Evaluating the Impact of Passengers on the Safety of Older Drivers	Journal of Safety Research Vol. 34 2003, pgs. 343-351
54	Hogan, David B.	The Older Driver	University of Calgary, Feb. 1999
55	Hu, P.S. et. al.	Projecting Fatalities in Crashes Involving Older Drivers, 2000-2025	ORNL and Battelle, 2000
56	Hunt, Linda	A Profile of Occupational Therapists as Driving Instructors and Evaluators for Elderly Drivers	IATSS Research, 20(1): 46-47. 1996
57	Insurance Institute for Highway Safety	Older Drivers Up Close: they aren't dangerous except maybe to themselves.	Status Report Vol. 36 No. 8, 2001
58	Jonah, B.A.	Age Differences in Risky Driving	Health Education Research: Theory and Practice, 5(2), pp. 139-149, 1990.

No.	Author	Title	Source
59	Kent, Richard, Funk, Jim, and Crandall, Jeff	How Future Trends in Societal Aging, Air Bag Availability, Seat Belt Use, and Fleet Composition Will Affect Serious Injury Risk and Occurrence in the United States	Traffic Injury Prevention 4, pgs 24-32, 2003
60	Kerschner, Helen, and Aizenberg, Rhonda	Transportation in an Aging Society: Focus Groups Project	Beverly Foundation, Nov. 1999
61	Khattak, Aemal J., Pawlovich, Michael D., Souleyrette, Reginald R., and Hallmark, Shauna L.	Factors related to more severe older driver traffic injuries	Journal of Transportation Engineering Vol. 128 No. 3 May/ June 2002 pgs. 243-249.
62	King, Jason D.	GrandDriver	Summary and Media Kit, 2003
63	Koppa, Rodger	Automotive Adaptive Equipment and Vehicle Modifications	Draft from TRB Conference Transportation in an Aging Society: A Decade of Experience, 2002.
64	Kostyniuk, L. P.; Eby, D. W.; Miller, L. L. .	Crash trends of older drivers in Michigan: 1998-2002	Sponsor: Michigan Office of Highway Safety Planning, Lansing. Report No. UMTRI-2003-22.
65	Lee, B.H.Y and Schofer, J.L.	Restraint Use and Age and Sex Characteristics of Persons Involved in Fatal Motor Vehicle Crashes	Presented at the Transportation Research Board Annual Conference, 2003.
66	Lerner, E. Brooke, Jehle, Dietrich V.K., Billittier, Anthony J., Moscati, Ronald M, Connery Cristine M., Stiller, Gregory	The influence of demographic factors on seatbelt use by adults injured in motor vehicle crashes	Accident Analysis and Prevention 33 (2001) 659-662
67	Li, G.; Braver, E.R. and Chen, L-H.	Fragility versus excessive crash involvement as determinants of high death rates per vehicle-mile of travel among older drivers.	Accident Analysis and Prevention 35:227-35, 2003
68	Lyman, S.; Ferguson, S.A.; Braver, E.R. and Williams, A.F.	Older driver involvements in police reported crashes and fatal crashes: trends and projections.	Injury Prevention 8:116-20, 2002
69	Mackay, Murray	Crash Protection for Older Persons	Transportation in an Aging Society, TRB Conference, 1988

No.	Author	Title	Source
70	Malfetti, James L., and Winter, Darlene J.	Development of A Guide for People Concerned About An Older Driver.	AAA Foundation for Traffic Safety, 1991
71	Malfetti, James L., and Winter, Darlene J.	Drivers 55 Plus: Test Your Own Performance.	AAA Foundation for Traffic Safety, 1994
72	Margolis, Karen L., Kerani, Roxanne Pieper, Mcgovern, Paul, Songer, Thomas, Cauley, Jane A. and Ensrud, Kristine, E.	Risk Factors for Motor vehicle Crashes in Older Women	The Journals of Gerontology Series A: Biological Sciences and Medical Sciences 57:M186-M191, 2002.
73	Marottoli, Richard A., and Drickamer, Margaret A.	Psychomotor Mobility and the Elderly Driver	in Medical Considerations in the Older Driver, Clinics in Geriatric Medicine, Sheldon M. Retchin, Vol 9, No. 2, May 1993
74	Maupin, John E., Schlundt, David, Warren, Rueben, Miller, Stephania, Goldzweig, Irwin, Warren, Hershell	Reducing Unintentional Injuries on the Nation's Highways: Research and Programs Policy to Increase Seat Belt Use	Journal of Health Care for the Poor and Underserved 15 (2004): 4-17
75	McCoy, G. F., Johnstone, R.A, and Duthie, R. B.	Injury to elderly in Road Traffic Accidents	J Trauma 29:494, 1989
76	McCoy, Patrick T., et. al.	Evaluation of Countermeasures for Improving Driving Performance of Older Drivers	Transportation Research Record 1405, 1993
77	McGwin, Jr. , G., and Brown, D. B.	Characteristics of traffic crashes among young, middle-aged, and older drivers.	Accident Analysis and Prevention, 31, 181-198, 1999.
78	McKnight A. James, and Urquijo, J.I.	Signs of Deficiency Among Elderly Drivers	Transportation Research Record 1405, 1993
79	McKnight, A. James	The Freedom of the Open Road: Driving and Older Adults	Generations Summer 2003
80	McKnight, A. James	Too Old to Drive?	Issues in Science and Technology Online, Winter 2000

No.	Author	Title	Source
81	Memmott, Jefferey L.	Overall Travel Patterns of Older Americans	Presented at Annual Transportation Research Board conference Jan. 2004.
82	Milton, K.	Impact of Public Information on the Safe Transportation of Older People	Draft from TRB Conference Transportation in an Aging Society: A Decade of Experience, 2002.
83	Mitchell, Christopher G. B.	Some implications for road safety of an ageing population	Transport Trends, UK Department of Transport, 2000
84	Mitchell, Christopher G. B.	Transport in an Ageing Society	Transport Trends, UK Department of Transport, 2000
85	Molnar, Lisa J., Eby, David W., Miller, Linda L.	Promising Approaches for Enhancing Elderly Mobility	University of Michigan Transportation Research Institute, Report Number: UMTRI-2003-24, Sep. 2003
86	Morris, Andrew, Welsh, Ruth, Frampton, Richard, Charlton, Jude, and Fildes, Brian.	An Overview of the Requirements for the Crash Protection of Older Drivers	46th Annual Proceedings, AAAM Sep-Oct 2002
87	Mueller, Kim, Veneziano, David, and Hallmark, Shauna	Evaluation of Racial Differences in Seat Belt and Child Restraint Use: A Review of Current Literature	Center for Transportation Research and Education, Iowa State University, January 2004.
88	Natalani, Tiffani, Carr, Kristen, Vala, Marilyn, and Boroughf, William	Variables Influencing Shoulder Belt Positioning of Four Point Safety Belts	In Balci, Rana et.al. Human Factors in Automotive Design papers from the 2001 SAE World Congress.
89	National Highway Traffic Safety Administration	Buying a Safer Car 2003	http://www.nhtsa.dot.gov/NCAP/BASC2003/index.html, accessed 2003, Washington DC: NHTSA
90	National Highway Traffic Safety Administration	Fifth/Sixth Report to Congress: Effectiveness of Occupant Protection Systems and their Use.	www-nrd.nhtsa.dot.gov/pdf/nrd-30/NCSA/Rpts/2002/809-442.pdf, accessed in 2003, DOT HS 809 442, 2001. Washington, DC: NHTSA.
91	National Highway Traffic Safety Administration	Initiatives to Address Safety Belt Use	www.nhtsa.dot.gov/people/injury/SafetyBelt/OPIPT_FinalRpt_07-17-03.html, accessed in 2003, Washington , DC : NHTSA

No.	Author	Title	Source
92	National Highway Traffic Safety Administration	Motor Vehicle Occupant Protection Facts- Children Youth and Young Adults	http://www.nhtsa.dot.gov/people/injury/airbags/OccupantProtectionFacts/index.htm, posted 09/27/2004, Washington DC: NHTSA
93	National Highway Traffic Safety Administration	NHTSA Vehicle Safety Rulemaking Priorities and Supporting Research: 2003-2006	http://www.nhtsa.dot.gov/cars/rules/rulings/PriorityPlan/FinalVeh/Index.html, accessed in 2003, Washington DC: NHTSA
94	National Highway Traffic Safety Administration	Older Drivers: Cues for Law Enforcement	http://www.nhtsa.dot.gov/people/injury/olddrive/cuesindex.html, accessed on 10.23.03, Washington DC: NHTSA.
95	National Highway Traffic Safety Administration	Safety Issues for Vehicles Adapted for Use by Persons with Disabilities	http://www.nhtsa.dot.gov/cars/rules/adaptive/btsrn/index.html, accessed in 2003, Research Note June 2002, Washington DC: NHTSA
96	National Highway Traffic Safety Administration	Traffic Safety Facts 2000: Older Population	http://www-nrd.nhtsa.dot.gov/Pubs/2000OLDPOP.PDF, DOT HS 809 328. Washington DC: NHTSA, 2001.
97	National Highway Traffic Safety Administration	Traffic Safety Facts 2003: A Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting System and the General Estimates System	DOT HS 809 775. Washington DC: NHTSA, 2005.
98	National Highway Traffic Safety Administration	Traffic Safety Facts 2003: Older Population	DOT HS 809 766. Washington DC: NHTSA, 2004.
99	National Transportation Safety Board	Public Hearing on Medical Oversight of Non-Commercial Drivers	Transcripts of the Proceedings, March 18-19 2003
100	Nelson, David E., Bolen, Julie, and Kresnow, Marcie-Jo	Trends in Safety Belt Use by Demographics and by Type of State Safety Belt Law, 1987 through 1993	American Journal of Public Health Vol. 88, No. 2, February 1998, pp. 245-249.
101	Nicolle, Colette	Tailoring New Automotive Technologies to the Elderly Benefits All Drivers	Ergonomics in Design 95 Q3 14
102	Oguntoyinbo, Kristin	Emerging Hispanic Community Faces Challenges on North Carolina Roadways	Directions, Vol. IV, No. 2, Winter 2001, pp. 6–7

No.	Author	Title	Source
103	Organization for Economic Cooperation and Development	Ageing and Transport: Mobility Needs and Safety Issues	Organization for Economic Co-Operation and Development, 2001
104	Ostrow, Andrew C., Shaffron, Peter, and McPherson, Kenard	The Effects of Joint Range of Motion Physical Fitness Training Program on the Automobile Driving Skills of Older Adults	Journal of Safety Research Vol. 23, pp207-219, 1992
105	Parada, Mario A., Cohn, Lawrence D., Gonzalez, Eugenia, Byrd, Theresa, and Cortes, Miguel	The Validity of Self-Reported Seat Belt Use: Hispanic and Non-Hispanic Drivers in El Paso	Accident Analysis and Prevention, Vol. 33, No. 1, January 2001, pp. 139–143
106	Perel, Michael	Helping Older Drivers Benefit from In-Vehicle Technologies	Presented at Experimental Safety Vehicle Conference, Paper 98-S2-O-11, 1998
107	Pierce, Susan	The Occupational Therapist's Roadmap to Safety for Seniors	Gerontology, Vol. 26, No. 3, September 2003.
108	Pike, J.A.	The Elderly and Vehicle Related Injury	Presented at the Human Factors and Ergonomics Society Annual Meeting, 1989
109	Pike, Jeffrey	Protecting the Older Driver: Vehicle Concepts	Draft from TRB Conference Transportation in an Aging Society: A Decade of Experience, 2002.
110	Porter, Robert S., and Zhao, Ning	Patterns of Injury in Belted and Unbelted Individuals Presenting to a Trauma Center after Motor Vehicle Crash: Seat Belt Syndrome Revisited	Injury Prevention, Annals of Emergency Medicine, 32:4 October 1998
111	Preusser, D.F., and Preusser, C.W.	Evaluation of Louisiana's Safety Belt Law Change to Primary Enforcement	DOT HS-808-620, Washington DC: NHTSA, 1997
112	PRNewswire.com	Lear Corporation Displays Innovative Transgenerational Seat in "Secrets of Aging" Exhibit at Boston Museum of Science	Lear Corporation, Company News on Call, Mar. 31, 2000.
113	Rouhana, Stephen W., et al.	Biomechanics of 4-Point Seat Belt Systems in Frontal Impacts	Stapp Car Crash Journal Vol. 47 (October 2003) pp. 367-399

No.	Author	Title	Source
114	Sapolsky, Barry S.	Click It or Ticket Campaign: Follow-up Observational Survey of Safety Belt Use in Florida.	Florida Department of Transportation. August 2001.
115	Schieber, Frank	Beyond TRB 218: A Select Summary of Developments in the Field of Transportation and Aging since 1988.	Prepared for the Transportation Research Board, 1999
116	Shinar, David, Schechtman, Edna, Compton, Richard	Self Reports of safe driving behaviors in relationship to sex, age, education, and income in the US adult driving population	Accident Analysis and Prevention 33 (2001) 111-116
117	Silverstein, Nina M., Gottlieb, Alison S., and Van Ranst, Elizabeth	Use of Video Intervention to Increase Elders' Awareness of Low-Cost Vehicle Modifications that Enhance Driving Safety and Comfort	Transportation Research Record: Journal of the Transportation Research Board, No. 1922, TRB: Washington D.C. 2005, pp. 15-20.
118	Skinner, David, and Stearns, Mary D.	Safe Mobility in an Aging World	Presented at Annual Meeting, Transportation Research Board, 1999
119	Smiley, A.	Adaptive Strategies of Older Drivers	Draft from TRB Conference Transportation in an Aging Society: A Decade of Experience, 2002.
120	Staplin, Loren; Ball, Karlene; Park, Denise; Decina, Lawrence E, Lococo, Kathy H., Gish, Kenneth W., and Kotwal, Bari	Synthesis of Human Factors Research on Older Drives and Highway Safety Volume 1	Publication No. FHWA-RD-97-094, Washington DC: FHWA, Final Report 1997
121	Staplin, Loren; Lococo, Kathy H., Stewart, Joseph and Decina, Lawrence E	Safe Mobility for Older People Notebook	http://www.nhtsa.dot.gov/people/injury/olddrive/safe/, DOT HS 808 853, Washington DC: NHTSA, 1999.
122	Stearns, Mary D., Sussman, E.D. , and Skinner D.	Quantifying the Relationships: Aging, Driving Cessation, Health, and Costs	A Project Memorandum presented by Volpe Center to USDOT, January 2004
123	Steinfeld, Aaron, and Steinfeld, Edward	Universal Design In Automobile Design	In Universal Design Handbook, Preiser, Wolfgang F. E. and Ostroff, Elaine. New York : McGraw-Hill 2001

No.	Author	Title	Source
124	Steinfeld, Edward, Tomita, Machiko, Mann, William C. and DeGlopper, William.	Use of passenger vehicles by older people with disabilities.	Journal of Occupational Therapy Research, Summer 1999
125	Stevens JA, Hasbrouck L, Durant TM, Dellinger AM, Batabyal PK, Crosby AE, et al.	Surveillance for injuries and violence among older adults.	MMWR Surveillance Summaries 1999;48(SS-8):27–50.
126	Stiles, Martha C., and Grieshop, James I.	Impacts of Culture on Driver Knowledge and Safety Device Usage Among Hispanic Farm Workers	Accident Analysis and Prevention, Vol. 31, No. 3, May 1999, pp. 235–241
127	Swigart, Thomas	ITS and the Older Driver: An Auto Industry Perspective	In Mobility and Transportation in the Elderly, K. Warner Schaie and Martin Pietrucha, pgs. 299-313, 2000
128	Ticer, Sgt. Robert	A Compendium of Law Enforcement Older Driver Programs	http://www.nhtsa.dot.gov/PEOPLE/injury/olddrive/LawEnforcementOlderDriver03/index.htm, accessed in 2003, Washington DC: NHTSA.
129	Transport Canada	DRAFT Benefit and Cost Considerations for Improving Chest Protection in Frontal Collisions in Canada	Road Safety and Motor Vehicle Regulation Directorate, Transport Canada, May 2003
130	Transportation Resarch Board	Buckling Up: Technologies to Increase Seat Belt Use	TRB Special Report 278, Washington DC: TRB, National Academies of Sciences, 2003
131	Transportation Resarch Board	Transportation in an Aging Society: Recommendations	TRB Special Report 218, Washington DC: TRB, National Academies of Sciences, 1988
132	The Road Information Program	Designing Roadways to Safely Accommodate the Increasingly Mobile Older Driver	http://www.tripnet.org/OlderDrivers2003Study.PDF, Washington DC: TRIP, July 2003
133	Ucles, Jose Alberto	NHTSA Launches Successful Campaign to Promote Seat Belt Use Among Hispanics	NHTSA Now, Washington DC: NHTSA, Vol. 7, No. 7, 14 June 2001, pp. 1, 3.

No.	Author	Title	Source
134	Vivoda, Jonathon M., Eby, David W., Kostyniuk, Lidia P.	Differences in Safety Belt Use by Race	Accident Analysis and Prevention, 36 (2004) 1105-1109.
135	Wagner, Essie K., and Gotschall, Cathy	Older Road Users: Examining the Relationship Between Injuries and Fatalities	Transportation Research Record 1818, 2003
136	Waller, P.F.	Accidents: Traffic	In Birren J.E. Encyclopedia of Gerontology: Age, Aging and the Aged (Vol. 1, pp. 19-25) San Diego: Academic Press, 1996.
137	Waller, P.F.	The Older Driver	Human Factors Vol. 33 (5) pp. 499-505, 1991.
138	Walz, Marie	NCAP Test Improvements With Pretensioners and Load Limiters	http://www.nhtsa.dot.gov/cars/rules/regrev/evaluate/809563.html DOT HS 809 562 Washington DC: NHTSA , 2003
139	Wang, Claire et. al.	Physician's Guide to Assessing and Counseling Older Drivers	American Medical Association, 2003
140	Wang, Stewart C.	An Aging Population: Fragile, Handle With Care	Research Paper presented and the Second Annual CIREN Conference 1998
141	Wang, Stewart C.	Body Changes with Aging	Presented at the Seventh Quarterly CIREN meeting - December 6, 2001. Topic: Age-Related Injuries
142	Weinand, Manfred	Safety Measures for Elderly Drivers: The situation in Germany	IATSS Research, 20(1): 67-74. 1996.
143	Wells, JoAnn K., Williams, Allan, Farmer, Charles M.	Seat belt use among African Americans, Hispanics, and Whites	Accident Analysis and Prevention 34 (2002) 523-529
144	Williams, Alan F.	Teenage Passengers in Motor Vehicle Crashes: A Summary of Current Research	http://www.iihs.org/research/topics/pdf/teen_passengers.pdf Arlington, VA: IIHS, December 2001

No.	Author	Title	Source
145	Williams, A. F., and Ferguson, S. A.	Rationale for Graduated Licensing and the Risks it Should Address	Injury Prevention, 2002 Sep;8 Suppl 2:ii9-14
146	Yanik, A. J.	Factors to Consider when Designing Vehicles for Older Drivers	From the Human Factors and Ergonomics Society Annual Meeting. 1989
147	Zhou, Qing, Rouhana, Stephen W., and Melvin, John W.	Age Effects on Thoracic Injury Tolerance	40th Stapp Car Crash Conference Proceedings 1996

B. Data Sources

1. *Behavioral Risk Factor Surveillance System (BRFSS)* [Data file]. 2002. Atlanta, GA: National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention. Available from www.cdc.gov/brfss/index.htm.

2. *Consumer Assessment Survey (CAS)* [Data file], 1991-2001. Buffalo, NY: RERC Aging, State University of New York at Buffalo. Available from William C. Mann, OTR, Ph.D., Chair and Professor, Department of Occupational Therapy, University of Florida, PO Box 100164, Gainesville, FL 32610on Technology for Successful Aging in UFL.

3. *Crash Injury Research and Engineering Network (CIREN)* [Data file]. 1996. Washington, DC: National Highway Traffic Safety Administration.

4. *Fatality Analysis Reporting System (FARS)* [Data file]. (2006). Available from www-fars.nhtsa.dot.gov/. Washington, DC: National Center for Statistics and Analysis, National Highway Traffic Safety Administration.

5. *Motor Vehicle Occupant Safety Surveys (MVOSS)* [Data file]. 2003. Washington, DC: National Highway Traffic Safety Administration.

6. *National Automotive Sampling System (NASS)* [Data file]. Available from www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/NASS.html] Washington, DC: National Center for Statistics and Analysis, National Highway Traffic Safety Administration.

7. *National Household Transportation Survey (NHTS)* [Data file]. 2001. Washington, DC: Bureau of Transportation Statistics and Federal Highway Administration.

8. *National Occupant Protection Use Survey (NOPUS)*. 2006. Washington, DC: National Highway Traffic Safety Administration.

9. *Older Americans 2004: Key Indicators of Well-Being.* (2004). Washington, DC: Federal Interagency Forum on Aging-Related Statistics.

8.2 Data Analyses and Reports

A. Statistics on Aging

TABLE A.1a Number of People 65 and Older and 85 and Older, Selected Years 1900-2000 and Projected 2010-2050*

Year	65 and older	85 and older
Estimates	In millions	
1900	3.1	0.1
1910	3.9	0.2
1920	4.9	0.2
1930	6.6	0.3
1940	9.0	0.4
1950	12.3	0.6
1960	16.2	0.9
1970	20.1	1.5
1980	25.5	2.2
1990	31.2	3.1
2000	35.0	4.2
Projections		
2010	40.2	6.1
2020	54.6	7.3
2030	71.5	9.6
2040	80.0	15.4
2050	86.7	20.9

TABLE A.1b Percentage of the Population 65 and Older 1900-2000*

Year	65 and older	85 and older
Estimates	Percent	
1900	4.1	0.2
1910	4.3	0.2
1920	4.7	0.2
1930	5.4	0.2
1940	6.8	0.3
1950	8.1	0.4
1960	9.0	0.5
1970	9.9	0.7
1980	11.3	1.0
1990	12.6	1.2
2000	12.4	1.5
Projections		
2010	13.0	2.0
2020	16.3	2.2
2030	19.6	2.6
2040	20.4	3.9
2050	20.6	5.0

*Reference Population: These data refer to the resident population.

TABLE A.1c Life Expectancy, By Age and Sex, Selected Years 1900-2001

Age and sex	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2001
	Years											
Birth												
Both sexes	49.2	51.5	56.4	59.2	63.6	68.1	69.9	70.8	73.9	75.4	77.0	77.2
Men	47.9	49.9	55.5	57.7	61.6	65.5	66.8	67.0	70.1	71.8	74.3	74.4
Women	50.7	53.2	57.4	60.9	65.9	71.0	73.2	74.6	77.6	78.8	79.7	79.8
At Age 65												
Both sexes	11.9	11.6	12.5	12.2	12.8	13.8	14.4	15.0	16.5	17.3	18.0	18.1
Men	11.5	11.2	12.2	11.7	12.1	12.7	13.0	13.0	14.2	15.1	16.2	16.4
Women	12.2	12.0	12.7	12.8	13.6	15.0	15.8	16.8	18.4	19.0	19.3	19.4
At Age 85												
Both sexes	4.0	4.0	4.2	4.2	4.3	4.7	4.6	5.3	6.0	6.2	6.4	6.5
Men	3.8	3.9	4.1	4.0	4.1	4.4	4.4	4.7	5.1	5.3	5.6	5.7
Women	4.1	4.1	4.3	4.3	4.5	4.9	4.7	5.6	6.4	6.7	6.8	6.9

Note: The life expectancies (LEs) for decennial years 1910 to 1990 are based on decennial census data and deaths for a 3-year period around the census year. The LEs for decennial year 1900 are based on deaths from 1900 to 1902. LEs for years prior to 1930 are based on the death registration area only. The death registration area increased from 10 States and the District of Columbia in 1900 to the coterminous United States in 1933. LEs for 2000 were computed using population counts from Census 2000. LEs for 2001 were computed using 2000-based postcensal estimates.

TABLE A.1d Life Expectancy, By Age and Race, 2001

	Total		Men		Women	
Age	White	Black	White	Black	White	Black
Birth	77.7	72.2	75.0	68.6	80.2	75.5
At Age 65	18.2	16.4	16.5	14.4	19.5	17.9
At Age 85	6.4	6.7	5.6	5.7	6.7	7.0

Reference population: These data refer to the resident population
Source: Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System

Table A.1e. Leading causes of death among people age 65 and over, by sex 2001

Men	
1	Diseases of heart
2	Malignant neoplasms
3	Cerebrovascular diseases
4	Chronic lower respiratory diseases
5	Influenza and pneumonia
6	Diabetes mellitus
7	Accidents (unintentional injuries)
8	Alzheimer's disease
9	Nephritis, nephrotic syndrome and nephrosis
10	Septicemia
Women	
1	Diseases of heart
2	Malignant neoplasms
3	Cerebrovascular diseases
4	Chronic lower respiratory diseases
5	Alzheimer's disease
6	Influenza and pneumonia
7	Diabetes mellitus
8	Nephritis, nephrotic syndrome and nephrosis
9	Accidents (unintentional injuries)
10	Septicemia

Reference population: These data refer to the resident population.
Source: Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System.

Table A.1f. Leading causes of death among people age 85 and over, by sex 2001

Men	
1	Diseases of heart
2	Malignant neoplasms
3	Cerebrovascular diseases
4	Chronic lower respiratory diseases
5	Influenza and pneumonia
6	Alzheimer's disease
7	Nephritis, nephrotic syndrome and nephrosis
8	Accidents (unintentional injuries)
9	Diabetes mellitus
10	Pneumonitis due to solids and liquids
Women	
	All races
1	Diseases of heart
2	Cerebrovascular diseases
3	Malignant neoplasms
4	Alzheimer's disease
5	Influenza and pneumonia
6	Chronic lower respiratory diseases
7	Diabetes mellitus
8	Nephritis, nephrotic syndrome and nephrosis
9	Accidents (unintentional injuries)
10	Septicemia

Reference population: These data refer to the resident population.
Source: Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System.

TABLE A.1g Percentage of People Age 65+ Who Reported Having Selected Chronic Conditions By Sex, 2001-2002

Sex	Heart Disease		Hyper-tension		Stroke		Emphysema		Asthma		Chronic Bronchitis		Any Cancer		Diabetes		Arthritic Symptoms	
		SE		SE		SE		SE		SE		SE		SE		SE		SE
Total	31.2	0.5	50.1	0.5	8.8	0.3	5	0.2	8.4	0.3	6.1	0.3	20.7	0.4	15.6	0.4	35.9	0.5
Men	36.6	0.8	47.3	0.9	9.5	0.5	6.5	0.4	7.3	0.5	5.1	0.4	24.5	0.8	18.0	0.7	31.3	0.8
Women	27.1	0.6	52.2	0.7	8.2	0.4	3.8	0.3	9.2	0.4	6.8	0.4	17.9	0.5	13.9	0.5	39.3	0.6
White, not Hispanic or Latino	32.4	0.5	48.5	0.6	8.6	0.3	5.3	0.3	8.3	0.3	6.4	0.3	23.1	0.5	14.1	0.4	36.5	0.6
Black, not Hispanic or Latino	26.2	1.5	66.3	1.5	9.3	1	3.9	0.7	9.1	0.9	5.3	0.8	9.4	0.9	23.4	1.2	35	1.5
Hispanic or Latino	22.0	1.7	47.9	2.1	8.8	1.1	2.4	0.7	8.1	1.0	4.7	0.9	9.4	1.2	23.7	1.4	31.4	1.7

Note: Data are based on a 2-year average from 2001-2002. Data for arthritic symptoms are from 2000-2001
Reference population: These data refer to the civilian non-institutionalized population.
Source: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey

TABLE A.1h Body Weight Status Among People Age 65 and Over, By Sex and Age Group, Selected Years 1960-2002

Sex and age group	1960-1962	SE	1971-1974	SE	1976-1980	SE	1988-1994	SE	1999-2002	SE
Percent										
Underweight										
Both sexes										
65 and over	na		na		na		2.8	0.3	2	0.4
65-74	4.2	0.7	3.4	0.5	3	0.5	2.1	0.5	1.9	0.4
75 and over	na		na		na		3.9	0.5	2.2	0.7
Men										
65 and over	na		na		na		1.8	0.4	0.8	0.3
65-74	6	0.9	3.3	0.6	3.5	0.7	1.4	0.4	0.9	0.4
75 and over	na		na		na		2.6	0.6	0.6	0.4
Women										
65 and over	na		na		na		3.5	0.5	2.9	0.7
65-74	2.7	0.9	3.5	0.6	2.7	0.6	2.7	0.7	2.8	0.7
75 and over	na		na		na		4.7	0.6	3.1	1.2
Healthy weight										
Both sexes										
65 and over	na		na		na		37.1	1.3	29.1	1.4
65-74	40.7	2.9	41.3	1.3	39.7	1.3	33.8	1.8	24.8	1.9
75 and over	na		na		na		42.2	1.3	35	2.2
Men										
65 and over	na		na		na		33.8	1.7	26.4	1.1
65-74	46.2	3.8	42.1	1.5	42.3	1.7	30.1	2.2	22.8	1.8
75 and over	na		na		na		40.9	1.9	32.0	2.2
Women										
65 and over	na		na		na		39.6	1.4	31.2	2.2
65-74	36.4	3.5	40.6	1.8	37.8	1.7	37.0	2.0	26.4	3
75 and over	na		na		na		43.0	1.6	36.9	3.3
Overweight										
Both sexes										
65 and over	na		na		na		60.1	1.3	68.8	1.3
65-74	55.1	3.1	55.3	1.2	57.2	1.5	64.1	1.7	73.3	1.9
75 and over	na		na		na		53.9	1.2	62.8	2.2
Men										
65 and over	na		na		na		64.4	1.7	72.8	1.2

*Aging Statistics are from Older Americans 2004

65-74	47.8	3.8	54.6	1.5	54.2	1.9	68.5	2.1	76.2	1.8
75 and over	na		na		na		56.5	2.0	67.4	2.3
Sex and age group	1960-1962	SE	1971-1974	SE	1976-1980	SE	1988-1994	SE	1999-2002	SE
Percent										
Overweight										
Women										
65 and over	na		na		na		56.9	1.3	65.9	2.0
65-74	60.9	3.7	55.9	1.8	59.5	1.7	60.3	1.8	70.9	3
75 and over	na		na		na		52.3	1.5	59.9	3.3
Obese										
Both sexes										
65 and over	na		na		na		22.2	0.9	29.8	1.2
65-74	17.5	1.9	17.2	1.0	17.9	0.9	25.6	1.2	35.9	1.7
75 and over	na		na		na		17.0	1.1	21.5	1.6
Men										
65 and over	na		na		na		20.3	1.5	26.5	1.7
65-74	10.4	2.1	10.9	0.7	13.2	1.1	24.1	1.8	31.9	2.3
75 and over	na		na		na		13.2	2.1	18.0	2.2
Women										
65 and over	na		na		na		23.6	1.1	32.2	1.7
65-74	23.2	2.8	22.0	1.5	21.5	1.3	26.9	1.5	39.3	3
75 and over	na		na		na		19.2	1.3	23.6	2.2

na Data not available
Note: Data are based on measured height and weight. Height was measured without shoes; 2 pounds were deducted from data for 1960-1962 to allow for weight of clothing. Underweight is defined as having a body mass index (BMI) less than 18.5 kilograms/meter^2. Healthy weight is defined by a BMI of 18.5 to less than 25 kilograms/meter^2. Overweight is defined as having a BMI greater than or equal to 25; obese is defined by a BMI of 30 or greater. Percentages do not sum to 100 because the percentage of people who are obese is a subset of the percentage of those who are overweight. See Appendix C for the definition of BMI.
Reference Population: These data refer to the civilian noninstitutionalized population.
Source: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey

B. Behavioral Risk Factor Surveillance System -BRFSS

1. Methods

1.1 Case selection:

The following criteria were applied to select cases for analysis:

Respondents needed to be age 65 or older and provide seat belt use information as follows:

- Responses to the seat belt use question (How often do you use seat belts when you drive or ride in a car?) had to be one of the following: Always, Nearly always, Sometimes, Seldom, or Never.
- Those providing the following responses to the seat belt use question were not included in the analysis: Don't know/Not sure, Never drive or ride in a car, or Refused

1.2 Analyses

The BRFSS data was collected in each of the States using individual methods. Weights were calculated for records to reflect the complex schemes of data collection, corrections for nonresponse, and a number of other circumstances (weight = 50308*_finalwt/34778119). The primary analysis was chosen to reflect both State-specific data collection and final weights. Specifically, the SAS callable version of SUDAAN's logistic regression was employed (Proc Rlogist). SUDAAN employs Taylor-series linearization methods to estimate correct variances for data collected with complex designs that may include PSU selection, stratification, and unequal weights. It appears that there was no PSU selection since data had been submitted in 2002 from every State. However, final weights varied greatly, by almost a factor of 1,000.

1.3 Variables

All variables used in the SUDAAN analyses were redefined to have *consecutive* (e.g., without gaps) integer values between 1 and some positive integer greater than 1. The following variables and categories were analyzed.

Variables asked of the total sample- Core Questionnaire:

Age	65+	
	1:3	65-74/ 75-84/ 85+

Seat Belt Use

Four Variables include: Seatbelt, Sbltcat, Sblt2cat, and Sblt3cat

Seatbelt	1:5	Always / Nearly always / Sometimes/ Seldom /Never
Sbltcat	1:3	Always/ Nearly always, Sometimes/ Seldom, Never
Sblt2cat	1:2	Always, Nearly always/ Sometimes, Seldom, Never
Sblt3cat	1:3	Nearly always, Sometimes/ Seldom, Never/ Always

Sex	1:2	Male/Female

Race/ Hispanic	1:4	White NH/Black NH/Hispanic/Other
Education	1:5	< Grade 8 (Elementary School)/ Grade 9-11 (Some High School)/ Grade 12 (High School/ GED)/ College 1-3 (Some College)/ College 4+ (College+)
Marital	1:4	Married/Divorced/Widowed/Single
Labor Status	1:4	Retired/ In labor force/ At home/ Unable to work
Income2	1:10	Less than $10,000/ $15,000/ $20,000/ $25,000/ $35,000/ $50,000/ $75,000/ $75,000+/ Don't Know/ Refused
Income3	1:4	Less than $25,000/ $25,000-50,000/ $50,000-75,000/$75,000+
Body Mass Index	1:4	Underweight/Normal/Overweight/Obese
Smoke Risk (History)	1:4	Never smoked/ Did, not now/ Did, now rarely/ Smokes now
Smoke Risk (Age)	1:4	First smoked before age 12/ 13-18/ 19-60/ Other
General Health	1:5	Excellent/ Very good/ Good/ Fair/ Poor
State	1:54	Using FIPS Identifiers for the states.
Drinking and Driving	1:4	None/ 1-2/ 3+/ Other

Variables only asked of a subset of the total sample:

Variables in the Core Questionnaire- Women Only

Mammogram	1:2	Yes/ No/ Others
Last Mammogram	1:4	Within the last year/ Within the last 5 years/ 5 or more/ Never/ Others

Variables in the Core Questionnaire- Men Only

PSA (Prostate) Test	1:2	Yes/ No/ Others
Last PSA Test	1:4	Within the last year/ Within the last 5 years/ 5 or more/ Never/ Others

Variables in the Optional Modules (Asked in Selected States)

Last Checkup 1:3 Within the last year/ Within the last 5 years/ 5 or more/ Others

Use of Special Equipment (for Health Problem)
1:2 Yes/ No/ Others

Major Health Problem 1:4 Arthritis Rheumatism/ Back or neck Problem/ Fractures bone or joint injury/ Walking Problem/ Others

Joint Pain in Last 30 Days
1:2 Yes/ No/ Others

Seen Doctor for Joint Pain
1:2 Yes/ No/ Others

Doctor Diagnoses Arthritis
1:2 Yes/ No/ Others

Activities limited due to Joint Pain
1:2 Yes/ No/ Others

2. Results for Variables asked of the Total Sample

Below are parameter estimates, test statistics and odds ratio estimates produced by SUDAAAN. The model was fitted to the 2-level belt use variable, **sblt2cat**, and it predicts the probability of **Sometimes, Seldom, Never** using seatbelts. There was no intercept in the model

2.1 Identifying variables significantly affecting seat belt use.

Table A below shows the overall significance test for the effect of the 11 variables that were entered in the model. Except for the 3-way age variable, all were statistically related to the 2-way belt use variable.

Table A. Significant tests for the effect of contrasts

Contrast	Degrees of Freedom	Wald F	P-Value
Overall Model	39	1513.00	0.0000
Sex	1	149.07	0.0000
Age (3 Categories)	2	0.29	0.7480
Race / Hispanic	3	6.34	0.0009
Education	4	6.55	0.0002
Marital Status	3	8.91	0.0001
Labor Status	3	17.17	0.0000
Income 2	6	2.98	0.0138
Body Mass Index	3	29.75	0.0000
Smoke Risk (history)	3	25.41	0.0000
Smoke Risk (age)	3	2.84	0.0466
General Health	4	8.83	0.0000

2.2 Odds ratio characterization of characteristics

An odds ratio greater than 1 indicates that among respondents at that level **Sometimes, Seldom, Never** using seatbelts is more common than among respondents at the baseline level whose odds ratio is (by definition) equal to 1. For example, males (SEX = 1) are more likely to say that they use belts sometimes, seldom, or never than females (SEX = 2). The odds for infrequent belt use were different by predictor level as summarized below.

The probability of infrequent belt use is as follows:

- Higher among males than females;
- Higher among younger than older people (though this effect was not significant);
- Lower among Hispanics than Whites, NH;
- Higher among people with less education than persons with more education;
- Higher among divorced and single people than among married persons;
- Higher among people in the work force than among those who are retired;
- Higher at the low end of the income spectrum than in the middle;
- Higher among current smokers than among people who never smoked;

- Higher among people who started to smoke young than people who started to smoke later in life; and
- Higher among people in worse general health than among people with good general health.

Table B. Population estimates for odds ratios of **Sometimes, Seldom, Never** using belts: the ratio of such odds relative to baseline odds as function of variable level.

Independent Variables and Effects	Odds Ratio	Lower 95% Limit Odds Ratio	Upper 95% Limit Odds Ratio
Intercept	0.03	0.02	0.04
Sex			
1 (Men)	2.23	1.95	2.56
2 (Women)	1.00	1.00	1.00
Age 3 Categories			
1 (65-74)	1.04	0.93	1.17
2 (75-84)	1.00	1.00	1.00
3 (85+)	0.98	0.78	1.24
Race/ Hispanic			
1 (White)	1.00	1.00	1.00
2 (Black)	0.84	0.68	1.05
3 (Hispanic)	0.39	0.24	0.65
4 (Other)	1.08	0.91	1.28
Education			
1 (Elementary School)	1.40	1.11	1.77
2 (Some High School)	1.33	1.00	1.76
3 (High School/ GED)	1.20	0.98	1.46
4 (Some College)	1.00	1.00	1.00
5 (College+)	0.99	0.77	1.26
Marital Status			
1 (Married)	1.00	1.00	1.00
2 (Divorced)	1.29	1.14	1.47
3 (Widowed)	1.16	0.98	1.37
4 (Single)	1.73	1.25	2.39
Labor Status			
1 (Retired)	1.00	1.00	1.00
2 (In Labor Force)	1.52	1.33	1.74
3 (At Home)	1.15	0.89	1.49
4 (Unable to Work)	0.95	0.71	1.29
Income 2			
1 (Less than $10,000)	1.39	1.02	1.89
2 (Less than $15,000)	1.09	0.90	1.32
3 (Less than $20,000)	1.04	0.85	1.27
4 (Less than $25,000)	1.06	0.89	1.26
5 (Less than $35,000)	1.00	1.00	1.00
6 (Less than $50,000)	0.90	0.69	1.17

7 (Less than $75,000)	1.03	0.77	1.38
8 ($75,000 +)	0.85	0.61	1.19
9 (Don't Know)	1.10	0.89	1.35
10 (Refused)	0.79	0.62	1.01
Body Mass Index			
1 (Underweight)	1.24	0.82	1.89
2 (Average)	1.00	1.00	1.00
3 (Overweight)	1.31	1.21	1.42
4 (Obese)	1.83	1.58	2.11
Independent Variables and Effects	Odds Ratio	Lower 95% Limit Odds Ratio	Upper 95% Limit Odds Ratio
Smoke Risk (history)			
1 (Never Smoked)	1.00	1.00	1.00
2 (Did, not now)	1.04	0.78	1.37
3 (Did, now rarely)	0.77	0.51	1.14
4 (Smokes now)	1.95	1.50	2.53
Smoke Risk (age)			
1 (First smoked < 12)	0.79	0.44	1.42
2 (First smoked 13-18)	0.80	0.68	0.94
3 (First smoked 19-60)	1.00	1.00	1.00
4 (Other)	1.06	0.72	1.57
General Health			
1 (Excellent)	0.89	0.75	1.05
2 (Very Good)	0.86	0.67	1.10
3 (Good)	1.00	1.00	1.00
4 (Fair)	1.10	0.95	1.28
5 (Poor)	1.63	1.35	1.98

2.3. Parameter estimates

Logistic regression parameter estimates are presented in Table C. These estimates are interpreted the same way as the odds ratios.

Table C. Estimated Regression Parameters.

Independent Variables and Effects	Beta Coeff	SE Beta	Lower 95%	Upper 95%	T-Test	P-Value
Intercept	-3.62	0.21	-4.05	-3.19	-16.90	0.0000
Sex						
1 (Men)	0.80	0.07	0.67	0.94	11.84	0.0000
2 (Women)	0.00	0.00	0.00	0.00	-	-

Independent Variables and Effects	Beta Coeff	SE Beta	Lower 95%	Upper 95%	T-Test	P-Value
Age 3 Categories						
1 (65-74)	0.04	0.06	-0.07	0.15	0.76	0.4493
2 (75-84)	0.00	0.00	0.00	0.00	-	-
3 (85+)	-0.02	0.11	-0.25	0.21	-0.16	0.8761
Race/ Hispanic						
1 (White)	0.00	0.00	0.00	0.00	-	-
2 (Black)	-0.17	0.11	-0.39	0.05	-1.57	0.1212
3 (Hispanic)	-0.93	0.25	-1.43	-0.44	-3.78	0.0004
4 (Other)	0.08	0.08	-0.09	0.25	0.93	0.3557
Education						
1 (Elementary School)	0.34	0.12	0.11	0.57	2.91	0.0053
2 (Some High School)	0.28	0.14	0.00	0.56	2.03	0.0475
3 (High School/ GED)	0.18	0.10	-0.02	0.38	1.82	0.0741
4 (Some College)	0.00	0.00	0.00	0.00	-	-
5 (College+)	-0.02	0.12	-0.26	0.23	-0.12	0.9038
Marital Status						
1 (Married)	0.00	0.00	0.00	0.00	-	-
2 (Divorced)	0.26	0.06	0.13	0.38	4.00	0.0002
3 (Widowed)	0.14	0.08	-0.02	0.31	1.73	0.0894
4 (Single)	0.55	0.16	0.22	0.87	3.39	0.0013
Labor Status						
1 (Retired)	0.00	0.00	0.00	0.00	-	-
2 (In Labor Force)	0.42	0.07	0.29	0.56	6.24	0.0000
3 (At Home)	0.14	0.13	-0.12	0.40	1.07	0.2900
4 (Unable to Work)	-0.05	0.15	-0.35	0.26	-0.31	0.7615
Income 2						
1 (Less than $10,000)	0.33	0.15	0.02	0.64	2.12	0.0388
2 (Less than $15,000)	0.08	0.10	-0.11	0.28	0.87	0.3865
3 (Less than $20,000)	0.04	0.10	-0.16	0.24	0.40	0.6908
4 (Less than $25,000)	0.06	0.09	-0.12	0.23	0.67	0.5033
5 (Less than $35,000)	0.00	0.00	0.00	0.00	-	-
6 (Less than $50,000)	-0.11	0.13	-0.38	0.16	-0.83	0.4125
7 (Less than $75,000)	0.03	0.15	-0.26	0.32	0.20	0.8449
8 ($75,000 +)	-0.16	0.17	-0.50	0.18	-0.95	0.3451

Independent Variables and Effects	Beta Coeff	SE Beta	Lower 95%	Upper 95%	T-Test	P-Value
9 (Don't Know)	0.09	0.10	-0.12	0.30	0.89	0.3800
10 (Refused)	-0.23	0.12	-0.47	0.01	-1.94	0.0574
Body Mass Index						
1 (Underweight)	0.22	0.21	-0.20	0.64	1.04	0.3051
2 (Average)	0.00	0.00	0.00	0.00	-	-
3 (Overweight)	0.27	0.04	0.19	0.35	6.84	0.0000
4 (Obese)	0.60	0.07	0.46	0.75	8.35	0.0000
Smoke Risk (history)						
1 (Never Smoked)	0.00	0.00	0.00	0.00	-	-
2 (Did, not now)	0.04	0.14	-0.25	0.32	0.25	0.8036
3 (Did, now rarely)	-0.27	0.20	-0.67	0.13	-1.34	0.1875
4 (Smokes now)	0.67	0.13	0.40	0.93	5.10	0.0000
Smoke Risk (age)						
1 (First smoked < 12)	-0.24	0.30	-0.83	0.35	-0.81	0.4209
2 (First smoked 13-18)	-0.23	0.08	-0.39	-0.06	-2.70	0.0094
3 (First smoked 19-60)	0.00	0.00	0.00	0.00	-	-
4 (Other)	0.06	0.20	-0.33	0.45	0.30	0.7660
General Health						
1 (Excellent)	-0.12	0.08	-0.29	0.05	-1.46	0.1497
2 (Very Good)	-0.15	0.12	-0.40	0.10	-1.24	0.2216
3 (Good)	0.00	0.00	0.00	0.00	-	-
4 (Fair)	0.09	0.07	-0.06	0.24	1.25	0.2163
5 (Poor)	0.49	0.10	0.30	0.68	5.14	0.0000

3. Results for Variables Asked of a Subset of the Total Sample

Below are parameter estimates, test statistics and odds ratio estimates produced by SUDAAAN. The model was fitted to the 2-level belt use variable, **sblt2cat**, and it predicts the probability of **Sometimes, Seldom, Never** using seat belts. There was no intercept in the model

3.1 Identifying variables significantly affecting seat belt use.

Table A below shows the significance test for the effect of the three variables that were entered in the model and found to be statistically related to the 2-way belt use variable.

Table A. Significant tests for the effect of contrasts

Contrast	Degrees of Freedom	Wald F	P-Value
Overall Model	13	295.02	0.0000
Model Minus Intercept	12	97.60	0.0000
Intercept	-	-	-
Group Membership Variable RBLTP5	4	81.93	0.0000
How Long Since Last Mammogram	4	8.62	0.0000
PSA (Prostate) Test	2	15.06	0.0000
Doctor Diagnoses Arthritis	2	4.95	0.0107

3.2 Odds ratio characterization of characteristics

An odds ratio greater than 1 indicates that among respondents at that level **Sometimes, Seldom, Never** using seat belts is more common than among respondents at the baseline level whose odds ratio is (by definition) equal to 1.

The probability of infrequent belt use is as follows:

- Lower among women who had a mammogram within the past 5 years;
- Lower among men who had a PSA test; and
- Lower among those who were diagnosed with arthritis.

Independent Vari-ables and Effects	Odds Ratio	Lower 95% Limit Odds Ratio	Upper 95% Limit Odds Ratio
Intercept	0.25	0.17	0.36
IP_Always			
1	1.00	1.00	1.00
2	0.62	0.53	0.74
3	0.47	0.39	0.57
4	0.27	0.22	0.32
5	0.25	0.20	0.33
How Long Since Last Mamogram:			
Within last year	0.53	0.42	0.66
Within last 5 years	0.69	0.54	0.87
5+ years	1.01	0.76	1.35
Never	1.00	1.00	1.00
Others	0.80	0.65	0.99
PSA Test			
Yes	0.66	0.55	0.80
No	1.00	1.00	1.00
Others	0.81	0.62	1.06
Doctor Diagnosed Arthritis			
Yes	0.88	0.79	0.98
No	1.00	1.00	1.00
Others	1.47	1.02	2.11

3.3. Parameter estimates

Logistic regression parameter estimates are presented in the table below. These estimates are interpreted the same way as the odds ratios.

Independent Variables and Effects	Beta Coeff	SE Beta	Lower 95%	Upper 95%	T-Test	P-Value
Intercept	-1.41	0.19	-1.78	-1.03	-7.53	0.0000
IP_Always						
1	0.00	0.00	0.00	0.00	-	-
2	-0.47	0.08	-0.64	-0.31	-5.71	0.0000
3	-0.75	0.09	-0.94	-0.56	-7.90	0.0000
4	-1.32	0.09	-1.51	-1.14	-14.40	0.0000
5	-1.37	0.13	-1.63	-1.12	-10.96	0.0000
How Long Since Last Mamogram:						
Within last year	-0.64	0.11	-0.87	-0.42	-5.73	0.0000
Within last 5 years	-0.38	0.12	-0.62	-0.14	-3.13	0.0029
5+ years	0.01	0.14	-0.28	0.30	0.08	0.9345
Never	0.00	0.00	0.00	0.00	-	-
Others	-0.22	0.11	-0.43	-0.01	-2.10	0.0405
PSA Test						
Yes	-0.41	0.09	-0.60	-0.23	-4.50	0.0000
No	0.00	0.00	0.00	0.00	-	-
Others	-0.22	0.13	-0.49	0.05	-1.61	0.1144
Doctor Diagnosed Arthritis						
Yes	-0.13	0.05	-0.23	-0.02	-2.46	0.0171
No	0.00	0.00	0.00	0.00	-	-
Others	0.38	0.18	0.02	0.75	2.11	0.0393

4. Baby Boomers

Seat Belt Use By Demographic Characteristics

Qx: How often do you use seat belts when you drive or ride in a car?

*Base: Respondents between the ages of **39-64.***

	Always/ Nearly Always	Sometimes / Seldom/ Never	Never Drive or Ride/ Don't Know/ Refused/ Missing
Sex			
Male	83.17%	15.39%	1.44%
Female	90.10%	8.56%	1.34%
Race			
White	86.75%	11.99%	1.26%
Black	88.68%	9.24%	2.08%
Hispanic	91.67%	6.28%	2.05%
Other	88.20%	10.27%	1.54%
Sex / Race			
Male			
White	82.30%	16.47%	1.24%
Black	85.27%	12.01%	2.73%
Hispanic	89.62%	7.71%	2.67%
Other	85.77%	12.62%	1.60%
Female			
White	89.84%	8.90%	1.27%
Black	90.45%	7.81%	1.74%
Hispanic	93.12%	5.26%	1.61%
Other	90.25%	8.27%	1.47%
Education			
No School	90.32%	5.98%	3.70%
Elementary Only	82.28%	13.97%	3.75%
Some High school	80.50%	17.60%	1.90%
HS Grad/GED	84.26%	14.60%	1.14%
Some College	87.33%	11.23%	1.43%
College+	91.78%	7.01%	2.21%
Income			
Lower < $14,999	83.00%	15.06%	1.94%
Lower Middle $15,000-34,999	84.71%	14.16%	1.13%
Upper Middle $35,000-74,999	87.79%	11.12%	1.08%
Upper >$75,000	90.68%	7.93%	1.39%

C. Fatality Analysis Reporting System- FARS

Predicting Belt Use in Fatality Analysis Reporting System (FARS) from a Large Set of Pre- and Post-Crash Variables: Draft Results

The analyses below relate seat belt use among occupants age 65 and older to selected pre- and post-crash variables from the FARS dataset. There are important reasons why the interpretation of the results from these analyses is challenging:

- First, FARS includes only those people who were involved in a motor vehicle crash in which one or more people died within 30 days of the crash; people in crashes with no fatal injury are not in FARS. The exclusion of crashes without a fatal injury produces consequences that are somewhat arbitrary from the point of view of interpretability. For example, in a crash between Vehicles A and B, seat belt use in Vehicle B will affect the FARS inclusion probabilities of Vehicle A occupants. If B's driver is belted, he or she has a better chance of survival than if he or she is not belted. Hence, if all of B's occupants survive, Vehicle A's occupants will not be in FARS, whereas if one or more among Vehicle B's occupants are killed, they will be. In other words, factors not relevant to Vehicle A, or to its occupants, can determine whether or not its crash was in FARS.

- Second, in addition to pre-crash variables such as driver age and sex the analyses also include post-crash variables such as injury and ejection. Because pre-crash variables directly affect seat belt use, crash probability, and inclusion in FARS, and also indirectly affect crash outcomes that themselves affect FARS inclusion, the simple relationships we estimate that relate seat belt use probability to the model variables, all of them, pre- and post-crash, are purely descriptive. They simply specify that in FARS this is the relation between variables and seat belt use. Post-crash variables are not included in the model.

- Also, in FARS the race/ethnicity variable (RE) cannot be meaningfully defined. This is because variables for race and ethnicity were available only for fatally injured occupants; these items were added to police reports from the national mortality tapes. For example, coding for Hispanic ethnicity was missing for occupants with no injury, other injury, and fatal injury for 21 percent, 52 percent, and 27 percent of all occupants. Hence the RE = 4 (OTHER/UNK) includes all surviving FARS occupants and the variable is confounded with injury severity.

1. Methods

1.1 Case Selection

Only occupants age 65 and older, in passenger vehicles (cars, vans, SUVs, and pickup trucks), with known seat positions were included in the analysis.

1.2 Variables

The following variables were selected for analysis and re-coded as needed:

Pre-Crash Variables

Sex		
Crash Year		
Crash Day		
Age	OLDAGE	Category: 3=85+; 2=75+; 1=65+
Weekend	WEEKEND	1= Weekend, 0= Weekday
Vehicle Type	BODY_CAT	1=Car; 2=SUV; 3=Minivan; 4=Van; 5=Pickup
Rural/ Urban	RURALFLG	1=Rural; 0=Urban
Road Type	ROADCAT	1=High-Level; 2= Mid-Level; 3=Minor
Light Condition	LITEDARK	1=Light; 2=Dark; 3=Other or Unknown
Weather	WTHRFLAG	1=Adverse Weather; 0= Not Adverse or Unknown
Vehicle Model Year	MOD_YR3	3= 1997+; 2=1991+; 1= Before 1991
No. of Occupants	OCCUP3	1=1 Occupant; 2=2 Occupants; 3=3+ Occupants
Night/ Day	NITEFLAG	1=6pm-<6am; 0= 6am-<6pm
No. of Vehicles	VEHICLE3	1=1 Vehicle; 2= 2 Vehicles; 3= 3+ Vehicles
Race/ Ethnicity	RE	1=White-NH; 2=Black-NH; 3=Hispanic; 4=Other
Seat Position	SEAT3	1=Front Left, 2=Front Other, 3=Rear 2nd or 3rd
Restraint Type	REST3	0=None; 1=Other; 2=Lap and Shoulder
Belt Use	BUSE_FLG	1=Belt Used; 0=Belt Not Used or Unknown
Proper Belt Use	B_OK_FLG	1=Proper Use; 0=Improper, Other, Unknown
Air Bag Available	AV_AVAIL	1=Available; 0= Unavailable or Unknown
Body Mass Index	BMI (Weight/Height**2)	
	BMI4	0=Underweight and Normal (BMI less then 25) 1=Overweight (BMI 25-30) 2=Obese (BMI30+) 4=Unknown

Post-Crash Variables

Air Bag Deployed	AB-DPLOY	1=Deployed; 0= Not Deployed or Unknown
Ejection Category	EJECT3	2=Full; 1=Partial; 0= Not Ejected or Unknown
Injury	INJURY3	2=Fatal; 1=Other; 0=None
Rollover	ROLLFLAG	1=Rollover; 0=Not Rollover or Unknown

1.3 Modeling of Seat Belt Use as a Function of Pre- and Post-Crash Variables.

Stepwise logistic regression was used to estimate, *by sex*, the probability of the binary belt use flag as a function of the following potential predictors:

Age, Sex, Crash Year, Crash Day, Vehicle Type, Weather, Rural/ Urban, Road Type, Light Condition, No. of Occupants, Vehicle Model Year, No. of Vehicles, Restraint Type, Seat Position, Air Bag Availability, Body Mass Index

Odd ratio (OR) estimates and model parameters are presented. For ordinal variables, a single parameter is estimated. For nominal variables (identified by the class statement in the model), Odds ratios are relative to the variable's baseline level, as follows:

- OR=1 serves as the baseline level.
- OR > 1 indicates a level with a higher belt use probability than the baseline level.
- OR < 1 indicates a level with a lower belt use probability then the baseline level.

2. Results

2.1 Pre-Crash Variables Affecting Seat Belt Use Probability.

Eleven significant belt use probability predictors were selected for males and 10 for females. Table 2.1 details those pre-crash variables that were found to be significant in predicting seat belt use by sex.

Table 2.1 Statistically significant pre-crash variables affecting belt use probability, by sex.

	Male		Female	
Variable	Wald Chi Square	Pr > Chi Square	Wald Chi Square	Pr > Chi Square
Air Bag Availability	24.31	0.0000	24.76	0.0000
Body Mass Index	43.75	0.0000	35.66	0.0000
Vehicle Type	120.98	0.0000	29.69	0.0000
Light Condition	20.26	0.0000	-	-
Vehicle Model Year	116.88	0.0000	44.72	0.0000
No. of Occupants	411.26	0.0000	33.00	0.0000
Age	-	-	9.85	0.0017
Road Type	33.11	0.0000	18.06	0.0000
Rural/ Urban	19.07	0.0000	-	-
Seat Position	241.59	0.0000	310.79	0.0000
No. of Vehicles	268.05	0.0000	187.76	0.0000
Crash Year	43.19	0.0000	31.02	0.0000

2.2 Odds Ratio Estimates and Confidence Limits for Pre-Crash Variables

Table 2.2 presents OR estimates and their 95 percent confidence intervals by sex for the significant predictors. The male and female effects were not compared for significant difference.

Higher level belt use was associated with:

- Air bag availability;
- Cars, SUVs, minivans, and vans relative to pickup trucks;
- In more recent model year vehicles;
- In vehicles with more occupants; this effect seems to be stronger among males than females; and
- In front left and front rear seating positions relative to 2nd and 3rd row seating positions; a very large effect.

Lower level of belt use was associated with:

- Higher Body Mass Index;
- Dark and light conditions relative to unknown light conditions; for males only: the effect was more pronounced for dark;
- Older age; females only;
- On more minor roads;
- In rural areas, for males only;
- In single vehicle crashes relative to crashes with 2 or more involved vehicles; and
- In older crash years relative to more recent crash years.

Table 2.2 Model for significant belt use odds ratios and parameter estimates by sex

	Male			Female		
Effect	Odds Ratio	Lower Confi-dence Lim-its 95%	Upper Confi-dence Limits 95%	Odds Ratio	Lower Confi-dence Limits 95%	Upper Confi-dence Limits 95%
Air Bag Availability	1.22	1.13	1.32	1.26	1.15	1.38
Body Mass Index Underweight/ Normal vs. Unknown	0.89	0.83	0.97	0.83	0.76	0.90
Body Mass Index Overweight vs. Unknown	0.84	0.78	0.90	0.81	0.74	0.89
Body Mass Index Obese vs. Unknown	0.73	0.66	0.80	0.73	0.65	0.82
Vehicle Type Car vs. Pickup	1.50	1.39	1.61	1.44	1.26	1.64
Vehicle Type SUV vs. Pickup	1.33	1.17	1.52	1.38	1.15	1.66
Vehicle Type Minivan vs. Pickup	1.40	1.23	1.59	1.44	1.20	1.73
Vehicle Type Van vs. Pickup	1.54	1.29	1.84	1.33	1.01	1.74
Light Condition Light vs. Other	0.96	0.87	1.06	-	-	-
Light Condition Dark vs. Other	0.79	0.70	0.89	-	-	-
Vehicle Model Year	1.32	1.25	1.38	1.21	1.15	1.29
No. of Occupants	1.74	1.65	1.84	1.23	1.15	1.32
Age	-	-	-	0.93	0.88	0.97
Road Type	0.88	0.84	0.92	0.90	0.86	0.94
Rural/ Urban	0.87	0.82	0.93	-	-	-
Seat Position Front Left vs. 2nd or 3rd row	4.38	3.64	5.28	3.65	3.10	4.30
Seat Position Front Other vs. 2nd or 3 rdrow	3.46	2.88	4.16	3.17	2.79	3.61
No. of Vehicles 1 vs. 3+	0.50	0.45	0.55	0.53	0.47	0.59
No. of Vehicles 2 vs. 3+	0.80	0.73	0.87	0.88	0.80	0.97
Crash Year 99 vs. 03	0.75	0.68	0.82	0.78	0.70	0.87
Crash Year 00 vs. 03	0.80	0.73	0.88	0.78	0.70	0.87
Crash Year 01 vs. 03	0.82	0.75	0.90	0.89	0.80	0.99
Crash Year 02 vs. 03	0.88	0.80	0.97	0.92	0.82	1.03

2.3 Parameter estimates in the final model.

		Male		Female	
Variable	Class Value	Parameter Estimate	Pr > Chi-Square	Parameter Estimate	Pr > Chi-Square
Body Mass Index	0	0.04	0.12	-0.01	0.70
	1	-0.03	0.27	-0.03	0.31
	2	-0.16	0.00	-0.14	0.00
Vehicle Type	1	0.11	0.00	0.10	0.01
	2	-0.01	0.91	0.06	0.38
	3	0.04	0.41	0.10	0.11
	4	0.14	0.04	0.02	0.87
Light Condi-tion	1	0.05	0.03	-	-
	2	-0.14	0.00	-	-
Seat Posi-tion	1	0.57	0.00	0.48	0.00
	2	0.33	0.00	0.34	0.00
No. of Vehi-cles	1	-0.39	0.00	-0.38	0.00
	2	0.08	0.00	0.13	0.00
Crash Year	1999	-0.13	0.00	-0.11	0.00
	2000	-0.05	0.08	-0.11	0.00
	2001	-0.03	0.36	0.02	0.51
	2002	0.04	0.17	0.06	0.10

2.4 Model Fit and Type III Chi Square Statistics by Sex

Model fit was tested using Hosmer-Lemeshow (HL) chi-square statistics. This statistic compares observed and expected frequencies of seat belt users (events) and nonusers (nonevents) in 10 groups of nearly equal size. Groups are formed so that people in each group have roughly the same model-predicted belt use probability. As Table 2.4b shows, the expected numbers closely track the observed numbers indicating that model-based probability estimates of belt use are good. Also, the HL statistics did not reject the models at the 5 percent level of statistical significance (Table 2.4a). (However, a similarly defined overall model for males and females combined was rejected by the HL statistic.)

Table 2.4a Hosmer-Lemeshow Statistics by Gender

Obs	Sex	Chi Sq	DF	Probability ChiSq
1	1	7.8339	8	0.4499
2	2	8.4865	8	0.3874

Table 2.4b Observed and Expected Frequencies by Gender

Obs	Sex	Group	Total	Events Observed	Events Expected	Nonevents Observed	Nonevents Expected
1	1	1	2179	783	799.92	1396	1379.08
2	1	2	2178	1001	1012.49	1177	1165.51
3	1	3	2172	1164	1134.54	1008	1037.46
4	1	4	2175	1238	1236.30	937	938.70
5	1	5	2176	1334	1332.51	842	843.49
6	1	6	2177	1415	1424.57	762	752.43
7	1	7	2179	1511	1515.17	668	663.83
8	1	8	2175	1640	1603.17	535	571.83
9	1	9	2180	1702	1705.02	478	474.98
10	1	10	2188	1826	1849.59	362	338.41
11	2	1	1843	889	891.59	954	951.41
12	2	2	1840	1096	1105.31	744	734.69
13	2	3	1843	1207	1214.63	636	628.37
14	2	4	1841	1256	1279.04	585	561.96
15	2	5	1846	1361	1332.70	485	513.30
16	2	6	1842	1400	1377.00	442	465.00
17	2	7	1845	1429	1424.49	416	420.51
18	2	8	1841	1458	1464.72	383	376.28
19	2	9	1840	1485	1506.93	355	333.07
20	2	10	1831	1576	1559.95	255	271.05

As the table shows, the average predicted belt use percent of females (71%) exceeded the average predicted belt use percent for males (63%) by about 8 percentage points. The roughly 8 to 19 percent female-male difference remained roughly the same across the percentiles.

Table 2.4c Male and female predicted probability distributions

Obs	Sex	Mean Prob	P99	P95	P90	Median	P10	P5	P1
1	1	0.62510	0.88677	0.83973	0.80770	0.63383	0.42904	0.37761	0.29527
2	2	0.71459	0.87400	0.84886	0.83185	0.73511	0.56043	0.49805	0.39702

2.5 Predictor Averages by Expected Probability Deciles.

To further clarify differences between low and high probability belt users, average values were calculated by belt use probability decile for variables measured on ordinal scales. The averages are tabulated by belt use probability decile (BusProbR10) in the table below. Each decile included about 4,020 people. As decile rank increased from 0 to 9:

- Average expected (IP_1) and observed (BUSE_FLG) belt use probabilities increased from 0.40 to 0.85.
- Crash year increased by 1.3 years from about 2000.5 to 2001.8.
- Female percentage increased from about 15% to over 60%.
- Crashes on rural roads became less common
- Crashes on major roads became more common.
- The number of vehicle occupants increased.
- Model years became more recent.
- Air Bag availability increased from 8% to 95%.

Table 2.5 Belt use probability decile for variables

Obs	Belt Use Probability Decile	Type	Freq	Average Expected	Average Observed	Crash Year	Sex	Age	Weather	Rural/ Urban	Road Type	No. of Occupants	Vehicle Model Year	Airbag Availability
1	0	1	4018	0.40	0.40	2000.5	1.15	1.60	0.10	0.74	2.10	1.46	1.47	0.08
2	1	1	4020	0.51	0.51	2000.6	1.24	1.68	0.12	0.65	1.98	1.55	1.66	0.18
3	2	1	4020	0.57	0.57	2000.9	1.29	1.69	0.10	0.60	1.91	1.56	1.83	0.27
4	3	1	4016	0.63	0.63	2000.8	1.38	1.70	0.11	0.60	1.92	1.59	1.89	0.35
5	4	1	4021	0.67	0.67	2000.7	1.48	1.75	0.10	0.57	1.91	1.59	1.84	0.39
6	5	1	4019	0.71	0.70	2001.0	1.56	1.72	0.11	0.58	1.88	1.68	1.93	0.42
7	6	1	4020	0.74	0.76	2001.0	1.59	1.67	0.12	0.56	1.83	1.78	2.13	0.54
8	7	1	4017	0.77	0.77	2001.1	1.62	1.65	0.11	0.56	1.81	1.87	2.30	0.70
9	8	1	4020	0.81	0.81	2001.3	1.67	1.62	0.12	0.57	1.77	1.96	2.56	0.86
10	9	1	4020	0.85	0.84	2001.8	1.60	1.51	0.13	0.56	1.62	2.29	2.81	0.95

2.6 Frequencies

Obs	Sex	Class	Variable	Value	Belt Use Yes	Belt Use No	Total
1	1	Day of the Week	0	1	1682	959	2641
2	1		0	2	1905	1189	3094
3	1		0	3	1911	1163	3074
4	1		0	4	1954	1181	3135
5	1		0	5	1978	1179	3157
6	1		0	6	2227	1349	3576
7	1		0	7	1957	1145	3102
8	1	Crash Year	1	1999	2653	1894	4547
9	1		0	2000	2529	1627	4156
10	1		0	2001	2750	1705	4455
11	1		0	2002	2798	1543	4341
12	1		0	2003	2884	1396	4280
13	1	Vehicle Type	1	Car	8861	4635	13496
14	1		0	SUV	921	508	1429
15	1		0	Minivan	979	484	1463
16	1		0	Van	410	247	657
17	1		0	Pickup	2443	2291	4734
18	1	Light Condition	1	Light	10732	6266	16998
19	1		0	Dark	1473	1114	2587
20	1		0	Other/ Unknown	1409	785	2194
21	1	No. of Vehicles	1	1	3080	2849	5929
22	1		0	2	8271	4425	12696
23	1		0	3+	2263	891	3154
24	1	Seat Position	1	Front Left	11289	6914	18203
25	1		0	Front Other	1991	916	2907
26	1		0	2^{nd} or 3^{rd} Row	334	335	669
27	1	Body Mass Index	1	Underweight/ Ave.	3726	2286	6012
28	1		0	Overweight	4373	2759	7132
29	1		0	Obese	1551	1136	2687
30	1		0	Other	3964	1984	5948

2.6 Frequencies (cont.)

Obs	Sex	Class	Variable	Value	Belt Use Yes	Belt Use No	Total
31	2	Day of the Week	0	1	1755	747	2502
32	2		0	2	1778	741	2519
33	2		0	3	1876	687	2563
34	2		0	4	1800	733	2533
35	2		0	5	1897	765	2662
36	2		0	6	2096	849	2945
37	2		0	7	1955	733	2688
38	2	Crash Year	1	1999	2650	1252	3902
39	2		0	2000	2464	1112	3576
40	2		0	2001	2680	1039	3719
41	2		0	2002	2667	979	3646
42	2		0	2003	2696	873	3569
43	2	Vehicle Type	1	Car	10577	4062	14639
44	2		0	Suv	754	324	1078
45	2		0	Minivan	853	334	1187
46	2		0	Van	200	120	320
47	2		0	Pickup	773	415	1188
48	2	Light Condition	1	Light	10849	4193	15402
49	2		0	Dark	1197	566	1763
50	2		0	Other/ Unknown	1111	496	1607
51	2	No. of Vehicles	1	1	2497	1500	3997
52	2		0	2	8550	3105	11655
53	2		0	3+	2110	650	2760
54	2	Seat Position	1	Front Left	6647	2410	9057
55	2		0	Front Other	5562	1929	7491
56	2		0	2nd or 3rd Row	948	916	1864
57	2	Body Mass Index	1	Underweight/ Ave.	4391	1796	6187
58	2		0	Overweight	3564	1497	5061
59	2		0	Obese	1523	700	2223
60	2		0	Other	3679	1262	4941

2.7 Post-Crash Variables Affecting Seat Belt Use Probability.

Probability of belt use predicted from pre-crash variables plus post-crash variables were added to the stepwise regression model to determine the additional information about belt use attributable to post-crash variables.

Post-crash variables added to the stepwise logistic regression include:
Air Bag Deployed, Ejection Category, Injury, Rollover, and IP_1- Model Predicted Probability of Belt Use.

Eleven significant belt use probability predictors were selected for males, 9 for females. Unsurprisingly, the new variables for predicted probability, ejection and injury, have chi-squares much larger than any of the previously included variables. This confirms that belt use actually affects crash outcomes in terms of ejection and injury severity. Putting it differently, we see that the probability of belt use predicted from pre-cash variables, plus ejection and injury explain most of the belt use variation.

Table 2.8. Statistically significant pre-crash and post-crash variables affecting belt use probability, by sex.

	Male		Female	
Variable	Wald Chi Square	Pr > Chi Square	Wald Chi Square	Pr > Chi Square
Air Bag Deployed	-	-	4.14	0.0419
Vehicle Type	-	-	20.71	0.0004
Ejection Category	706.89	0.0000	633.56	0.0000
Injury	1072.00	0.0000	410.54	0.0000
IP_1	541.88	0.0000	489.99	0.0000
Light Condition	11.03	0.0040	20.50	0.0000
No. of Occupants	20.21	0.0000	11.40	0.0007
Age	7.47	0.0063	-	-
Road Type	8.50	0.0036	8.14	0.0043
Rollover	15.96	0.0001	-	-
Rural/ Urban	30.79	0.0000	12.56	0.0004
Seat Position	7.15	0.0281	-	-
No. of Vehicles	17.98	0.0001	-	-

2.8 Odds Ratio Estimates and Confidence Limits for Pre- and Post-Crash Variables.

Table 2.9 presents odds ratio estimates and their 95 percent confidence intervals by sex for the significant predictors. The male and female effects were not compared for significant difference.

Predicted probability, IP_1, has odds ratios of 78.5 and 58.9 for males and females, respectively, indicating that each 0.1 percentage point change in predicted belt use probability increases belt use odds by about 7.8 and 5.8.

The effect on belt use odds attributable to having observed ejection and injury are also huge, but in the opposite direction, because high values for these variables (ejection and fatal injury) are associated with low belt use probabilities. In other words, other things being equal in terms of pre-crash determinant of belt use, the post-hoc estimate for the probability that belts were used is hugely increased in the absence of ejection and nonsevere or nonfatal injury. This observation is new.

Table 2.9 Model for significant belt use odds ratios and parameter estimates by sex

	Male			Female		
Effect	Odds Ratio	Lower Confidence Limits 95%	Upper Confidence Limits 95%	Odds Ratio	Lower Confidence Limits 95%	Upper Confidence Limits 95%
Air Bag Deployment	-	-	-	1.10	1.00	1.21
Vehicle Type Car vs. Pickup	-	-	-	0.98	0.85	1.13
Vehicle Type SUV vs. Pickup	-	-	-	1.42	1.15	1.76
Vehicle Type Minivan vs. Pickup	-	-	-	1.09	0.89	1.33
Vehicle Type Van vs. Pickup	-	-	-	0.87	0.65	1.16
Ejection Category	0.19	0.17	0.22	0.22	0.19	0.25
Injury	0.42	0.40	0.44	0.53	0.50	0.57
IP_1	78.52	54.38	113.37	58.87	41.04	84.45
Light Condition Light vs. Other	1.18	1.06	1.31	1.25	1.10	1.41
Light Condition Dark vs. Other	1.08	0.94	1.24	1.03	0.87	1.21
No. of Occupants	0.84	0.78	0.91	0.92	0.87	0.96
Age	1.07	1.02	1.11	-	-	-
Road Type	0.93	0.89	0.98	0.93	0.88	0.98
Rollover	1.24	1.12	1.38	-	-	-
Rural/ Urban	1.22	1.13	1.30	1.14	1.06	1.23
Seat Position Front Left vs. 2nd or 3rd row	0.87	0.69	1.09	-	-	-

Seat Position Front Other vs. 2nd or 3rd row	1.00	0.81	1.25	-	-	-
No. of Vehicles 1 vs. 3+	1.25	1.11	1.42	-	-	-
No. of Vehicles 2 vs. 3+	1.23	1.12	1.36	-	-	-

D. Motor Vehicle Occupant Safety Survey – MVOSS

Analyses of the MVOSS Dataset

1. Methods

1.1 Case Selection

The following criteria were applied to select cases for analysis:

- Respondents between the ages of 65 to 97,
- Who reported that they drove at least a few times a year, and
- The vehicles they report that they drove most often were equipped with either shoulder and or lap safety belts.

Analysis was conducted for both the Combined Dataset (N=12,377) for information on seat belt use and various demographic characteristics as well as for Version A (N=6,180) to better understand attitudes and beliefs regarding seat belts.

1.2 Statistical Methods

The following statistical methods were used to analyze the MVOSS dataset:

Statistical association between selected respondent characteristics (e.g. age, gender, education, income, previous injury, vehicle type, race, driving frequency, air bag, and restraint type) and restraint use frequency (e.g. Lap, Lap2, Lap3, Shoulder, Shoulder2, Shoulder3, AnyBelt, Anybelt2, and Anybelt3) was tested for statistical significance using Cochran-Mantel-Hanszel statistics based on table scores against alternative hypotheses represented by non-zero correlation, row mean score differences (ANOVA) statistics, and general association statistics.

The probabilities of rejecting the null hypothesis against these alternatives are tabulated in columns 1, 2, and 3, respectively in the statistic tables. The general association statistic (column 3) requires no assumption about ordinality, and is always interpretable. The ANOVA statistic requires the hypothesis that the column variable, here the belt use rate frequencies, is measured on ordinal scale for interpretability. Thus, these statistics are also always interpretable. The correlation statistic requires that the row variable characteristic be also ordinal. Under many conditions, the correlation statistic has the greatest power to reject null hypothesis of no-statistical association between the characteristic and belt use measure. However, it is not interpretable for race, restraint type and vehicle type.

2. Variables from the MVOSS Combined Dataset

Type of Seat Belt Use

Variables for describing belt use: Shoulder, Lap, and AnyBelt.

- Respondents with an unspecified frequency value were assigned the SAS missing value code,
- Lap and Shoulder were recoded to increase with increasing use frequency
- AnyBelt was defined as the highest of the Lap and Shoulder use frequencies

Shoulder- When driving this (car/truck/van), how often do you wear your shoulder belt?

All of the Time- 4
Most of the Time- 3
Some of the Time- 2
Rarely- 1
Never- 0
Don't Know, Refused- Missing
[Shoulder = A12B9]

Lap- When driving this (car/truck/van), how often do you wear your lap belt?
All of the Time- 4
Most of the Time- 3
Some of the Time- 2
Rarely- 1
Never- 0
Don't Know, Refused- Missing
[Lap = A13B10]

Anybelt- Highest of the Lap Shoulder Frequencies
All of the Time- 4
Most of the Time- 3
Some of the Time- 2
Rarely- 1
Never- 0
Don't Know, Refused- Missing
[AnyBelt= Max (Lap,Shoulder)]

- 2-level restraint use variables Shoulder2, Lap2, AnyBelt2;
  The 2-level variable regroups the answers as:
  All of the Time, Most of the Time-1
  Some of the Time, Rarely, Never- 0

- 3-level restraint use variables: Lap3, Shoulder3, AnyBelt3;
  The 3-level variable regroups the answers as:
  All of the Time- 1
  Most of the Time, Some of the Time- 0
  Rarely, Never- -1

Age Groups

Age: What is your age?

3-level variable for age groups

65-74- -1

75-84- 0

85+- 1

Driver

DriveFreq- How often do you drive a motor vehicle?

Used to identify a 2-level variable identifying drivers and non-drivers.

Driver- Almost every day, a few days a week, a few days a month, a few days a year- 1

Non-Driver- Never drive- 0

[Drives = A1B1]

Frequency Drives

DriveFreq- How often do you drive a motor vehicle?

4-level variable that increases with driving frequency (does not include non drivers).

Almost every day/ every day- 4

Few days a week- 3

Few days a month- 2

Few days a year- 1

[Drives = A1B1]

Vehicle Has Seat Belts

VhasBelt- Do the seat belts in the front seat of the (car/truck/van) go across your shoulder only, across your lap only, or across both your shoulder and lap?

2-level variable for identifying drivers of vehicles with a belt

Across shoulder, Across lap, Across Both- 1

Vehicle has no belts- 0

[VhasBelt = A6B4]

Type of Restraint

Restraint type- Do the seat belts in the front seat of the (car/truck/van) go across your shoulder only, across your lap only, or across both your shoulder and lap?

3-level categorical variable

Shoulder- 1

Lap- 2

Both- 3

[RType=A6B4]

Race

Race- Which of the following racial categories describes you?
4-level categorical variable
White- 1
Black- 2
American Indian or Alaskan Native, Asian, Native Hawaiian or Other Pacific Islander, Hispanic/Latino, Other- 3 Not Black or White
Refused- 4
[Race = A103A1B1]

Education

Education- What is the highest grade or year of school you completed?
4-level variable;
8^{th} grade or less, 9^{th} grade, 10^{th} grade, 11^{th} grade- 1 /< High School/
12^{th} grade/ GED- 2 /High School/
Some College- 3
College Graduate or Higher- 4
[Education = A105B133]

Income

Income- Which of the following categories best describes your total household income before taxes in 2002?
Don't Know, Refused- Missing
[Income = A106B134]

Type of Vehicle

VType- Is the vehicle you drive most often a car, van, motorcycle, sport utility vehicle, pickup truck, or other type of truck?
4-level categorical variable
Car- 1
Van or Minivan- 2
Pickup truck, Other truck- 4
SUV- 5
Motorcycle, Don't Know, Refused- Missing
[VType = A5B2]

Air Bag Availability

Air Bag- Does the (car/truck/van) you normally drive have an air bag?
2-level variable
Yes- 1
No, Don't Know, Refused- 0
[Air Bag = A63B73;]

Prior Injuries in Motor Vehicle Crashes

Injury- Have you ever been injured in a motor vehicle accident?
2-level variable;
Yes- 1
No, Don't Know, Refused- 0
[Injured= A86B110;]

3. Results for Respondent Characteristic Association With Restraint Use for the Combined Dataset

The tables are of the results using the Any Belt variable to indicate restraint use- the highest of the lap shoulder frequencies

3.1 Age Groups

When breaking down older adults into three age groups 65-74, 75-84, and 85+ no significant statistical association was found between the age groups and level of restraint use.

Age Groups	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
65-74	9.6412 0.94%	11.255 1.09%	21.817 2.12%	58.964 5.73%	926.67 90.11%	1028.3
75-84	3.9287 0.71%	0 0.00%	18.076 3.29%	32.971 6.00%	494.53 90.00%	549.51
85+	0 0.00%	2.1096 1.02%	5.7724 2.79%	13.364 6.45%	185.82 89.74%	207.07
Total (N)	13.5699	13.3649	45.6645	105.3	1607.01	1784.91

p=0.26
Frequency Missing= 2.5432602711

3.2 Gender

Among older adults age 65 and older the level of restraint use was significantly associated with gender. Females (92.61%) claim that they use restraints “all of the time” at a higher rate than males (86.86%).

Gender	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
Males	9.3057 1.16%	9.372 1.17%	25.148 3.14%	61.269 7.66%	694.73 86.86%	799.82
Females	4.2642 0.43%	3.993 0.41%	20.516 2.08%	44.031 4.47%	912.29 92.61%	985.09
Total (N)	13.5699	13.3649	45.6645	105.3	1607.01	1784.91

p= 0.00
Frequency Missing= 2.5432602711

3.3 Race

The results of the combined dataset for the MVOSS telephone survey indicate that race was not significantly associated with restraint use differences for adults over 65.

Race	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
White	12.163 0.80%	11.605 0.76%	40.781 2.68%	89.934 5.91%	1366.5 89.84%	1520.9
Black	0 0.00%	0.864 0.91%	2.5433 2.67%	4.7763 5.01%	87.086 91.41%	95.27
Other	0.7035 0.71%	0 0.00%	0 0.00%	4.9497 5.02%	92.914 94.26%	98.567
Refused	0.7035 1.00%	0.8958 1.28%	2.3399 3.34%	5.6398 8.04%	60.563 86.34%	70.142
Total (N)	13.5699	13.3649	45.6645	105.3	1607.01	1784.91

p=0.93
Frequency Missing= 2.5432602711

3.4 Education

Adults 65 and over with a higher level of education report more frequent rate of belt use in the MVOSS telephone survey. The level of education indicated by respondents is positively and significantly associated with the level of restraint use. Older adults who completed college degrees were more likely to claim that they use their seat belts “all of the time” than adults with a lower level of education.

Education	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
Less than High School	3.0196 1.20%	3.1349 1.24%	9.3706 3.71%	10.53 4.17%	226.33 89.68%	252.39
High School	8.3281 1.40%	6.1381 1.03%	18.37 3.10%	42.613 7.18%	517.69 87.28%	593.14
Some College	0 0.00%	1.6306 0.43%	9.2046 2.41%	24.478 6.40%	347.06 90.76%	382.37
College +	2.223 0.43%	1.5655 0.30%	7.083 1.36%	24.938 4.77%	486.6 93.15%	522.41
Total (N)	13.5699	12.4691	44.0281	102.558	1577.68	1750.3

p=0.05
Frequency Missing= 37.154051186

3.5 Income

While income also appears to be significantly associated with certain restraint use variables, this association is not systematically related to higher use rates in all of the analyses conducted. In addition to the inconsistent results there are many missing values due to the fact that numerous respondents refused to report their total household income.

Income	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
Less than $5,000	0 0.00%	0 0.00%	0.8153 1.70%	1.6306 3.41%	45.382 94.89%	47.828
$5,000 to $14,999	5.2418 2.66%	2.9888 1.52%	3.9648 2.01%	11.797 5.99%	173.06 87.82%	197.05
$15,000 to $29,999	1.6126 0.45%	0.9091 0.25%	15.696 4.40%	25.276 7.08%	313.59 87.82%	357.08
$30,000 to $49,999	1.6793 0.50%	2.2709 0.67%	5.6115 1.67%	21.857 6.49%	305.48 90.67%	336.9
$50,000 to $74,999	2.1104 1.35%	0 0.00%	2 1.28%	7.5902 4.84%	145.05 92.54%	156.75
$75,000 to $99,999	0.7035 1.01%	3.4559 4.97%	0 0.00%	1.9994 2.88%	63.368 91.14%	69.527
$100,000 or more	0 0.00%	2.0996 3.01%	1.8183 2.61%	5.2905 7.59%	60.529 86.80%	69.737
Total (N)	11.3476	11.7244	29.906	75.4413	1106.45	1234.87

p=0.01

Frequency Missing= 552.58519819

3.6 Driving Frequency

The results for MVOSS question regarding driving frequency show that this characteristic is not systematically associated with the level of restraint use reported by older adults for lap, shoulder, and any belt. There is evidence of a monotonic relationship between driving frequency and shoulder restraint use, however, additional factors would need to be controlled to better interpret this result.

Driving Frequency	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
Almost every day/every day	0 0.00%	0 0.00%	0 0.00%	0 0.00%	9.984 100%	9.984
Few days a week	0 0.00%	0 0.00%	0 0.00%	3.3551 4.25%	75.587 95.75%	78.942
Few days a month	4.762 1.09%	1.7279 0.39%	11.279 2.57%	22.398 5.11%	397.87 90.83%	438.04
Few days a year	8.8078 0.70%	11.637 0.93%	34.385 2.73%	79.547 6.32%	1123.6 89.32%	1257.9
Total (N)	13.5699	13.3649	45.6645	105.3	1607.01	1784.91

p= 0.79

Frequency Missing = 2.5432602711

3.7 Type of Vehicle

Similar to other studies, results of the MVOSS telephone survey indicate that vehicle type is significantly associated with restraint use. Older adults reporting that the vehicle they drive most often is a pickup truck were more likely to report lower belt use rates than older adults driving any other passenger vehicle.

Type of Vehicle	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
Car	10.55 0.81%	7.6814 0.59%	22.926 1.77%	64.286 4.96%	1189.7 91.86%	1295.2
Van/ Minivan	0.9091 0.56%	0.3517 0.22%	9.9567 6.16%	8.5313 5.28%	141.83 87.78%	161.58
Pickup Truck	2.1104 0.95%	4.8628 2.19%	10.99 4.94%	22.118 9.94%	182.46 81.99%	222.54
SUV	0 0.00%	0.469 0.46%	1.7916 1.75%	7.8612 7.69%	92.08 90.10%	102.2
Total (N)	13.5699	13.3649	45.6645	102.796	1606.11	1781.5

p=0.00
Frequency Missing = 5.9558593673

3.8 Air Bag Availability

MVOSS results indicate that older adults with air bags installed in the vehicles they normally drive are more likely to use their belts. Belt use and air bag availability are significantly and positively associated.

Air Bag Installed	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
No	7.5127 1.89%	0.8958 0.23%	9.3147 2.34%	27.629 6.94%	352.74 88.61%	398.09
Yes	6.0571 0.44%	12.469 0.90%	36.35 2.62%	77.671 5.60%	1254.3 90.44%	1386.8
Total (N)	13.5699	13.3649	45.6645	105.3	1607.01	1784.91

p=0.02
Frequency Missing = 2.5432602711

4. Results for Logistic Regression of Restraint Use on Respondent Characteristics for the Combined Dataset

Stepwise regression was used to predict 2-way restraint use probability as a function of the characteristics: age, gender, education, previous injury, vehicle type, race, driving frequency, air bag, and restraint type. Income was not included among the potential predictors because it had too many missing values (N=458).

Results are presented for the use of lap belts, shoulder belts and any belt. We note that the final models passed the Hosmer- Lemeshow test of model fit for lap belt use and the use of any belts, but the model fit was rejected by the chi-square statistic for shoulder belt use near the threshold level, p~ 0.04.

4.1 Lap belt use

Stepwise regression was conducted to identify characteristics of MVOSS respondents 65 and older who are most likely to respond to the lap seat belt use question as “all of the time”. The two variables that were found to be positively and significantly related to the level of lap belt use were education and the presence of air bags in the vehicle.

Obs	Variable	ClassVal0	DF	Estimate	StdErr	WaldChiSq	Prob ChiSq
1	Intercept		1	1.5476	0.3138	24.3181	<0.0001
2	Education		1	0.3313	0.1100	9.0745	0.0026
3	Air Bag		1	0.6861	0.2372	8.3699	0.0038

4.2 Shoulder belt use

For shoulder belt use MVOSS respondents most likely to respond “all of the time” were females and those who report a higher level of education. However, prior injury and more frequent driving were found to be negatively related to the probability that older adults report shoulder belt use “all of the time.”

Obs	Variable	ClassVal0	DF	Estimate	StdErr	WaldChiSq	Prob ChiSq
1	Intercept		1	3.3787	1.0988	9.4542	0.0021
2	Gender		1	0.5507	0.2478	4.9384	0.0263
3	Education		1	0.4743	0.1202	15.5810	<0.0001
4	Injured		1	-0.5757	0.2579	4.9845	0.0256
5	DriveFreq		1	-0.5678	0.2600	4.7696	0.0290

4.3 Any belt use

The results of a stepwise regression for any belt use indicate that the characteristics of older adults that are positively related to a higher rate of belt use are being female and a higher level of education. Those respondents who are female or report a higher level of education are more likely to state that they use either a lap and or a shoulder belt “all of the time.” On the other hand, prior injury is negatively related to reports of higher belt use.

Obs	Variable	ClassVal0	DF	Estimate	StdErr	WaldChiSq	Prob ChiSq
1	Intercept		1	1.2235	0.4732	6.6862	0.0097
2	Gender		1	0.7050	0.2507	7.9105	0.0049
3	Education		1	0.4260	0.1196	12.6932	0.0049
4	Injured		1	-0.5300	0.2662	3.9630	0.0465

5. Results for Respondent Characteristic Association With Restraint Use for Version A Variables

The Version A questionnaire included numerous questions regarding attitudes and behavior patterns in connection to seat belt use or nonuse. This questionnaire was directed toward half the total respondents who were included in the combined dataset (N=6,180). Various characteristics and their association to seat belt use among older adults were analyzed.

5.1 Time to Die

Respondents were asked a question regarding their fatalistic attitudes: “Do you agree or disagree that if it is your time to die, you'll die, so it doesn't matter whether you wear your seat belt?” The response to this question was found to be significant in that older adults with a fatalistic attitude are more likely to use a seat belt rarely or never and those who disagree were more likely to use belts “all of the time.”

Time to Die	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
Disagree	0 0.00%	2.6731 0.43%	14.094 2.30%	25.255 4.12%	570.8 93.15%	612.78
Agree	2.6822 1.56%	3.501 2.04%	5.229 3.05%	8.7752 5.12%	151.32 88.23%	171.51
Total (N)	2.68223	6.13811	19.3234	34.0305	722.119	784.293

p=0.00
Frequency Missing= 43.189537839

5.2 Favor Seat Belt Law

Older adults who favor a seat belt law for drivers and front-seat passengers are more likely to report using a seat belt all of the time (92.48%) than those who do not favor such a law (78.55%).

Favor Seat Belt Law	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
Do not Favor	1.7731 3.10%	3.4559 6.04%	0 0.00%	7.0472 12.31%	44.957 78.55%	57.233
Favor	0.9091 0.12%	4.4102 0.58%	22.051 2.91%	29.575 3.91%	699.87 92.48%	756.82
Total (N)	2.68223	7.86605	22.0508	36.6224	744.828	814.049

p=0.00
Frequency Missing= 13.433704404

5.3 Body Mass Index

Body mass index (BMI) is an objective scientific measure that used to calculate body weight adjusted for height. The BMI ranges are based on the effect body weight has on disease and death. As BMI increases, the risk for some disease increases. There is a direct and significant association between a respondent's BMI and the rate of seat belt use. Obese older adults are less likely to report using a seat belt all of the time then those with a lower BMI.

Body Mass Index	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
Obese	2.6822 1.62%	4.365 2.64%	8.0015 4.84%	11.548 6.98%	138.89 83.93%	165.49
Overweight	0 0.00%	0.864 0.29%	6.9118 2.34%	10.526 3.57%	276.77 93.80%	295.07
Average/ Underweight	0 0.00%	2.6371 0.83%	7.1375 2.25%	11.912 3.76%	294.95 93.15%	316.64
Total (N)	2.68223	7.86605	22.0508	33.9854	710.616	777.201

p=0.00

Frequency Missing= 50.281928767

5.4 Seat Belt Use Is a Habit

Respondents were asked whether a series of statements regarding seat belt use pertained to them. One of these regards seat belt use as habit-based behavior. Older adults who indicated that one of the reasons that they use seat belts is because it is a habit were more likely to report using a seat belt all the time (95.98%) than those who responded negatively to this statement (68.74%).

It's a Habit	Never	Rarely	Some of the Time	Most of the Time	All the Time	Total (N)
No	0 0.00%	6.1381 4.99%	16.732 13.60%	15.594 12.68%	84.561 68.74%	123.02
Yes	0 0.00%	1.7279 0.25%	5.3193 0.76%	21.029 3.01%	671.06 95.98%	699.14
Total (N)	0	7.86605	22.0508	36.6224	755.624	822.163

p=0.00

Frequency Missing= 5.3192931963

5.5 Uncomfortable Without a Seat Belt

Respondents who indicated they wear a seat belt because they are uncomfortable without it were more likely to report that they wear the belt all the time (97.08%) as opposed to those who did not think that this reason applied to them (83.20%).

I'm Uncomfortable Without It	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
No	0 0.00%	7.0021 2.31%	16.867 5.57%	26.983 8.92%	251.8 83.20%	302.65
Yes	0 0.00%	0.864 0.17%	5.1838 1.02%	8.73 1.72%	491.57 97.08%	506.34
Total (N)	0	7.86605	22.0508	35.7133	743.365	808.995

p=0.00
Frequency Missing= 18.48758607

5.6 Avoid Serious Injury

Respondents who indicated that they wear a seat belt in order to avoid serious injury were more likely to report all-the-time belt use (92.82%) than those who not think that this reason applied to them (62.01%).

Avoid Serious Injury	Never	Rarely	Some of the Time	Most of the Time	All the Time	Total (N)
No	0 0.00%	3.5462 13.78%	2.7274 10.60%	3.501 13.61%	15.958 62.01%	25.732
Yes	0 0.00%	4.3199 0.55%	19.323 2.44%	33.121 4.19%	734.3 92.82%	791.07
Total (N)	0	7.86605	22.0508	36.6224	750.26	816.799

p=0.00
Frequency Missing= 10.68374353

5.7 Set a Good Example

Among older adults a higher rate of seat belt use is associated with the interest in setting a good example for others. Older adults who agreed that one of the reasons they wear a belt is to set a good example were more likely to report all of the time belt use (93.98%) than those who did not think that this reason applies to them (86.35%).

Set a good example	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
No	0 0.00%	5.2741 2.30%	8.8655 3.86%	17.186 7.49%	198.11 86.35%	229.44
Yes	0 0.00%	2.5919 0.44%	13.185 2.26%	19.436 3.32%	549.47 93.98%	584.68
Total (N)	0	7.86605	22.0508	36.6224	747.578	814.117

p=0.00
Frequency Missing= 13.365968697

5.8 Seat Belts Are Just as Likely to Harm You

Respondents were asked to indicate if they agree or disagree with a series of statements related to seat belt use. The first of these stated that seat belts are just as likely to harm you as help you; older adults who agreed with this statement were more likely to report rarely or never using a seat belt. Many older adults are worried about the harm of seat belts (33%).

Seat belts are just as likely to harm you as help you	Never	Rarely	Some of the Time	Most of the Time	All the Time	Total (N)
Disagree	0 0.00%	3.501 0.66%	15.958 3.02%	18.846 3.57%	490.18 92.75%	528.49
Agree	2.6822 1.05%	4.365 1.71%	6.0929 2.38%	13.23 5.18%	229.18 89.68%	255.56
Total (N)	2.68223	7.86605	22.0508	32.0768	719.369	784.045

p=0.06

Frequency Missing= 43.437902096

5.9 Want a Seat Belt in an Accident

Most older respondents indicated that they would want seat belts on in the event of a crash and those who agreed with this statement were more likely to indicate all-the-time belt use (92.28%) than those that disagreed with this statement (73.93%). Seventeen percent of those who disagree with that statement rarely or never use their belts.

If I were in an accident 55_4	Never	Rarely	Some of the Time	Most of the Time	All of the Time	Total (N)
Disagree	1.7731 8.76%	1.7279 8.54%	0.864 4.27%	0.9091 4.49%	14.958 73.93%	20.233
Agree	0.9091 0.12%	6.1381 0.79%	19.369 2.48%	33.94 4.34%	721.39 92.28%	781.75
Total (N)	2.68223	7.86605	22.2326	34.8493	736.349	801.979

p=0.00

Frequency Missing= 25.503717655

5.10 Lower Medical Insurance Costs

Older adults who indicated that medical insurance costs would be lower if more people used their seat belts were more likely to report using a seat belt all the time (93.15%) than those who disagreed with this statement (84.93%).

Lower Medical Insurance Costs	Never	Rarely	Some of the Time	Most of the Time	All the Time	Total (N)
Disagree	1.7731 1.10%	5.2741 3.27%	6.2284 3.87%	11.003 6.83%	136.85 84.93%	161.13
Agree	0.9091 0.16%	2.5919 0.46%	13.23 2.33%	22.073 3.90%	527.82 93.15%	566.63
Total (N)	2.68223	7.86605	19.4589	33.0762	664.674	727.757

p=0.00

Frequency Missing= 99.725458146

6. Results for Logistic Regression of Restraint Use on Respondent Characteristics for Version A Variables

Stepwise regression was used to predict 2-way restraint use probability as a function of the following attitudes and characteristics: age, fatalistic attitude, passenger seat belt use, belief in a seat belt law, body mass index, use based on habit, comfort, to avoid injury, and to set a good example, statements regarding seat belts including the likelihood of harm, importance of seat belts in a crash, and use of seat belts as lowering medical insurance.

Results from the analyses suggest that use of a seat belt due to habit and because the occupant is uncomfortable without it are positively related to the probability that the self reported use of frequency wearing any belt (as well as lap belt and shoulder belt) is all of the time. That is, wearing a seat belt as a result of habit or due to lack of comfort without the belt are associated ing belt use all of the time.

6.1 Lap belt use

Obs	Variable	ClassVal0	DF	Estimate	StdErr	WaldChiSq	Prob ChiSq
1	Intercept		1	0.8845	0.3114	8.0675	0.0045
2	Seat Belt Use Is a Habit		1	1.9617	1.4381	20.0513	<.0001
3	I'm Uncomfortable Without It		1	1.5960	0.4963	10.3423	0.0013

6.2 Shoulder belt use

Obs	Variable	ClassVal0	DF	Estimate	StdErr	WaldChiSq	Prob ChiSq
1	Intercept		1	0.8817	0.2967	8.8282	0.0030
2	Seat Belt Use Is a Habit		1	2.6003	0.4704	30.5555	<.0001
3	I'm Uncomfortable Without It		1	1.1025	0.4906	5.0491	0.0246

6.3 Any belt use

Obs	Variable	ClassVal0	DF	Estimate	StdErr	WaldChiSq	Prob ChiSq
1	Intercept		1	1.0457	0.3061	11.6729	0.0006
2	Seat Belt Use Is a Habit		1	2.5814	0.4959	27.1022	<.0001
3	I'm Uncomfortable Without It		1	1.1044	0.5200	4.5103	0.0337

E. National Automotive Sampling System / Crashworthiness Data System NASS CDS

Predicting Belt Use in NASS From a Large Set of Pre- and Post-Crash Variables

In these analyses, first we used pre-crash variables to estimate belt use probability. As a second step, we classified occupants into 5 groups on predicted belt use probability. Thus, occupants placed in the same group had approximately the same predicted belt use probability. In the third step, the additional effect of post-crash factors on belt use probability was estimated. Crudely speaking, the third analysis answers the question: controlling for pre-crash factors affecting belt use among occupants, what is the effect of post-crash variables for injury and ejection on actually using belts. This is a question that is close, though not the same, as the question, what is the effect of using belts on reducing injuries, once we control for factors affecting crash probability.

1. Methods

1.1 Case Selection

Only occupants 65 and older, in passenger vehicles (cars, vans, SUVs, and pickup trucks), with known belt use were included in the analyses. A few other cases were also excluded as shown in SAS code.

1.2 Variables

The following variables were selected for analysis and recoded as needed:

Ejection	EJECTION	1= No; 2= Yes
Injury	INJSEV	1= No Injury; 2= Possible Injury; 3= Nonincapacitating Injury; 4= Incapacitating Injury; 5= Killed; 6= Injury Severity Unknown
ISS	ISS5	0, 1-8, 9-15, 16-24, 25+
Light Condition	LITEDARK	1=Light; 2=Dark; 3=Other or Unknown
MAIS	MAIS	1=Not Injured; 2=Minor Injury; 3= Moderate Injury; 4=Serious Injury; 5=Severe Injury; 6=Critical Injury; 7=Maximum Injury; 8= Unknown Injury Level
Road Type	MAJ_ROAD	1=Major Road; 0= Not or Unknown
No. of Occupants	NUMOCC	1=1 Occupant; 2=2 or more Occupants
No. of Vehicles	NUMVEH	1=1 Vehicle; 2= 2 Vehicles; 3= 3+ Vehicles
Age	OLDAGE	Category: 3=85+; 2=75+; 1=65+
Race	RACE3	1=Black; 2=White; 3=Other
Sex	SEX	1=Male; 2=Female
Seat Position	SEAT3	1=Front Left, 2=Front Other, 3=Rear 2nd or 3rd
Vehicle Type	VEH	1=Car; 2=SUV; 3=Van; 4=Truck
Weather	WTHRFLAG	1=Adverse Weather; 0= Not Adverse or Unknown
Crash Year	YEAR	Year of Crash
Belt Use	Belt use was recoded from NASS variables Manual Belt Use, Automatic Belt Use and renamed.	
	SOMEBLT3	1= Seat Belt Used; 0= Seat Belt Not Used

1.3 Modeling of Seat Belt Use as a Function of Pre- and Post-Crash Variables.

1.3.1 Effects on belt use of pre-crash variables (Sex, Age, No. of Vehicles, No. of Occupants, Seat Position, Crash Year, Road Type, Light Condition, Vehicle Type, Weather, and Race) were modeled using SUDAAN. This analysis accounted for the NASS design.

1.3.2 Stepwise SAS logistic regression was used to estimate the probability of the binary belt use flag as a function of the potential predictors:
Sex, Age, No. of Vehicles, No. of Occupants, Seat Position, Crash Year, Road Type, Light Condition, Vehicle Type, Weather, and Race

1.3.3 Predicted belt use probability, IP_1, estimated by the stepwise regression, was used to form 5 groups that included occupants with similar predicted belt use probability. The group membership variable, RBltp5, was then used in subsequent analyses in combination with post-crash variables for injury (Injury, ISS, and MAIS) and ejection to estimate the added effect of the post-crash variables after the pre-crash variables are controlled.

2. Results

2.1 Effect of Pre-Crash Variables on Belt Use Probability- SUDAAN Based Estimates

The contrast table shows that statistically significant effects were found for only three variables: Sex, Vehicle Type, and Seat Position.

Variance Estimation Method: Taylor Series (WR)
SE Method: Robust (Binder, 1983)
Working Correlations: Independent
Link Function: Logit
Response variable Belt Use (SOMEBLT3)
By: Contrast.

Contrast	Degrees of Freedom	Wald F	P-Value Wald F
Overall Model	15	1208.88	0.0000
Model Minus Intercept	15	15626.71	0.0000
Intercept	-	-	-
Sex	**1**	**22.38**	**0.0003**
Age	2	3.22	0.0687
No. of Vehicles	2	1.97	0.1743
No. of Occupants	1	4.17	0.0592
Seat Position	**2**	**11.28**	**0.0010**
Crash Year	4	0.62	0.6529
Road Type	1	1.25	0.2804
Light Condition	2	1.47	0.2606
Vehicle Type	**3**	**3.83**	**0.0322**
Weather	1	2.21	0.1574
Race	2	1.79	0.2010

The odds ratio table shows that belt use is higher among women than men, it is lower in the 2nd and 3rd rows of seats than in the front row, and in general, lower in passenger vehicles than in cars.

Independent Variables and Effects	Odds Ratio	Lower Confidence Limits 95%	Upper Confidence Limits 95%
Intercept	0.26	0.08	0.80
Sex			
Male	1.00	1.00	1.00
Female	0.61	0.48	0.76
Age			
1=65+	0.66	0.40	1.07
2=75+	0.59	0.38	0.92
3=85+	1.00	1.00	1.00
No. of Vehicles			
1 Vehicle	1.63	0.92	2.89
2 Vehicles	1.00	1.00	1.00
3+ Vehicles	1.19	0.69	2.04
No. of Occupants			
1 Occupant	1.00	1.00	1.00
2+ Occupants	0.59	0.33	1.02
Seat Position			
Front Left	1.00	1.00	1.00
Front Other	1.33	0.83	2.12
2nd or 3rd row	5.62	2.57	12.28
Crash Year			
1999	1.30	0.50	3.38
2000	0.98	0.49	1.96
2001	1.00	1.00	1.00
2002	0.90	0.51	1.57
2003	0.74	0.34	1.61
Road Type			
Major Road	1.00	1.00	1.00
Not Major Road	0.71	0.36	1.37
Light Condition			
Light	1.00	1.00	1.00
Dark	0.98	0.54	1.76
Other or Unknown	1.86	0.83	4.16
Vehicle Type			
Car	1.00	1.00	1.00
SUV	0.46	0.18	1.17
Van	0.60	0.25	1.47
Truck	0.84	0.40	1.73
Weather			
Adverse Weather	1.00	1.00	1.00
Not Adverse or Unknown	1.59	0.82	3.10
Race			
Black	1.00	1.00	1.00
White	0.65	0.39	1.07
Other	0.64	0.23	1.73

2.2 SAS Stepwise Logistic Regression Results

Among the 11 pre-crash variables in the model, the SAS stepwise regression identified 7 as statistically significant, they are listed below. It is to be expected that adjusting for complex sample design variances are increased and the number of remaining significant effects is decreased.

Obs	Variable	DF	Wald Chi Sq	Probability ChiSq
1	Sex	1	16.1709	<.0001
2	Age	2	12.1464	0.0023
3	No. of Vehicles	2	58.6016	<.0001
4	No. of Occupants	1	17.7897	<.0001
5	Seat Position	2	54.9859	<.0001
6	Crash Year	4	14.7653	0.0052
7	Race	2	8.2453	0.0162

2.3 Effect of Injury Severity on Belt Use Controlling for Pre-Crash Variables.

The 5 –level ISS variable has a significant effect on belt use even after pre-crash variables are controlled:

Contrast	Degrees of Freedom	Wald F	P-Value Wald F
Overall Model	9	195.88	0.0000
Model Minus Intercept	8	28.66	0.0000
Intercept	-	-	-
ISS	4	18.06	0.0000
Group Membership Variable (RBltp5)	4	6.84	0.0024

Specifically, the odds ratio for non-belt-use increased from 1.67 to 14.65 (relative to the no-injury level) as ISS increased from 1-8 to 25+.

Independent Variables and Effects	Odds Ratio	Lower Confidence Limits 95%	Upper Confidence Limits 95%
Intercept	0.02	0.01	0.06
ISS			
0	1.00	1.00	1.00
1-8	1.67	0.74	3.80
9-15	7.73	3.86	15.48
16-24	5.08	1.90	13.59
25+	14.65	6.49	33.10
Rank for Variable IP_1			
1	1.00	1.00	1.00
2	2.39	0.65	8.85
3	2.51	0.80	7.84
4	3.84	1.43	10.36
5	4.41	1.38	14.07

2.4 Effect of Police-Reported Injury Severity on Belt Use Controlling for Pre-Crash Variables.

The 5 –level Injury variable has a significant effect on belt use even after pre-crash variables are controlled:

Contrast	Degrees of Freedom	Wald F	P-Value Wald F
Overall Model	10	299.76	0.0000
Model Minus Intercept	9	135.18	0.0000
Intercept	-	-	-
Injury	5	10.24	0.0002
Group Membership Variable (RBltp5)	4	7.64	0.0014

Specifically, the odds ratio for non-belt-use increased from 3.77 to 16.91 as injury increased from possible injury (2) to killed (5).

Independent Variables and Effects	Odds Ratio	Lower Confidence Limits 95%	Upper Confidence Limits 95%
Intercept	0.01	0.00	0.05
Injury			
1=No Injury	1.00	1.00	1.00
2=Possible Injury	3.77	1.46	9.76
3=Nonincapacitating Injury	2.83	1.11	7.23
4=Incapacitating Injury	6.58	2.36	18.35
5=Killed	16.91	6.44	44.38
6=Injury Severity Unknown	3.45	0.42	28.51
Rank for Variable IP_1			
1	1.00	1.00	1.00
2	2.23	0.71	7.00
3	2.40	0.76	7.63
4	3.84	1.50	9.82
5	4.01	1.29	12.49

2.5 Effect of Maximum AIS (MAIS) on Belt Use Controlling for Pre-Crash Variables

The 8–level MAIS variable has a significant effect on belt use even after pre-crash variables are controlled:

Contrast	Degrees of Freedom	Wald F	P-Value Wald F
Overall Model	6	49.02	0.0000
Model Minus Intercept	6	32.50	0.0000
Intercept	-	-	-
MAIS	2	94.36	0.0000
Group Membership Variable (RBltp5)	4	8.22	0.0010

Specifically, the odds ratio for non-belt-use increased from 1.67 to 14.65 as MAIS increased from minor injury (2) to serious/severe /critical/maximum levels (4-7). The unknown injury level is 8.

Independent Variables and Effects	Odds Ratio	Lower Confidence Limits 95%	Upper Confidence Limits 95%
Intercept	0.02	0.01	0.06
MAIS			
1=Not Injured	1.00	1.00	1.00
2=Minor Injury	1.37	0.58	3.26
3=Moderate Injury	6.39	2.43	16.86
4=Serious Injury	7.25	3.62	14.55
5=Severe Injury	4.44	2.03	9.70
6=Critical Injury	2453.76	0.00	***
7=Maximum Injury	inf	inf	inf
8=Unknown Injury Level	2.38	0.40	14.25
Rank for Variable IP_1			
1	1.00	1.00	1.00
2	2.27	0.68	7.58
3	2.35	0.76	7.28
4	3.56	1.42	8.92
5	4.15	1.36	12.67

2.6 Effect of Maximum Ejection on Belt Use Controlling for Pre-Crash Variables

Actually, the non-belt-use odds ratio for ejected occupants (relative to those not ejected) was estimated at “infinity” since very few among the belt users were ejected.

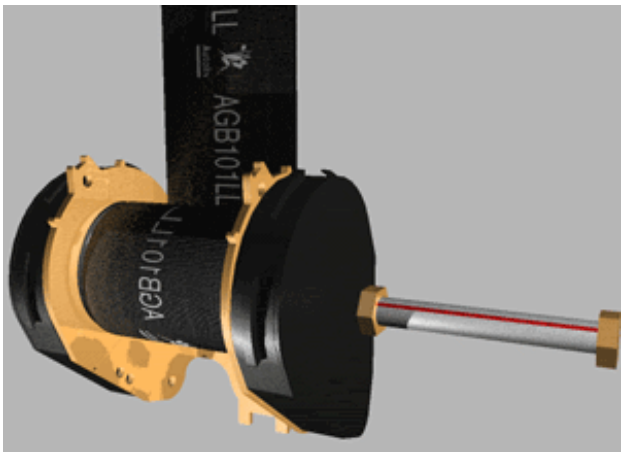
8.3 Photographs of Vehicle Design Features

V-4 Belt, Source- Dr. Stephen Rouhana, Ford Motor Company

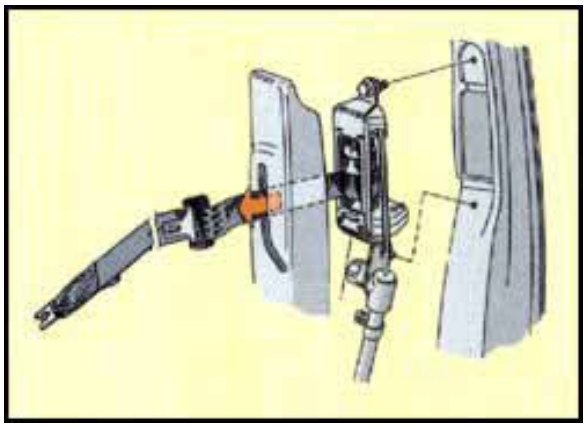
Inflatable Belt, Source- Dr. Stephen Rouhana, Ford Motor Company

Pretensioner, Source- www.autoliv.com

Load Limiter, Source- www.autoliv.com



Height Adjusters, Source- www.autoliv.com



8.4 Media Material

A. GrandDriver Campaign Materials

GrandDriver®

Thank you for bringing GrandDriver® to your state! By implementing this program, you are taking a positive step towards improving highway safety in your region by educating older drivers and their families on aging and driving. The GrandDriver campaign produced excellent results in the pilot program, and we are sure that with a little guidance, it can do the same for yours.

On the following pages, you will find information on how to develop and execute your own GrandDriver program. Also included are advertising materials, media relations tools, professional development ideas, funding recommendations as well as support organizations. Many of these items are found on the enclosed CD-ROM and can be modified to meet your needs.

Keep in mind this is not an all-or-nothing campaign. We encourage you to develop your GrandDriver program according to the needs and resources of your jurisdiction. Each element provided in the guidebook is designed to communicate the message effectively, whether used alone or in concert with additional elements.

Because of the urgency of this issue and positive results created from the pilot campaign, we recommend that you not keep this great resource to yourself. Sharing the GrandDriver kit with government officials, such as your state legislature and state unit on aging, will get more people talking about the issue and could lead to GrandDriver funding for your state.

Last, but certainly not least, we cannot discuss the success of GrandDriver without mentioning the agencies whose support and guidance made this project possible.

AAMVA Board of Directors
AAMVA PACE Committee
AAMVA Older Driver Working Group
National Highway Traffic Safety Administration
Department of Health and Human Services/U.S. Administration on Aging
AARP Driver Safety Program
American Automobile Association
National Association of Area Agencies on Aging

Again, we appreciate that your state is taking the issue of aging and driving seriously. Please feel free to contact us with any questions on how you can implement GrandDriver and help older adults get around safe and sound in their later years.

Sincerely,
Linda R. Lewis
President and CEO
American Association of Motor Vehicle Administrators

Why Do We Need GrandDriver?

Today there are more than 18 million drivers in the U.S. over the age of 70. By 2020 that number will soar to over 30 million. The rise in population, coupled with the higher fatality rates of older drivers sets up a dangerous scenario for drivers across the nation.

In response to these statistics and the prevailing myths about older drivers, the American Association of Motor Vehicle Administrators created the GrandDriver program. GrandDriver is an education and awareness campaign designed to educate the public about the effects of age on driving ability, and to encourage drivers to make wise choices as they grow older.

The Pilot Results

The GrandDriver pilot program ran in the Washington, D.C., metropolitan area from April through September 2003 with outstanding results. The campaign garnered more than five million dollars in advertising equivalency, held 64 speaking engagements and distributed 30,000 brochures. Research studies showed our target audiences were driven to the desired actions: talking with family members, self-monitoring their driving, and keeping themselves and others informed on the issue.

Getting Started

Assembling and mobilizing a core group of stakeholders and volunteers is key to the success of this or any grassroots program. This steering committee should meet often to discuss the campaign's progress and to remain mobilized. Your partners will not only provide you with additional communication vehicles but will also provide immeasurable "in-kind" resources. Some of the stakeholders should include but are not limited to:

- State motor vehicle agency employees (license examiners/medical advisory board members)
- State Patrol/Police
- State Units on Aging
- State AARP Driver Safety Coordinators/Instructors
- Governor's Highway Safety Office Representatives
- Driver Rehabilitation Specialists/Occupational Therapists
- NHTSA Regional Administrators
- State Medical Association/Society

How Do I Get Financial Support?

GrandDriver can be one of the most rewarding programs you'll ever undertake, but you can't do it alone. You will need the physical and financial support of government and state organizations in your area. Use this box as a sales tool to approach the following potential funding sources:

- Governor's Highway Safety Office
- State legislature
- Area agencies on aging
- Corporate partners
- Grants
- Transportation agencies
- Not-for-profit organizations

How GrandDriver Can Work for Your State

Based on our experience with the GrandDriver program, we've created this guidebook so you can create a successful campaign in your state. The book outlines the various public relations and advertising elements that were effective in the greater Washington area, provides sample materials for you to adapt and use, and offers suggestions for tailoring the program to your state. On the following pages, you'll find the strategies and tools to implement the following:

I. Media Relations
II. Advertising
III. Brochures
IV. Web Site and Toll-free Number
V. Special Events
VI. Speakers Bureau
VII. Professional Outreach

After reading this guidebook, open the accompanying CD-Rom to find advertising and media relations files that can be modified for use in your GrandDriver campaign.

B. Buckle Up America Brochure

"Should I turn off the air bag?"

No. Doctors recommend that pregnant women wear seat belts and leave the air bag switch on; they work together to protect both the mother and the unborn baby in a crash.

"Should I adjust my seat?"

Yes. You should move the front seat as far back as possible. Your breastbone should be at least 10 inches from the steering wheel or dashboard. As your abdomen grows during pregnancy, move the seat back to keep as much distance as possible while still allowing a driver to reach the pedals.

Need more help? Contact us

For more information about child safety seats, booster seats, inspection/fitting stations in your area, seat belts, air bags, and other highway safety issues, call the DOT Auto Safety Hotline at 1-888-DASH-2-DOT (1-888-327-4236) or visit our web site at www.nhtsa.dot.gov

BUCKLE UP AMERICA

NHTSA People Saving People www.nhtsa.dot.gov

Thanks to the American College of Obstetricians and Gynecologists (ACOG) and National Healthy Mothers, Healthy Babies Coalition for their review and input for the brochure.

DOT HS 809 506
September 2002

"Should pregnant women wear seat belts?"

ANSWERS TO AN EXPECTANT MOTHER'S COMMON QUESTIONS ABOUT TRAFFIC SAFETY

"I'm pregnant. Should I wear a seat belt?"

Yes. Doctors recommend it. In a crash, seat belts are the best protection for both you *and* your unborn child.

"What if the car or truck has air bags?"

You still need to buckle up. Air bags are designed to work with seat belts, not replace them. Without a seat belt, a pregnant woman can be thrown into a rapidly opening air bag—a movement of such force could injure or even kill the mother and her unborn child.

"What's the right way to wear my seat belt?"

NEVER place the lap belt above or on your belly.

Once your baby is born, don't forget these steps to keep your child safe:

4 STEPS FOR KIDS

1. Use **REAR-FACING INFANT SEATS** in the back seat from birth to at least one year old and at least 20 pounds.
2. Use **FORWARD-FACING TODDLER SEATS** in the back seat from age one to about age four and 20 to 40 pounds.
3. Use **BOOSTER SEATS** in the back seat from about age four and 40 pounds to at least age eight unless 4'9".
4. Use **SEAT BELTS** at age eight or older or taller than 4'9". All children 12 and under should ride in the back seat.

www.nhtsa.dot.gov

C. *Buckle Up America* Logos

BUA Logos Designed for Various Demographic Groups

Buckle Up America Faith Logo

Buckle Up America Youth Logo

Buckle Up America Nurse Logo

D. CarFit Checklist

DATE	PARTICIPANT #	VEHICLE MAKE, MODEL+YEAR

CarFit

Helping Mature Drivers Find Their Perfect Fit

1.	"Are you the only driver?"		YES	NO
	If no, has the spouse been scheduled to go through the CarFit program today? If no, suggest the driver go through the CarFit items with the spouse at home.			
2.	**Is the driver using the vehicle's seat belt?**		YES	NO
	Does the driver use it all the time? If no, why?		YES	NO
	Is the belt being used correctly?		YES	NO
	Is driver able to unbuckle/buckle and reach for the belt without problem?		YES	NO
	Is driver is able to use the belt without discomfort?		YES	NO
3.	**Steering Wheel Tilt/Head Restraint** Can the driver view the speedometer?		YES	NO
	Is the steering wheel tilted up or down too much?		YES	NO
	Does the driver know how to adjust the steering wheel?		YES	NO
	Were verbal instructions given on the steering wheel tilt?		YES	NO
	Is the head restraint properly adjusted to the center of the driver's head?		YES	NO
	Does the driver know how to adjust the head restraint?		YES	NO
	Were verbal instructions given on the head restraint?		YES	NO
4.	**Distance between chest and steering wheel (minimum 10")**	**Approx_____ inches**		
	Can the concern be resolved via a seat adjustment?		YES	NO
5.	**Line of sight above steering wheel (should be ≥3")**	**Approx_____ inches**		
	Can driver adjust seat with proper controls?		YES	NO
	Were verbal instructions given on seat adjustment?		YES	NO
	After ideal seat adjustment, has driver obtained ≥3" line of sight above steering wheel?		YES	NO
6.	**Positioning To Gas Pedal**		GOOD	POOR
	Is the driver able to reach and completely depress the gas pedal without reaching with his/her toes?		YES	NO
	If the vehicle has a clutch, watch the left foot movement to and from this pedal. Ask the driver to depress the clutch completely. Note any problems.			
7.	**Positioning To Brake Pedal** Is the driver able to reach and completely depress the brake pedal without reaching with his/her toes?		YES	NO
	Ask the driver to move foot between gas/brake pedals several times (without depressing the pedals). Was the driver's foot placement adequate?		YES	NO
8.	**Mirror Use (Prior to changing mirror settings)** Can driver identify object in rear view mirror?		YES	NO
	Can driver identify object in left outside mirror?		YES	NO
	Can driver identify object in right outside mirror?		YES	NO

	Were verbal instructions given on mirror adjustments?		YES	NO
	(IF APPLICABLE) After mirror adjustments, driver is able to obtain appropriate views through mirror(s).		YES	NO
9.	**Neck Mobility For Blind Spot Check** Can driver identify object over left shoulder?		YES	NO
	Can driver identify object over right shoulder?		YES	NO
10.	**Ignition Key**: Driver is able to remove the key, place the key into the ignition and start the engine. (PLEASE ASK THE DRIVER TO SET THE IGNITION TO THE AUXILIARY POSITION; DO NOT TURN ENGINE FULLY ON.)		YES	NO
11.	**Operation Of Vehicle Controls** Driver is able to reach/operate the right turn signal?		YES	NO
	Driver is able to reach/operate the left turn signal?		YES	NO
	Driver is able to reach/operate the emergency flashers?		YES	NO
	Driver is able to reach/operate the headlights?		YES	NO
	Driver is able to reach/operate the high/low beam headlights?		YES	NO
	Parking Brake: Driver is able to apply and release the parking brake. (ASK THE DRIVER TO REAPPLY THE PARKING BRAKE AND TO START THE ENGINE, LEAVING VEHICLE IN THE "NEUTRAL" POSITION)		YES	NO
	Driver is able to rotate steering wheel to far right?		YES	NO
	Driver is able to rotate steering wheel to far left?		YES	NO
	Driver is able to sound the vehicle's horn?		YES	NO
	** At this point, please ask driver to start vehicle and drive slowly to checkout location for OT to conduct vehicle walk around and checkout.			
12.	**Vehicle Walk Around** Ask the driver to get out and walk around the vehicle with you.			
	Driver is able to get in/out of vehicle with ease.		YES	NO
	Driver appears to have an adequate sense of balance.		YES	NO
	Driver is able to walk without difficulty.		YES	NO
	Driver appears to have adequate physical endurance.		YES	NO
	Driver uses an assistive device. Description:		YES	NO
	Vehicle has scratches and/or dents. Cause given:		YES	NO

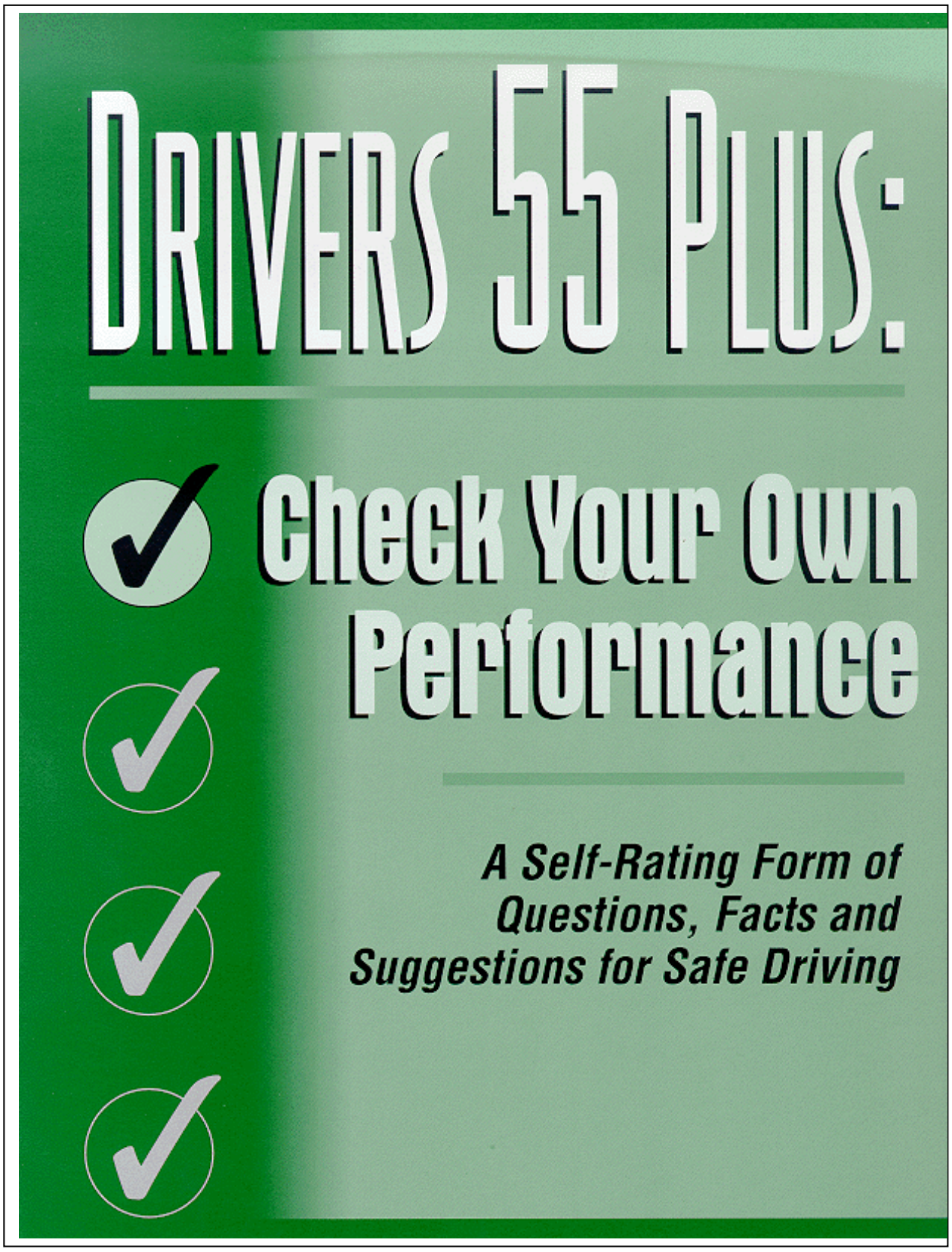
General Notes and Comments:	Seat belt Use:
	☐ Seat belt not buckled ☐ Shoulder strap is behind the driver's back ☐ Shoulder strap is under the driver's arm ☐ Seat belt is used correctly ☐ Other:

***Responses marked by a should be brought to the attention of the occupational therapist or driver rehabilitation specialist for a final check out.

CarFit is an educational program
created by the American Society of Aging and developed in collaboration with AAA (American Automobile Association), AARP and the American Occupational Therapy Association.

D18576 (1/08)

E. *Drivers 55 Plus* Test



Test Your Own Performance

The central idea is to help you drive as long as possible with safety to yourself and others.

By the year 2000, one of every three drivers in America will be over 55 years of age. Freedom to travel by automobile will continue to be an important factor to maintain personal independence and mental health.

Almost everyone concerned with traffic safety wants to keep older drivers on the highways as long as they can drive safely. Age should never be mistaken as the sole indicator of driving ability. In fact, drivers over 55 represent a wide range of abilities, and no individual should have his or her license jeopardized solely because of age.

However, skills necessary for safe driving – vision, reflexes, flexibility, hearing – begin to deteriorate around age 55 with an even greater loss after 75. Aging drivers can adjust their driving habits to cope safely with this decline, but to do this they must recognize their limitations and unsafe practices and be aware of remedial actions. Creating this awareness is the purpose of this older driver self-rating booklet.

The rating form on the next page is for your use alone. Answer the 15 questions as honestly as possible. Use the rating guide to compute your score and learn where your strengths and weaknesses lie. Then, read the Suggestions for Improvement section that corresponds to each question to see how you can improve your driving. If your answers reveal serious problems, you will be helped to understand when remedial measures may no longer be possible.

The central idea is to help you drive as long as possible with safety to yourself and others.

Now, please follow the instructions on the next page.

This book is based on the results of research conducted for the AAA Foundation for Traffic Safety by Dr. James L. Malfetti and Dr. Darlene J. Winter of the Safety Research and Education Project at Teachers College, Columbia University. The AAA Foundation for Traffic Safety assumes no liability for its contents or use thereof. If trade names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The AAA Foundation for Traffic Safety does not endorse products or manufacturers.

Founded in 1947, the AAA Foundation for Traffic Safety is a not-for-profit, publicly supported charitable research and educational organization dedicated to saving lives and reducing injuries by preventing traffic accidents.

Funding support for this book and the study upon which it is based was provided by voluntary contributions from motor clubs associated with the American Automobile Association and the Canadian Automobile Association, individual AAA club members, and AAA-affiliated insurance companies.

Drivers 55 Plus: Self-Rating Form

INSTRUCTIONS: For each of the following 15 questions, check the symbol (✓) of the one answer that most applies to you.

	Always or Almost Always	Some-times	Never or Almost Never
1. I signal and check to the rear when I change lanes	○	□	□
2. I wear a seat belt	○	□	□
3. I try to stay informed on changes in driving and highway regulations	○	▽	□
4. Intersections bother me because there is so much to watch from all directions	□	▽	○
5. I find it difficult to decide when to join traffic on a busy interstate highway	□	▽	○
6. I think I am slower than I used to be in reacting to dangerous driving situations	□	□	○
7. When I am really upset, I show it in my driving	□	□	○
8. My thoughts wander when I am driving	□	▽	○
9. Traffic situations make me angry	□	▽	○
10. I get regular eye checks to keep my vision at its sharpest	○	□	□
11. I check with my doctor or pharmacist about the effects of my medications on driving ability. *(If you do not take any medication, skip this question.)*	○	□	□
12. I try to stay abreast of current information on health practices and habits	○	▽	□
13. My children, other family members or friends are concerned about my driving ability	□	▽	○
Note new headings →	**None**	**One or Two**	**Three or More**
14. How many traffic tickets, warnings, or "discussions" with officers have you had in the past two years?	○	▽	□
15. How many accidents have you had during the past two years?	○	□	□

Self Scoring: Count the number of checkmarks in the squares and record the total in the square below. Follow the same procedure for the triangles and circles.

□ ▽ ○

These are your Check Mark Totals.
For score and interpretation, see next page. →

Scoring: There are 5 steps.

Step 1: Write the Check Mark Total recorded in the square on the previous page in the square to the right.  **X 5 =** _____

Step 2: Write the Check Mark Total recorded in the triangle on the previous page in the triangle to the right.  **X 3 =** _____

Step 3: Multiply the number in the square by 5.

Step 4: Multiply the number in the triangle by 3.

Step 5: Add the results of Steps 3 and 4.

YOUR SCORE IS _____

Interpretation of Score: The **lower** the score, the safer driver you are.

The **higher** the score, the more danger you are to yourself and others.

No matter what your score, look at the Suggestions for Improvement section for each area in which you checked a square or triangle. These are the areas in which you can improve the most.

SCORE	MEANING
0 to 15	**GO!** You are aware of what is important to safe driving and are practicing what you know. See the Suggestions for Improvement in the following section of this booklet, to learn how to become an even safer driver.
16 to 34	**CAUTION!** You are engaging in some practices that need improvement to ensure safety. Look to the Suggestions for Improvement section to see how you might improve driving.
35 and over	**STOP!** You are engaging in too many unsafe driving practices. You are a potential or actual hazard to yourself and others. Examine the areas where you checked squares or triangles. Read the Suggestions for Improvement section for ways to correct these problem areas.

These scores are based on what you and other drivers 55 and over have told us about driving practices and habits. Your score is based on your answers to a limited number of important questions. For a complete evaluation of your driving ability, many more questions would be required, along with medical, physical, and licensing examinations. Nevertheless, your answers and score give some indication of how well you are doing and how you can become a safer driver.

In general, a checked square for an item reflects an unsafe practice or situation that should be changed immediately. A checked triangle means a practice or situation that is unsafe, or on its way to becoming unsafe, if nothing is done to improve it. Checking circles is a sign that you are doing what you should to be (and remain) a safe driver.

Most of the square and triangle answers represent practices or situations that can be improved by most drivers. The following pages contain Suggestions for Improvement, divided into each of the 15 areas. You will want to focus on those for which you check squares or triangles.

Occupational Therapists and Driving

For Professionals
How to Get Started
Professional Development
Toolkit for Professionals
Join Our Listserv
Raise Community Awareness
Career Opportunities
For Physicians and Referrers
Reading Room

For Consumers & Caregivers
Getting Around Safe & Sound
Evaluating Your Driving Fitness
Community Mobility
Concerned About Family or Friends?
Reading Room


Find A Driving Rehab Specialist

Staying connected to your community is an important part of your well-being. For most of us, driving our own car is how we stay mobile and on the go. Driving is how we see the people we want to see and how we do the things we want to do at our convenience. But changes in our physical, mental, and sensory abilities can challenge our continued ability to drive safely.

Role of Occupational Therapy

Occupational therapists trained in driver rehabilitation understand the critical demands of driving and how our ability to move about our community affects the quality of our lives. These occupational therapists have the skills to evaluate an individual's overall ability to operate a vehicle safely, and, where appropriate, to provide rehabilitation to strengthen skills used in driving.

Occupational therapists have the science-based knowledge to understand progressive conditions and life changes that can affect driving. Because occupational therapists take the time to understand the role that driving plays in your life, they are able to help individuals make a smoother transition from driving to using other forms of transportation. In doing so, they help people maintain their autonomy, independence, and sense of worth.

A variety of tools are available that enable individuals to drive safely longer. These adaptive features can be added to a vehicle to help compensate for an individual's physical changes or functional loss, or simply to make the vehicle fit the person more comfortably and safely.

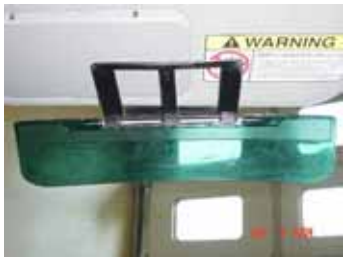
Although many businesses sell adaptive equipment, people who need such equipment should have a thorough assessment by an occupational therapy driving rehabilitation specialist to ensure that the right equipment is selected. In addition, the specialist can help make sure that the equipment is properly installed and can provide training on using the equipment **before** the person takes to the road in a vehicle.

AOTA's Buyer's Guide
Select vendors in the "Adaptive Equipment/Technology" category.

NHTSA Web page: Automotive Safety Issues for Persons With Disabilities
Includes adaptive equipment articles, brochures, regulations, standards, and a questionnaire.

Finding Features Shown in the Video

"Keep Moving Longer: Features for Safe Driving"
Following is a listing of the features demonstrated in the video along with suggestions as to where to find them and similar items and approximate price ranges. Some of the price ranges include prices from the web, so shipping might be an additional charge. Many of these products may be found on the web.



Visor Extender (Clip-on)
reduces glare from sun
auto supply store
$9-20

Convex Side-view Mirrors
increase peripheral vision, helping to eliminate blind spots so driver can see traffic to sides and rear without significant neck or body rotation; also helps during parking
auto supply store; discount department store

$15

Convex Rear-view Mirror (Clip-on)
increases peripheral vision, helping to eliminate blind spots so driver can see traffic to sides and rear without significant body rotation; also helps during parking
auto supply store; discount department store

$10-48

Safety Belt Pad
attaches around the safety belt to provide more padding and comfort for the user
auto supply store; medical supply catalog
$6- 25

Pedal Extenders
puts foot pedals closer to driver
(for people of short stature)
car dealership; mobility equipment dealer
$300-450 installed
(price depends upon length)

Support Handle (portable)
serves as a handhold on the outside of the car to help while entering and exiting
pharmacy with durable medical products
$40

Ceiling Hand Grip
can be held when maneuvering into and out of car; is standard on most cars on the passenger side. (Use arm strength to compensate for leg weakness.)
car dealership; mobility equipment dealer
$25 installed

Trash Bag/Silk Scarf
although not demonstrated in the
video, these items can be spread out on the seat to make turning easier when getting in and out of car
household items
$0

Ribbon on Safety Belt
permits easier, lower reach for the safety belt – grab the ribbon and pull belt over
household item
$0

Seat Cushion
preferably a slightly wedge shaped one, raises the upper body so driver can see over the dashboard and hood. Put the thicker end at the back of the seat.
pharmacy with durable medical products
$9-100

Safety Belt Extender (an extension strap)
One end is inserted into the safety belt receptacle on the driver's right side. The other end has a similar receptacle into which the safety belt from the left side is inserted. The extender provides a receptacle up higher, away from the seat, making it easier to fasten the belt.
(also for large people)
CAUTION: Some auto manufacturers believe these are not safe so don't have them; others feel they are safe and sell them or give them away.
car dealership
$0-115 – depends upon the make of car

Safety Belt Adjuster
positions safety belt so it is easier to reach for fastening
CAUTION: Have a professional recommend proper placement.
auto supply store; dealership
$7-10/pair

Key Extender
attaches to the ignition key to provide additional leverage rather than requiring wrist twisting to turn the key
medical supply catalog; mobility equipment dealer
$6-65

Features to Look for in a New Car

A very important step when purchasing a car is to sit in it and take a test drive if you can. How well does the car fit your body? How is the visibility, both front and rear? Another important step is to check whether the model you are considering has good crash test results (over). Some of the features listed below may be particularly helpful for making you feel comfortable and safe in your next car.

Extra wide and high doors

Higher seating

Adjustable driver's seat

Swivel seat for driver

Front seat heater/cooler

Large interior door handle (similar to bar for bathtub)

Adjustable steering wheel

Adjustable foot pedals

Ignition on dashboard rather than on steering column

Large print for digital gauges, (speed, miles)

Legible instrument controls

Voice operated systems (e.g., radio, phone, climate control)

Push button controls

Oversized knobs

Mirrors: large left side-view and rear-view mirrors; light sensitive rear-view mirror

Good visibility (be careful of wide pillars, high rear deck lids, and spoilers)

No tinted windows or items that could obstruct view

Front and side airbags; goal is protection for head, torso, and pelvic areas

Safety belts that are easy and comfortable to use

Safety belt that buckles at the midpoint of the torso

Safety belt wall anchors that are height adjustable

Built in emergency communication system

Automatic transmission

Power steering or variable assist power steering (which makes steering easier at low speeds and when parking)

Power brakes

Power windows

Power locks

There are additional new high tech features you may wish to consider. Two examples are a camera that sees what is behind the car and causes beeping or flashing of lights inside the car as you approach obstructions behind you; side view mirrors that display flashing chevrons when your turn signals are activated.

Resources

You may wish to check the following resources for crash test results and other useful information.

"Consumer Reports"
www.ConsumerReports.org

National Highway Traffic Safety Administration
www.NHTSA.gov

Web Resources on Older Drivers

AARP:
http://www.research.aarp.org/consume/fs51r_older_drivers.html
AARP, a nonprofit, nonpartisan organization for people age 50 and over, has information on safe transportation for older adults.

AAA Foundation for Traffic Safety:
http://www.seniordrivers.org/home/toppage.cfm
The AAA Foundation for Traffic Safety, a not-for-profit traffic safety organization, offers tips, a quiz, links and other safe driving information for senior drivers.

Administration on Aging:
http://www.aoa.dhhs.gov/research/drivers.html
The Administration on Aging, under the U.S. Department of Health and Human Services, provides home- and community-based services for older people. Its web site has articles about older driver safety, as well as seniors' changing needs and transportation options.

Insurance Institute for Highway Safety:
http://www.hwysafety.org/safety_facts/elderly.htm
The Insurance Institute for Highway Safety (IIHS) is an independent, nonprofit, research and communications organization funded by auto insurers. IIHS has facts and articles on older driver issues.

National Association of Area Agencies on Aging (N4A):
http://www.n4a.org/
N4A is the umbrella organization for the 655 area agencies on aging (AAAs) and more than 230 Title VI Native American aging programs in the U.S. The web site includes policy papers, event listings and information about the Eldercare Locator, its online and toll-free nationwide service which helps caregivers locate services for older adults in their own communities. For its members, N4A publishes Legislative Updates and Advocacy Alerts, and a newsletter.

National Highway Traffic Safety Administration (NHTSA):
http://www.nhtsa.dot.gov/people/injury/olddrive/
The National Highway Traffic Safety Administration (NHTSA) has up-to-date crash, fatality and injury statistics, and other information on seniors.

National Institute on Aging:
http://www.nia.nih.gov/health/agepages/drivers.htm
The National Institute on Aging (NIA), under the National Institutes of Health, focuses on understanding the nature of aging. Its web site discusses changes that older drivers face and ways they can adapt.

The American Occupational Therapy Association (AOTA):
http://www.aota.org (Search for "driving" or "transportation.")
The American Occupational Therapy Association is a professional organization. Its site has information and reports on driving that are relevant to older drivers.

ADED: The Association for Driver Rehabilitation Specialists:
http://www.aded.net (Click "Fact Sheets.")
ADED the Association for Driver Rehabilitation Specialists primarily supports professionals in the field of driver education and transportation equipment modification for persons with disabilities. It has useful information related to driving on its site. One may use the site to find a driver rehabilitation specialist.

National Mobility Equipment Dealers Association (NMEDA):
http://www.nmeda.org
The National Mobility Equipment Dealers Association, a non-profit trade association, increases independence for people with disabilities by providing safe adaptive transportation. By clicking on "Dealer Members," one can search for members across the country who are knowledgeable about major and higher tech modifications for cars.

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U.S. Department of Transportation
National Highway Traffic Safety Administration

NHTSA

www.nhtsa.gov