

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

**Occupant Protection Issues  
Among Older Drivers  
and Passengers:  
Volume I Final Report**





<b>1. Report No.</b> DOT HS 810 938		<b>2. Government Accession No.</b>		<b>3. Recipient's Catalog No.</b>	
<b>4. Title and Subtitle</b> Occupant Protection Issues Among Older Drivers and Passengers: Volume 1 Final Report				<b>5. Report Date</b>	
				<b>6. Performing Organization Code</b>	
<b>7. Authors</b> Levi, S. and De Leonardis, D.				<b>8. Performing Organization Report No.</b>	
<b>9. Performing Organization Name and Address</b> WESTAT 1650 Research Blvd. Rockville, MD 20850				<b>10. Work Unit No. (TRAIS)</b>	
				<b>11. Contract or Grant No.</b> DTNH22-03-C-05093	
<b>12. Sponsoring Agency Name and Address</b> Office of Behavioral Safety Research National Highway Traffic Safety Administration 1200 New Jersey Avenue SE. Washington, DC 20590				<b>13. Type of Report and Period Covered</b> Final September 2003 – December 2006	
				<b>14. Sponsoring Agency Code</b>	
<b>15. Supplementary Notes</b> Alan Block was the NHTSA Contracting Officer's Technical Representative (COTR) for this study.					
<b>16. Abstract</b> <p>With the older adult population of the United States growing at a rapid pace, the National Highway Traffic Safety Administration (NHTSA) is concerned with highway safety issues affecting this age group. NHTSA initiated a three-stage research study in order to gain a better understanding of the factors that contribute to seat belt use or nonuse among people 65 and older. The first stage included a literature review; discussions with experts in the fields of aging, vehicle design, law enforcement, physical mobility and human factors; and analyses of several national databases.</p> <p>This background research was followed by a series of 15 focus groups with older adults in four States. Participants discussed experiences and difficulties associated with seat belt use. Relevant topics included issues with comfort and convenience, effects of physiological conditions, trip and vehicle characteristics, presence of other passengers, types of media and communication tools to increase belt use among their peers, and a discussion of various seat-belt-related aftermarket devices. These focus groups pointed to a series of common seat-belt-related concerns and complaints among this select population.</p> <p>The final stage of the project was a human factors field study that provided detailed observation and measurement of seat belt use and acceptability among older occupants targeting comfort, convenience, and usability issues. Fifty-four older adults were exposed to six different seat belt systems and provided ratings regarding comfort, convenience, and likelihood of use. Participants also gave detailed descriptions of their experiences with the different systems, pointing out specific problems with usability and comfort.</p> <p>Conclusions include information to support the development of strategies to increase seat belt use among older adults and ideas for future related research on this topic.</p>					
<b>17. Key Words</b> Older drivers, older passengers, seat belts, occupant protection, focus groups, field data collection			<b>18. Distribution Statement</b> This document is available to the public through the National Technical Information Service, Springfield, VA 22161.		
<b>19. Security Classif. (of this report)</b> Unclassified		<b>20. Security Classif. (of this page)</b> Unclassified		<b>21. No. of Pages</b>	<b>22. Price</b>
<b>Form DOT F 1700.7 (8-72)</b>			Reproduction of completed page authorized		



## Table of Contents

<u>Chapter</u>	<u>Page</u>
Executive Summary .....	i
I. Introduction .....	1
II. Methodology .....	1
III. Summary of information sources .....	2
A. Demographic groups among older adults .....	2
B. Reasons for nonuse of seat belts .....	3
C. Vehicle design .....	5
D. Media and education campaigns .....	6
IV. Focus groups .....	7
A. Site selection .....	7
B. Participant sample .....	8
C. Procedures .....	9
D. Topics .....	9
E. Presentation of aftermarket devices .....	10
F. Key findings .....	10
V. Field data collection .....	16
A. Selection of seat belt systems .....	16
B. Participant sample .....	17
C. Design and procedure .....	17
D. Major themes .....	19
E. Data reduction .....	20
F. Database and analysis .....	20
G. Key findings .....	20
VI. Key findings and recommendations .....	30
References .....	34

## **List of Appendices**

A. Focus Group Question Path.....	A-1
B. Field Data Collection Materials.....	B-1
C. Tables and Graphs from In-Vehicle Study .....	C-1

## **EXECUTIVE SUMMARY**

The rapid growth of the population 65 and older in the United States over the next 50 years has the National Highway Traffic Safety Administration (NHTSA) concerned with highway safety issues for seniors. NHTSA is interested in preventing crash-related injuries and fatalities within this population. Research has shown that correct use of a seat belt is the most effective means in preventing serious or fatal injury in a motor vehicle crash. In order to better understand the factors that contribute to seat belt use or nonuse among people 65 and older, NHTSA initiated a three-stage research study.

The first stage included a literature review; discussions with experts in the fields of aging, vehicle design, law enforcement, physical mobility and human factors; and analyses of several national databases. This review of information sources pointed to several key concerns that influence seat belt use, nonuse, and misuse among older adults.

The background research was followed by a series of 15 focus groups, held in four States with older adults who travel regularly in private vehicles and who reported part-time or nonuse of seat belts. The focus groups served as a useful tool to explore a variety of the key issues influencing seat belt use and nonuse among the older adult population. The participants discussed experiences and difficulties associated with seat belt use. The topics reviewed included issues with comfort and convenience, effects of physiological conditions, trip and vehicle characteristics, presence of other passengers, types of media and communication tools to increase belt use among their peers, and a discussion of various seat-belt-related aftermarket devices. These focus groups pointed to a series of common seat-belt-related concerns and complaints among this select population and helped to direct the development of the subsequent in-vehicle field study. The focus groups also identified what might be done to increase belt use among older occupants, now and in the future.

The final stage of the project was a human factors field study that provided detailed observation and measurement of seat belt use and acceptability among older occupants. Field data collection was designed to provide the opportunity for a more quantitative approach in gathering information on issues related to comfort and convenience of seat belts for older drivers and passengers. Fifty-four older adults were exposed to six different seat belt systems and provided ratings regarding comfort, convenience, and likelihood of use. Participants also gave detailed descriptions of their experiences with the different systems, pointing out specific problems with usability and comfort. The analysis identified problem areas for countermeasure design as well as the most suitable configurations for target groups of older vehicle occupants.

The conclusions of this study on occupant protection issues among older drivers and passengers include information to support the development of strategies to increase seat belt use among older adults and ideas for future related research on this topic.

## **I. INTRODUCTION**

Over the next several decades the number of older adults in the United States is expected to grow dramatically. By the year 2030, people 65 and older are projected to constitute 71.5 million out of 364 million people or 19.6% of the U.S. population (Older Americans Update, 2006). With many older adults keeping their drivers licenses longer and driving more miles on the roadways, they are at increased risk for involvement in fatal crashes. Unless significant countermeasures are employed, traffic fatalities for older adults are projected to double or triple by the year 2030 (Eberhard et al., 2003).

In the interest of preventing crash-related injuries and fatalities within this population the National Highway Traffic Safety Administration (NHTSA) is identifying approaches to increase seat belt use among older adults. Although older adults are reported to use seat belts more than any other age group, there is still a percentage of older adults who never use seat belts or only use them part-time. Much of what we know about the reasons older adults do not use seat belts is anecdotal, including comfort and convenience, the presence of chronic health conditions such as arthritis, and resistance to seat belt use in general. Other factors attributed to low usage rates are obesity, low socioeconomic status, and race and ethnicity.

Design features of the vehicle, seat, and the seat belt may also influence belt usage by older adults. To illustrate, the source of the shoulder belt portion of the seat belt is most often located on the B-pillar and the buckle is located between the seat and seat back. Finding and using the shoulder belt and buckle can be a challenge for many older adults who are arthritic and have flexibility issues. Adjustable shoulder belts or seat belt extenders might make it easier for these occupants to access and use the seat belt as well as help older adults find a more comfortable fit and alleviate some of the pressure along the chest and waist. Documenting use patterns among older adults according to such design features may help to identify those features that are more user-friendly and are more likely to increase seat belt use among those older adults who would use the belt if some of the physical challenges were addressed.

The overall purpose of this study was to understand what factors contribute to seat belt use and nonuse among adults 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 the older adult population.

## **II. METHODOLOGY**

In order to fully comprehend the dynamics behind the decision to use or not use a seat belt various issues that may influence seat belt use among older adults must be explored. These include factors such as the physical conditions experienced by older adults, design features of the vehicle and seat belt, the weaknesses and strengths of various social marketing strategies, differences in the effectiveness of primary and secondary seat belt laws, and enforcement levels and techniques. To facilitate such an understanding, three different strategies were implemented. The first was a comprehensive review of a variety of information sources on topics related to seat belts and the older adult population. Sources of information included: literature addressing the older adult population and all factors that might affect seat belt use; informal discussions with experts in the field of traffic safety, aging, vehicle design and instrument technology, law enforcement, physical mobility and belt use; and a review of various key databases. The information review was intended to call attention to specific issues affecting seat belt use among older adults as well as reveal gaps in current research.



Following the review and based on its findings, a series of focus groups were conducted. The 15 focus groups were held in four states with older adults who travel regularly in a private vehicle and reported part-time or nonuse of seat belts. Participants represented a range of physical statures, frailties, disabilities, socioeconomic strata, and educational/professional backgrounds. Participants discussed topics relevant to seat belt use and nonuse including: issues of comfort and convenience, physiological conditions, types of trip and vehicle, presence of other passengers, media and communication tools to increase belt use among their peers, and a discussion of various seat-belt-related aftermarket devices. These focus groups pointed to a series of common issues and experiences with seat belts among this population.

In the final stage of the project, a human factors field study was conducted in which 54 older adults were exposed to six different seat belt systems. They provided ratings regarding comfort, convenience, and likelihood of use. Participants also described their experiences with the different systems, pointing out specific problems with usability and comfort. Further details on the methods and findings for each of the three stages of the study are presented in the upcoming sections of this report.

### **III. SUMMARY OF INFORMATION SOURCES**

Information regarding seat belt use by older adults, as well as reasons for nonuse, was compiled from discussions with experts in the field of seat belt use and seniors, literature sources, and various databases. A thorough literature review identified a number of topics that relate to seat belt use among older adults. These included demographic characteristics, anthropometric characteristics, physical limitations, normal belt use and seating practice, risk perception, and comfort and convenience.

Experts in the fields of seat belt use, older drivers, gerontology, occupant restraint design, and traffic safety research identified additional resources and provided descriptive information to explain nonuse among the older adult population. Additionally, databases and survey data sources including the Behavioral Risk Factor Surveillance System (BRFSS), Fatality Analysis Reporting System (FARS), Motor Vehicle Occupant Safety Survey (MVOSS), National Automotive Sampling System- Crashworthiness Data System (NASS CDS), and the Crash Injury Research and Engineering Network (CIREN) were analyzed.

The objective was to synthesize information from a variety of resources, to summarize what is known about seat belt use and identify the most important gaps in the literature. Key findings from the review are summarized below, an in-depth review is provided in Volume II Appendices.

#### *A. Demographic groups among older adults*

Seat belt use varies across different demographic groups. Women are more likely to use seat belts than men, and minorities use seat belts less often than white occupants (Glassbrenner, 2005; Lerner et al., 2001). However, while older adults repeatedly have higher usage rates than younger adults, research shows no clear differences in seat belt use across the age cohorts between 65 and 85 years (Kostyniuk et al., 2003; MVOSS, 2003; FARS, 2003).

Although numerous studies have examined the relationship between race/ethnicity and seat belt use, differences in seat belt use across various racial and ethnic groups in the older adult population is inconsistent. Using FARS and BRFSS there is some indication that seat belt use is lower among older African-Americans when compared to Whites (Cosby et al., 2003). Studies

suggest that in the African-American community part-time belt use is common (Cordy et al., 2002). Among Hispanics there is conflicting information regarding seat belt use with some studies pointing to lower usage rates among Hispanic older adults and others finding higher seat belt usage rates than White or African-American occupants (Parada et al., 2001; Harper et al., 2000; Sapolsky, 2001; Nelson et al., 1998). Some attribute the differences within the Hispanic community to country of origin, or time living in the United States (Arce et al., 2004; Stiles et al., 1999). In an observational study of Hispanic migrant farm workers in California, Stiles et al. (1999) found that only 37% wore their seat belts.

Socioeconomic status and level of education has been linked to seat belt use rates across all age groups (Cosby et al., 2003; Lerner et al., 2001; Mueller et al., 2004; Shinar et al., 2001; Wells et al., 2002). Generally, higher levels of education and income are related to higher levels of seat belt use. Although studies examining the relationship between education or income and seat belt use do not typically consider age differences, there is no reason to believe that older adults will behave differently from their younger counterparts. This argument is supported by the findings from the MVOSS (2003) and the BRFSS (2002), where older adults with higher levels of education were more likely to report using a seat belt all of the time.

#### *B. Reasons for nonuse of seat belts*

Characteristics of seat belt use among older adults are based on a variety of factors including risk perception, road type, trip length, weather, presence of other vehicle occupants, comfort and convenience, and physical conditions. While some of the factors influencing the decision to use or not use a seat belt are similar to those influencing younger adults, others are unique to the older adult population. Older passengers and drivers predate the presence of seat belts in motor vehicles, and therefore have different attitudes regarding the benefits of using seat belts. Since seat belt laws were instituted well after they began traveling in vehicles, seat belts may be viewed as a burden, and many may resent being told what to do.

Evidence on the relationship between risk perception and seat belt use by older adults is conflicted. Some experts contend that older adults are aware of their vulnerability in the event of a crash, and this awareness raises the likelihood they will use seat belts more often than younger adults. Conversely, other experts see no differences between older adults and any other age groups with regard to risk perception and seat belt use.

Type of trip including trip length, weather, and road type are common factors that affect belt use among older adults. Similar to younger adults, many older adults are more likely to use a seat belt on longer trips, in bad weather conditions, and on high-speed roadways because the perceived risk of being involved in a serious crash increases under these conditions. However, according to the National Household Travel Survey, older adults are taking fewer trips, many of their trips are short distance and local, and often they are traveling as passengers (Collia et al., 2003). All these types of trips are often associated with a perceived lower risk of crash involvement, and therefore, a lower use of seat belts.

The presence of passengers, particularly children, can raise the likelihood of seat belt use among older adults. In focus groups, older adults repeatedly mentioned that they will make a point of wearing a seat belt when grandchildren are in the vehicle to set a good example (Academy for Educational Development, 2002). In the 2003 MVOSS 93% of older adults who said they wear their seat belt because they want to set a good example for others also said they

wore their seat belt all the time. In addition, older adults indicate that they will use the seat belt upon the driver's request.

Major factors contributing to nonuse of seat belts among older adults are comfort and convenience. Complaints regarding comfort have been voiced by seniors in a variety of settings including focus groups, meetings with physicians and occupational therapists, and in response to surveys and studies (Balci et al., 2001; Steinfeld et al., 1999). Some of the common issues mentioned by older adults related to comfort and convenience include:

- Difficulty reaching for shoulder belt and pulling across the body;
- Shoulder belt cuts across neck or chokes occupant;
- Seat belt puts pressure on skin and chest;
- Difficulty inserting latch plate in belt buckle;
- Belt buckle and stalk are difficult to locate;
- Release method is confusing;
- Uncomfortable or difficult to use due to occupant girth and height;
- Desire not to wrinkle clothes.

Some of these discomforts may be alleviated by adjusting the seat belt using the height adjuster on the B-pillar available in many newer vehicle models. However, experts have noted that older adults are often unaware of this feature.

Problems with comfort and convenience may be exacerbated by the different types of physical limitations experienced by many older adults. Older adults with disabilities overwhelmingly said they do not like seat belts, finding them to be very uncomfortable and at times even painful (Steinfeld et al., 1999). Older adults who reported poorer health were more likely to report part-time belt use than older adults who indicated that they were in good health (BRFSS, 2002).

Specific physical conditions that may directly influence comfort and seat belt nonuse among older adults include:

- Arthritis, shoulder, and neck pain;
- Osteoporosis;
- Kyphosis;
- Increase in fragility due to aging;
- Presence of a pacemaker;
- Recovery from recent chest or abdominal surgery;
- Obesity; or
- Small stature.

These conditions could lead to misuse and nonuse by making it difficult for older adults to reach for the seat belt, pull it across to the buckle, and insert the latch plate into the buckle.

Misuse is common among older adults causing various belt-related injuries in crashes including lower chest and upper abdominal injuries (Cushman et al., 1990), and certain physiological conditions increase older adults' potential for crash injuries while using a seat belt.

In examining the relationship between body type (measured using body mass index (BMI)) and seat belt use, when compared to average sized older adults, both underweight and overweight older adults were more likely to indicate part-time use (BRFSS, 2002). Obese older adults are even more likely to report part-time and nonuse of seat belts.

Additional issues related to seat belt use among older adults include:

- Sex -- females are more likely to use seat belts than males;
- Marital status -- married older adults are more likely to use a seat belt than single individuals and divorcees;
- Air bag -- the presence of an air bag is positively related to seat belt use;
- Seating position -- passengers are more likely to use a seat belt in the front seat than in the rear positions; and
- Type of vehicle -- occupants of pickup trucks were the least likely to be using a seat belt (BRFSS, 2002; FARS, 2003).

### *C. Vehicle design*

Research indicates that older adults are experiencing a higher rate of fatalities and injuries in motor vehicle crashes per miles traveled than their younger counterparts. Kent and Matsuoka (2005) found that frailty and pre-existing health conditions play a role in crash fatalities in the older adult population. One of the issues related to increased fragility in older adults is their lower level of chest injury tolerance (Zhou et al., 1996), and the risk of fatality from rib fractures increases with age (Wang, 1998). When compared to younger drivers, older belted drivers are more likely to be hospitalized as a result of a crash (Cook et al., 2000).

In spite of the injuries, seat belts still have a significant positive impact on survivability in crashes and help to prevent more severe injuries among the older adult population (Coley et al., 2002). Identifying seat belt designs that may increase comfort and restraint use, and potentially reduce the injury rate is an important goal for the traffic safety community. There are various key design issues that may improve both usability and comfort of vehicle restraint systems, and therefore increase the likelihood that older adults will use seat belts. These design features include belt force limiters, belt pretensioners, dynamic optimization and different sensor systems, integrated seat belt systems, seat belt presenters, and seat belt reminder systems. These systems are either in the development phase or may be found in many of the newer vehicle models. Several manufacturers are working on advances in vehicle design with older adults and baby boomers in mind (Broge, 2001; Greene, 2004; Ehrenman, 2003). These new design features include power swivel chairs, night vision technology, and larger knobs and mirrors.

There are also a couple of promising advanced seat belt systems in the design and testing phase that may be easier to use and potentially provide additional protection for older adults in a crash. Some manufacturers are currently testing a four-point seat belt, with the potential to distribute crash forces across more of the body. Four-point seat belts fit like a pair of

suspenders with a buckle in the front. Another new design includes an inflatable seat belt, designed with sensors similar to those in air bags (Rouhana, 2003).

Finally, there are a variety of aftermarket devices that vary in their design and function. These devices improve ease of reach, pulling or buckling, or improve the fit of the seat belt, and might increase likelihood of use. The following aftermarket devices were mentioned by the experts:

- Shoulder belt pad – provides padding and prevents seat belts from chafing skin and neck;
- Seat cushion – raises the upper body for a better fit for the belt across the shoulder and hips;
- Pivoting seat – raised disk allows for easy twisting to reach for shoulder belt, raises upper body, and results in better fit for lap and shoulder belt;
- Ribbon or plastic loop – permits easier reach for the seat belt and allows occupant to pull the shoulder belt towards the body without twisting of the body;
- Seat belt adjuster – positions the seat belt so it is easier to reach for fastening and so that it is positioned on the shoulder and doesn't chafe the neck; and
- Seat belt extender – extends the buckle so that it is easier to fasten the seat belt.

Original vehicle manufacturers must certify that their seat belt systems conform to requirements specified by Federal Motor Vehicle Safety Standards that are designed to protect vehicle occupants. It is important that no aftermarket device be used that would detract from the injury protection properties contained in those Standards. An aftermarket device should not interfere with any of the following: the lap belt fitting over the hips and not the abdomen, the shoulder belt lying on the chest and over the shoulder, and removal of any slack from the belt.

#### *D. Media and education campaigns*

There is no one program specifically targeted at promoting seat belt use among older adults. Rather there are programs and media campaigns such as *Buckle Up America* that are designed for the general public and intended to include older adults as part of the target population, or programs designed to promote safety for older drivers that include brief references to seat belts.

Among the programs developed to target the older adult population is the American Association of Motor Vehicle Administrators (AAMVA) GrandDriver program which included earned media, a speakers bureau, Web site, and toll-free informational telephone line. The GrandDriver brochure focused on the basic rules of driving including the instruction to always use a seat belt as well as descriptions of assistive features in the vehicle including height adjustable seats and seat belt anchors. GrandDriver media kits are now offered to States; however, the exposure and effects of the GrandDriver campaign are unknown.

The CarFit program, a 20-minute assessment of older drivers in their motor vehicles, was developed by the American Society on Aging, AAA, AARP, and the American Occupational Therapy Association in partnership with occupational therapists and other experts in the field of older driver research. The program uses an assessment tool, a checklist, which includes a line item on seat belt use. This line item instructs the assessor to check for misuse and ease of use of the seat belt. Among the material distributed to the older driver is a section under safety procedures that specifically addresses seat belts. CarFit was pilot tested in 10 cities in the

spring of 2005 with more than 300 older drivers. Findings indicated that the program was effective in improving the fit and conditions for older drivers in their vehicles (ASA Web site: [www.asaging.org/asav2/carfit/](http://www.asaging.org/asav2/carfit/)). The CarFit program is now being implemented across the country.

Driver refresher training is another method by which information on seat belts and safe driving is being disseminated to older adults. Driver education is provided via various organizations including AAA and the AARP. Driver refresher training, videos, and material include information on seat belt use. AARP also includes a clip on methods to adjust the seat and belt so that the belt will fit properly. These courses are often connected with reductions in insurance rates and are therefore attended by many older adults.

The Gerontology Institute at the University of Massachusetts recently completed a study on "Promoting Safe Mobility Among Elders by Increasing Awareness of Vehicle Modifications." The project included focus groups, a video demonstration, and surveys. In the video, older drivers model the use of low-cost aftermarket devices to improve safe and comfortable driving. Many of the aftermarket devices mentioned by occupational therapists and driver rehabilitation therapists were included in the video. Those older adults who watched the video indicated that their awareness of adaptive features had increased and some indicated that they purchased one or more of the features described (Van Ranst et al., 2005).

NHTSA, AAA, and other organizations have developed brochures for older adults on safe driving. Much of this material mentions seat belts, although none specifically focus on this issue. Web sites tailored to older adults on safe driving are in place under the management of AOTA, the National Association for Area Agencies on Aging, American Medical Association, AAA, and AARP. Seat belts are featured on these Web sites, including admonitions to use belts, but these sources do not provide detailed guidance on how to improve the comfort or fit of a seat belt. Information specifically tailored to occupant restraint use among older adults is not available.

#### **IV. FOCUS GROUPS**

The focus group effort had two general objectives. First, it served as a useful qualitative method to explore a variety of key issues that influence seat belt use and nonuse among older adults. The group discussions provided a better understanding of what behaviors, attitudes, and physical limitations contribute to nonuse of seat belts among adults 65 and older. Second, it helped to direct the development of the subsequent in-vehicle study, and identified what might be done to increase belt use among older occupants, now and in the future.

##### *A. Site selection*

A total of 15 focus groups were conducted in four sites located across the country. One site was local to the Westat home offices in Rockville, Maryland. The remaining three sites were selected using Census data to identify States with larger numbers and percentages of older adults in their populations. States were also selected to represent different regions of the country, which allowed for the capture of responses that might vary by region. The four sites were:

- Miami, Florida - The State with the largest percentage of older adult residents (16.8%), an active senior community, and a warmer climate.

- Cedar Rapids, Iowa - The State has one of the highest percentages of older adults (14.7%), is located in the central region of the country, and has many seniors who remain in place upon retirement, often in rural communities.
- Boston, Massachusetts - Traditionally, one of the “older” States (13.3% of the population is over 65), many seniors live independently, and Massachusetts experiences extreme winters.
- Rockville, Maryland – Relative to the other 3 States, this State has a smaller percentage of older adults (11.4%), with 37% of seniors living alone. This State was selected in accordance with the contract which required a series of focus groups to be conducted local to Westat home offices.

In Maryland, Westat executed all necessary preparatory and logistic activities to conduct the focus groups. Focus group facilities were engaged in each of the remaining States to recruit and host the four focus groups. Project staff acted as the moderators at all focus groups.

### *B. Participant sample*

Each of the focus groups had between 8 and 12 participants. Participants were recruited through advertisements in local newspapers and flyers posted in facilities frequented by older adults (senior retirement communities, senior centers, and community centers). Some recruiting was conducted on site at various community centers and senior living facilities. All advertising material referred to a discussion on “transportation issues for seniors (age 65+) traveling in a personal vehicle at least once a week.” When potential participants called in response to the advertisements or flyers, they were given a brief screening that collected information on age, sex, race, driving practices, health issues, and seat belt use.

All participants were older adults who drive or ride in a passenger vehicle on a regular basis at least once a week. Participants admitted to at least part-time belt use in response to a question regarding how often they use a seat belt or a query regarding the last time they did not use a seat belt.

In order to encourage thorough and detailed discussions of several topics that might contribute to nonuse by older adults, participants from the general senior population were recruited for some focus groups while other focus groups targeted participants of a specific age range, race, or physical limitations (arthritis, bursitis, osteoporosis, recent chest/abdominal surgeries, or other dexterity issues). Identifying participants for the various groups was based on research indicating that age, race, and physical limitations may all be correlated with seat belt use among older adults (Cordy et al., 2002; Balci et al., 2001; Steinfeld et al., 1999). The 15 focus groups were divided into two age groups, participants 65 to 79 (9 groups) and participants 80 and older (6 groups). Specific demographic groups included *Impaired Groups*, with individuals who have physical limitations that interfere or affect their daily living activities, *African-American Groups* and *Hispanic Groups*. The physical and demographic breakdown of the 15 focus groups is provided in Table 1.

<b>Table 1: Physical and Demographic Characteristics Of the 15 Focus Groups</b>		
	<b>Age</b>	
	<b>65-79 Years Old</b>	<b>80+ Years Old</b>
<b>Unimpaired</b>	3 Groups	2 Groups
<b>Impaired</b>	2 Groups	2 Groups
<b>Hispanic</b>	2 Groups	1 Group
<b>African-American</b>	2 Groups	1 Group

### *C. Procedures*

The focus groups followed a structured question path (see Appendix A) led by a moderator. Each focus group was 1 ½ to 2 hours long and was audio-taped for review and analysis. The introduction indicated NHTSA sponsorship and presented the topic of older adults and seat belts. The moderator emphasized the need to discuss, in a non-judgmental way, their honest opinions and what they actually do with regard to using seat belts, rather than what they consider ideal or socially acceptable behavior.

The discussion began with an “ice breaker” question. Participants were asked to introduce themselves and respond to the question, “Can you tell me what comes to mind when you hear the words ‘seat belt’?” The ice breaker gave everyone in the room a chance to introduce themselves and directed the attention of the group to the topic at hand. The moderator then proceeded to guide participants through a range of topics related to seat belt use. At the end of the focus group meeting participants were reimbursed for their time.

### *D. Topics*

The focus group topics included issues related to seat belt use and nonuse discovered as being important to older adults during the literature review and discussions with experts. Each topic was introduced as a series of questions by the moderator.

The major focus group topics were:

- Comfort – seat belt features that are comfortable or uncomfortable;
- Convenience – difficulties reaching, buckling, and unbuckling;
- Physiological conditions – physical conditions that make seat belt use difficult or uncomfortable to use;
- Decision-making process – primary reasons participants choose to use or not to use a seat belt;
- Ideas for increasing comfort and convenience – discussion on better seat belt designs;
- Experiences with others and seat belts – riding with others including adults, seniors, and children; and
- Countermeasure proposals – review of various countermeasures including use of media outlets and other types of grassroots efforts.



### *E. Presentation of aftermarket devices*

The final minutes of each session were devoted to a presentation of various aftermarket devices. The devices presented in the focus groups were identified in the literature review stage of this project, and included shoulder belt pad, seat cushion, pivoting seat, ribbon or plastic loop, seat belt adjuster, and seat belt extender. The moderator began the discussion on the aftermarket devices by clarifying that these products are not endorsed by NHTSA and that these devices are of interest because they may be used to increase comfort and usability of seat belts.

These devices were selected for demonstration because they are either currently used by older adults or were recommended by occupational therapists or driver rehabilitation experts as devices that may improve comfort and ease of use of seat belts (Van Ranst et al., 2005). All of the devices, with the exception of the seat belt extender, which must be obtained directly from the vehicle manufacturer, are sold in a variety of catalogs and automobile equipment stores.

### *F. Key findings*

Several major themes emerged during the focus group discussions. The major themes were specific broad concerns that stood out based on commonality among the focus groups, the intensity of the discussion, the diversity of the described behavior, or significance of the issue. This section highlights the key findings and opinions voiced by the participants.

Participants had mixed opinions in response to the “ice breaker” regarding what comes to mind when the term seat belt is mentioned. While many of the individuals initially spoke of safety and protection, others were more negative in responding to the question, using words such as “restrained,” “constricted,” “nuisance,” “uncomfortable,” “harness,” “policemen,” or “ticket.” Some statements were more severe, including:

*It's an infringement on my privacy (MD 80+ Unimpaired Group).*

*Feels like I'm being decapitated (IA 65-79 Impaired Group).*

#### *Comfort*

In general, most participants spoke of the discomfort associated with twisting and turning to reach for and buckle the seat belt. Others described numbness or a pain in their extremities that they related with sitting immobile with the seat belt secured.

A number of smaller-statured women complained about the shoulder belt chafing, choking, or rubbing across their necks. The pressure on the neck proved to be extremely uncomfortable and even painful for some women. One woman described an allergic reaction to the material in the seat belt causing chafing along her neck. Some of the participants sought ways to remedy the discomfort by using seat belt covers, clothing pins or adjusters to hold the shoulder portion of the belt away from their neck, or cushions to boost themselves up so the shoulder portion of the belt may fit better.

Heavier participants mentioned problems using the seat belt as well as discomfort or tightness felt around the waist once secured. Some participants noted that seat belts are not long enough for larger people and are often uncomfortable and tight when secured. In addition, some of the older model vehicles have seat belts that tighten as you ride (automatic locking retractors). This

increases the tightness which adds to the discomfort. Some of the heavier participants were embarrassed about their experiences, while others were more open to discussing their difficulties with using the seat belt. Participants also described providing rides to overweight older adults who have difficulty with seat belts due to their girth.

The effects of weather were brought up in some of the focus groups. In Florida there was discussion about the seat belt material chafing the skin in the heat. On the other hand, participants in Maryland, Iowa, and Massachusetts talked about the difficulty and discomfort associated with using a seat belt while wearing bulky winter coats.

While some of the participants chose not to use their seat belts at all, a number of individuals spoke of various techniques used to alleviate pain and discomfort. These techniques included holding the shoulder belt away from the body, loosening the straps, moving the shoulder belt portion behind the upper body, securing the seat belt behind them and then sitting on it, as well as using various assistive devices including covers, pillows, and cushions.

### *Convenience*

Most participants mentioned a variety of challenges associated with reaching, pulling, buckling, and unbuckling the seat belt. A number of participants had difficulty reaching back for the shoulder belt. They complained about shoulder pain or difficulty twisting when reaching for the shoulder belt. Often, participants complained about the belt locking up midway through the buckling motion, and needing to start over which is very frustrating for them. In some cases the seat belt twists while being pulled and will not fasten, requiring them to start over with the entire process.

Many participants mentioned problems inserting the latch into the buckle portion of the seat belt. They noted difficulty finding the buckle as well as inserting the latch. For some participants unbuckling is problematic because the buckle is difficult to locate, and once they locate the buckle, it is difficult to release the latch from the buckle. These difficulties may result in an individual giving up on using the seat belt entirely or requesting assistance from other occupants which may be awkward and embarrassing.

*Terrible, I finally have to ask somebody to do it (unbuckle seat belt). It's embarrassing, awfully embarrassing (MA 80+ Impaired Group).*

Unfamiliar vehicles pose additional challenges. The source of the shoulder belt, the location of the buckle, and release mechanism in the buckle all vary across vehicle types. When in an unfamiliar vehicle, older adults identify more trouble with locating and putting on a seat belt. Many participants felt that the seat belt system should be standardized across all vehicles so, for example, the release mechanism for the buckle is in the same location in all vehicles.

One participant in Iowa was a habitual user of para-transit transportation. She repeatedly mentioned that the seat belts in para-transit vans are often difficult to access and use although they are required. She finds it embarrassing when the para-transit access driver needs to provide assistance.

Most of the participants do not use their seat belts in the rear seat. They felt seat belts in the rear passenger seats are both harder to find and more difficult to buckle. In many vehicles the buckle is recessed back between the seat and the seat back which makes it difficult to find and use.

### *Physiological conditions*

Older participants mentioned a number of physical conditions that either make it difficult for them to use the seat belt or prevent them from using the belt entirely:

- Arthritis, shoulder, or neck pain - These conditions make it difficult to twist, reach, pull, and buckle the seat belt. A number of the participants had full range of motion with only one arm which affects their ability to buckle up in either the driver or passenger side. In some cases the participants require assistance to buckle up. That is, on days when their arthritis or bursitis is “acting up” they cannot successfully buckle themselves, and need assistance from another passenger. Alternatively, some provide assistance to other seniors who have these conditions and need help buckling up.
- Recent surgery - A few participants had surgery in recent years or provided rides to seniors post-surgery and were able to describe the difficulties with belt use for this population. Surgeries that adversely affect seat belt use include shoulder, open heart, breast, and hip replacement surgeries. People who have recently had surgery near the chest experience pain and discomfort from the shoulder belt pressing on the chest. Others had surgery on their shoulders which limits their range of motion and impairs their ability to reach for shoulder belts. Finally, some participants stated that hip replacement made twisting to reach for the shoulder belt and buckle uncomfortable. Some participants found methods to alleviate discomfort including using the lap belt only, a cushion between the shoulder belt and chest, or loosening the shoulder belt by holding it away from their chest.

*When (husband) had this heart surgery, he had great difficulty with that tightness across his chest (MD 80+ Unimpaired Group).*

- Pacemakers - A few participants have a pacemaker or provide rides to seniors with pacemakers. These individuals complained the shoulder belt pressing on the area of the chest with the pacemaker causes additional discomfort.
- Asthma - There were a few participants who noted that the tightness of the shoulder belt causes shortness of breath or asthma attacks.

Across the various focus groups a number of participants mentioned that doctors can provide patients with a note to show to law enforcement in the event they are pulled over for not using a seat belt. The note simply states that for medical reasons the occupant cannot use a seat belt. A number of participants have received such a note in the past or knew of friends and acquaintances who had one.

### *Decision-making process*

Participants mentioned a number of reasons for increased belt use in recent years including personal experiences in crashes or of family members in crashes, mandatory seat belt laws, increased enforcement, receiving a citation, and reminders from friends and family. Additional factors that increase seat belt use are driving on high-speed roads, in heavy traffic, or in inclement weather.

Individuals mentioned a variety of reasons for not using a seat belt including the wish to be carefree, inherent laziness, stubbornness, the inconvenience of buckling and unbuckling every

time they need to get into and out of the vehicle, and not having to use seat belts when they were younger.

Because it is not their habit to put on their belts immediately, participants often said they simply forget to use their seat belts at the start of trips. When reminded by other passengers, drivers, or the seat belt reminder system they will put on their belt. These participants were more likely to advocate for various reminders in the vehicle including buzzers (belt reminder systems) and automatic seat belts.

Participants were least likely to use a seat belt when on short trips, or when riding along familiar, local, or low-speed roads. A short trip ranged from simply driving from one end of a shopping center parking lot to the other or as long as several miles within their communities. Many of the participants in the Iowa focus groups believed driving on rural roads or in the fields is less risky and thus they are less likely to use a seat belt. In addition, participants mention that they will not use a seat belt within the confines of their retirement communities or within a gated community. They believe State seat belt laws do not apply within the walls of the community, and also feel that they are at less risk of having a severe crash because the speed limits in the development are often 20 mph or below and there are many stop signs. Conversely, some of the participants noted that on long trips the seat belt becomes uncomfortable, and they will attempt to adjust, loosen, or simply remove the seat belt.

In Massachusetts, a secondary seat belt law State, there was some discussion regarding the fact that lack of a mandatory law decreases their likelihood of using a seat belt. In fact they interpreted the secondary law as allowing a person to choose whether or not to use a seat belt. Participants were quick to note that they are much more careful about using a seat belt while driving through Connecticut (a primary seat belt law State).

*I don't think it should have been optional because I think if you have a law it shouldn't be you can wear it if you want to (MA 65-79 African-American Group).*

Most participants agreed that in towns with strict enforcement policies or during seat belt enforcement campaigns they are more likely to buckle up. Many of the participants believe that seat belts are not needed in the back seat, because it is safer. In fact a number of individuals mentioned that, unlike in the front seat where you can be injured by an air bag or the windshield, in the rear seat the front seat will cushion you in the event of a crash.

While some participants indicate that seat belts provide safety "most of the time," in each of the four States, focus group participants mentioned a fear of being trapped in their belts in the event of a crash. Many felt that they would not be able to release the seat belt and might be trapped in the vehicle. In Florida this apprehension is directly related to the canals that run along the roadways and the participants there all expressed a strong fear of being trapped in the vehicle and drowning. Other participants mentioned that often an individual is knocked unconscious, and therefore, may not be able to extricate himself. Some participants suggested that seat belts automatically retract after a crash or after the engine is turned off.

Many of the participants did not like to use seat belts when they were wearing nice clothing. On these occasions they are more apt to hold the shoulder belt away from their bodies or not use them at all in order to prevent wrinkling. Participants cited church and other activities when they have on fancy dresses, beading, corsages, or jewelry. In one group Hispanic men complained about how seat belts wrinkle their guayaberas (linen shirts).

### *Ideas for increasing comfort and convenience*

Most participants advocated for the use of softer, more comfortable fabric for the seat belt design. Many believed that a softer material would resolve many of the comfort issues such as rubbing against the neck and clavicle.

Many thought better adjustments for the shoulder belt and seat would also assist in increasing comfort. Participants believed that having better adjustments for the shoulder belt and seat would allow them to achieve a customized and comfortable fit. The participants talked about new designs including automatic seat belts, and suspender-style seat belts. They had mixed opinions about these designs. While some felt these designs would help them to use the belt and increase comfort, others felt it would not increase their likelihood of use and would even be more cumbersome. Ignition interlocks were seen by some as a foolproof method to get people to use their seat belts; other participants thought this method would be invasive or dangerous. Some participants were familiar with automatic seat belts; however several considered them startling or unpleasant. Finally, a number of participants claimed that comfort was not the main issue, belt use is more a matter of habit and until it becomes a habit there is always a chance that a person will not use a seat belt.

### *Experiences with others and seat belts*

Participants were quick to note they are more likely to use a seat belt as passengers. Some individuals will use a seat belt when asked to by the driver either because they were “reminded” or out of respect for the driver’s wishes. Others are more likely to use one because they do not trust the driver’s abilities.

Interestingly, when participants learned that the driver of the vehicle is responsible for the passenger’s belt use, all said they would be more careful about using seat belts. Participants did not want to be responsible for drivers being cited for seat belt violations. In addition, many said they were more likely to buckle up in the presence of grandchildren or children so as to serve as role models. Participants noted that children are very quick to remind them to buckle up and are much more used to seat belts.

The younger set of focus group participants (age 65-79 years) discussed providing rides to seniors older than themselves. When providing rides to others, participants often encounter physical limitations that affect the older passengers’ seat belt use. Arthritis, obesity, post-surgery, as well as various other impairments and ailments often impede older adults’ ability to easily use their seat belts. Many of the participants found themselves having to assist their older relatives and friends.

*I’m older but I have older friends and it’s difficult for them to even get into the car. So you’ve got to help them in and then you buckle them up.... I don’t think they could have put the seat belt on themselves (MA 65-79 African-American Group).*

### *Perceived effectiveness of countermeasure proposals*

During the course of the focus group participants were asked for suggestions on how to communicate the importance of using seat belts to the older adult population. As members of AARP, many read the organization’s magazines and newsletters, and believed the magazines and letters to be good venues for communicating with the older adult population. Many of the

older participants felt that national campaigns are targeted at younger adults and therefore they ignore their message. In order to get the attention of older adults, they believed a campaign needs to focus on their generation and also suggested a more grassroots approach. Other venues mentioned include insurance companies' newsletters, senior center programs, health fairs, and various social events. Participants also recommended monetary incentives such as lower insurance premiums.

When trying to convey the message, participants overwhelmingly voiced interest in real-life images and stories of people who were in a crash and survived because they were restrained or died as a result of being unrestrained, rather than just using statistics. However, some did agree that numbers of fatalities or crashes may be included alongside the personal anecdotes. The importance of using large-size text was mentioned. Television and radio, specifically local news shows, are viewed by participants as the most effective. In the case of Hispanic participants they recommended using Latino channels.

Most of the participants would be interested in attending a CarFit type event, where drivers are reintroduced to their vehicles and their different features. However, some said that it would not be a good idea to compare the CarFit event to child-seat-fitting stations.

#### *Presentation of aftermarket devices*

The presentation of various aftermarket devices to increase comfort and usability of seat belts received extremely positive feedback. A number of participants wanted to know where they could purchase these items and if they are considered "safe." Participants said that not only were these devices likely to increase their comfort but they believed they would be more inclined to use their seat belts. Many of the smaller-stature participants who complained about the seat belt chafing at the neck were interested in the seat belt pad or seat belt adjuster. The shoulder pad was made of felt or sheepskin and wraps around the shoulder belt and minimizes chafing, while the adjuster moves the shoulder belt away from the neck.

A few heavy-set participants expressed an interest in the seat belt extender, assuming that it would minimize the tightness around the waist line and enable them to find the buckle more easily.

A number of the participants already own and use some of these devices. A few of the participants created their own shoulder belt pad, ordered extenders from their dealerships, or use seat cushions. The participants noted that they learned about the devices from friends or family members, and in some cases their children purchased devices for them. Those devices which raised the most interest included the shoulder belt pad, the plastic loop, and the seat belt extender. All three were incorporated into the field data collection study that followed the focus groups.

During the course of the focus groups many participants repeatedly came back to discomfort as a major reason for not using seat belts or using them incorrectly. Many participants attempted to maneuver the belt (hold the belt away from body, place shoulder belt behind upper body) or introduce devices (seat belt covers, clothes pins, cushions) that would address some of the sources of discomfort. With that in mind Westat designed a field data collection effort that specifically investigated various types of seat belt systems and their effect on seat belt use on the older adult population.

## V. FIELD DATA COLLECTION

The field data collection was designed to provide a more quantitative approach in gathering information on issues related to comfort and convenience of seat belts for older drivers and passengers. The procedures and design of the in-vehicle study were based on the results of the literature review, discussions with experts, evaluation of existing data sources, and the focus groups. The in-vehicle study allowed for careful examination of older occupants operating seat belts in various vehicle-seat configurations. A controlled experimental approach was applied, in which specific variables of interest were selected for evaluation.

The primary objective was to examine the relationship between seat belt system characteristics and user characteristics in determining comfort and convenience, and relating these factors to the likelihood of seat belt use. The participants provided ratings on the comfort and usability of various seat belt configurations, and responded to open-ended questions addressing specific seat belt configurations and features (see Appendix B for the Field Data Collection form).

### A. Selection of seat belt systems

The study consisted of six seat belt systems selected to provide a diversity of belt configurations, seat types, seat adjustability, and vehicle types. The three test vehicles varied in size. Features of the systems in the vehicles selected for this study are described below:

- Compact vehicle – In the particular model used, the shoulder belt descends from the B-pillar. The shoulder belt has an adjuster on the B-pillar. The seat belt buckle stalk extends from the seat in proximity to a relatively small center console. The latch plate was able to slide along the lap and shoulder belt. The vehicle had manual seat adjustments and a smaller cabin.
- Mid-size vehicle – In this particular model the shoulder belt descends from the B-pillar; in this two-door design the B-pillar is substantially further back than in a four-door design. The seat belt buckle stalk is recessed in the seat alongside a large console that descends to the floor of the vehicle. The latch plate was able to slide along the lap and shoulder belt. The vehicle had both manual and automatic seat adjustments.
- Full-size vehicle – In the model used the shoulder belt originates from the retractors attached to the front passenger seats. The seat belt buckle stalk protrudes from the seat in proximity to a medium-sized center console. The latch plate was sewn directly onto the straps of the lap and shoulder belt, making it stationary on the belt and requiring a very specific angle in order to be able to insert the plate in the buckle. Automatic adjustments and integrated seat belts with retractors attached to the driver and right-front passenger seats.

Participants experienced a total of six seat belt systems. Each test vehicle was experienced twice, once with the original belt system and once with a modified belt that included one of three aftermarket devices (seat belt extender, plastic loop, or shoulder pad). These devices generated considerable interest among the focus group participants. Each aftermarket device was paired with one of the three vehicle systems. The six seat belt systems were as follows:

- Compact
- Compact/Seat Belt Extender

- Mid-Size
- Mid-Size/Plastic Loop
- Full-Size
- Full-Size/Shoulder Pad

Each aftermarket device was paired with the one base system for which it was likely to be most effective in increasing comfort and usability of the seat belt system. The plastic loop was paired with the two-door mid-size vehicle to facilitate reaching for the seat belt. The shoulder pad was paired with the integrated seat belt system in the full-size vehicle to reduce chafing to the neck. The seat belt extender was paired with the compact vehicle to assist with buckling, especially in the case of the rear seat. The devices were not rotated among the different systems due to the limited number of data collection trials possible in the time frame of the study. Even with the limited number of trials, the in-vehicle task typically took between 90 minutes and 120 minutes to complete, and the length raised serious concerns regarding participant fatigue. Although this design may have resulted in a possible confounding effect of the vehicle base seat belt system on the utility of a particular aftermarket device, the findings may suggest that for some older adults, improving comfort and usability of the various seat belt systems might increase the likelihood that they will use them.

### *B. Participant sample*

All of the participants were recruited in the greater Washington, DC, area. Recruitment efforts targeted nonusers and part-time users who traveled in a personal vehicle at least once a week. A total of 54 test subjects participated in the study. Based on information gathered from literature review as well as findings from the focus groups, selected subgroups of older adults with various physical limitations were targeted for inclusion in the field study. The most common limitations cited by older adults were arthritis, flexibility issues, bursitis, osteoporosis, recent chest or abdominal surgery, pacemakers, weight, and stature. Participant characteristics were identified using a screener, similar to that used in recruiting for the focus groups.

### *C. Design and procedure*

The study used a three-factor experimental design with one between-subjects factor (participant group) and two within-subject factors (seat belt system, seating location). Data were collected for two seat locations, driver and front seat passenger, for all six systems. Data were collected for two systems in the rear left seating position in one of the vehicles (compact). All of the test vehicles had the same type of rear-seat belt system, the shoulder belt was integrated into the seat back (as opposed to a pillar on the side of the vehicle) and the buckle deeply recessed between the seat and the seat back. Given that many older adults have difficulty maneuvering into and out of the back seat and in order to keep the session to a reasonable length, data for the rear seating position were collected in only one vehicle.

Passenger data were collected for all participants, driver data were only collected for those participants who were active drivers. Therefore, each participant who was an active driver had 14 data collection trials and each non-driver ( $n=1$ ) had 8 data collection trials. The order in which participants encountered the various seat belt systems was randomized and counterbalanced to preclude any effects of sequence.





















































































































