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Validity of Self-Reported Data on Seat Belt Use:
The Behavioral Risk Factor Surveillance System

A dissertation

presented to

the faculty of the Department of Educational Leadership and Policy Analysis

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Doctor of Education

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by

Agnes Mary Banks Samples

May 2004

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Keyword: Behavioral Risk Factor Surveillance System

ABSTRACT

Validity of Self-Reported Data on Seat Belt Use:

The Behavioral Risk Factor Surveillance System

by

Agnes Mary Banks Samples

Personal lifestyle and behavior are associated with the 10 leading causes of death for Americans. Motor vehicle crashes kill more than 40,000 people and injure more than 3 million people annually in the United States, representing one of America's most serious health and economic problems. According to the National Highway Traffic Safety Administration (NHTSA), someone in America is injured in a motor vehicle crash every 14 seconds and someone is killed every 12 minutes (as cited in Ad Council, 2003). It is widely accepted that increased use of safety belts and reductions in driving while impaired are two of the most effective means to reduce the risk of death and serious injury of occupants in motor vehicle crashes.

The Centers for Disease Control and Prevention (CDC) and NHTSA monitor the use of seat belts by surveying the population. The CDC annually conducts a telephone survey called the Behavioral Risk Factor Surveillance System (BRFSS). The NHTSA conducts an observational survey called the National Occupant Protection Use Survey (NOPUS).

The purpose of this study was to examine three questions when estimating safety belt use in the United States: (1) Does the BRFSS differ from NOPUS? (2) Is there regional variation in the differences between BRFSS and NOPUS? (3) Do BRFSS and NOPUS data differ significantly depending on whether the safety belt law is primary, secondary, or none?

In this study, the two surveys were compared. Three research hypotheses were tested in the null format at the .05 level of significance using a two-tailed test. The *z* test was used to determine the difference in the nominal data of the two independent proportions.

The results of the study revealed that there is a difference between the self-reported BRFSS survey and the NOPUS observational data.

DEDICATION

This dissertation is dedicated to my beloved late mother, Agnes Mary Lowe Banks; my father, Billy Bruce Banks; my siblings, John, Greg, Janey, Andy, Lisa, Bruce, Stephanie, and Linda; my husband, Henry; and to his late parents, Burl and Gertie Samples.

Your enthusiastic support, encouragement, and grand sense of humor have made this dissertation possible.

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To all of you I extend my deepest gratitude.

CONTENTS

Chapter Page

Chapter Page

LIST OF TABLES

CHAPTER 1

INTRODUCTION TO THE STUDY

Personal lifestyle and behavior are associated with the 10 leading causes of death for Americans. Motor vehicle crashes kill more than 40,000 people, injure more than 3 million people annually in the United States, and represent one of America's most serious health and economic problems. According to the U.S. National Highway Traffic Safety Administration (NHTSA), someone in America is injured in a motor vehicle crash every 14 seconds and someone is killed every 12 minutes (as cited in Ad Council, 2003). The Progressive Auto Insurance Survey reported that the economic cost for each crash fatality in 2000 was more than $977,000 and an average of $1.1 million for each critically injured person (as cited in Buckle Up America, 2003). Research shows that it is almost nine times safer to wear your safety belt (Click It or Ticket, 2003). The Fatality Analysis Reporting System indicated that 70% of people injured in motor vehicle crashes in 2001 were unrestrained (as cited in Buckle Up America).

In 1966 with the passage of the Highway Safety Act and the National Traffic and Motor Vehicle Safety Act, the National Highway Safety Bureau was created, which later became the National Highway Traffic Safety Administration (NHTSA, 2004). Under the Department of Transportation, NHTSA is responsible for reducing deaths, injuries, and economic losses resulting from motor vehicle crashes by investigating safety defects in motor vehicles. Responsibilities also include setting and enforcing fuel economy standards, helping states and local communities reduce the threat of drunk drivers, investigating odometer fraud, establishing and enforcing vehicle anti-theft regulations, providing consumer information on motor vehicle safety topics, and promoting the use of safety belts and child safety seats and air bags (NHTSA).

In 1994, NHTSA began conducting a yearly seat belt survey called the National Occupant Protection Use Survey (NOPUS), which is an observed assessment of the nation's belt

use. The NOPUS observational survey, based on a probability sample, is called the Moving Traffic Study (Glassbrenner, 2002a).

Today, most states have enacted seat belt mandatory use laws aptly named primary enforcement and secondary enforcement. Primary enforcement allows police officers to stop and cite motorists simply for not wearing seat belts. With secondary enforcement, motorists must be stopped for another reason in order to receive a seat belt citation (Glassbrenner, 2002a). New Hampshire is the only state that has not enacted legislation requiring occupants over age 18 to use seat belts (Glassbrenner, 2002b).

Each state's transportation department is responsible for conducting its own observational survey but must meet the criteria established by NHTSA. The data are then reported to NHTSA for analysis. NHTSA does not publish the data from the Moving Traffic Study but will release the microdata when requested (Glassbrenner, 2002a).

As a means for monitoring and assessing the nation's health since 1984, the U.S. Department of Health and Human Services, Centers for Disease Control, and the National Center for Chronic Disease Prevention and Health Promotion have sponsored the Behavioral Risk Factor Surveillance System (BRFSS) (Nelson, Holtzman, Bolen, Stanwyck, & Mack, 2001). The BRFSS is the world's largest telephone surveillance system that measures health-risk behaviors.

The BRFSS assesses and monitors the health of civilian, noninstitutionalized persons 18 years of age and older who reside in households with telephones. Each state health department is responsible for conducting the BRFSS survey each month and reporting the information to the Centers for Disease Control for editing, processing, weighting, and analyzing. The survey consists of a core set of questions asked in all states, standardized optional questions on selected topics that are administered at each state's discretion, a rotating core of questions asked every other year in all states, and state-added questions developed to address state-specific needs. Questions cover behavioral risk factors (for example, alcohol and tobacco use), preventive health

measures, HIV/AIDS, health status, limitation of activity, and seat belt use; these topics are associated with five of the leading causes of death of Americans: heart disease, cancer, stroke, chronic obstructive pulmonary disease, and unintentional injuries (*15 Leading Causes of Death*, 2001).

Statement of the Problem

Does it matter where one lives, or whether one's state has strict enforcement of highway laws? Does social desirability (the desire to look good) influence self-reported seat belt use? The BRFSS, the world's largest telephone survey system, employs a self-report approach to collecting data whereby measures are subject to several forms of error. Social desirability may influence the self-reported measure when states adopt strict legislation amongst adult drivers as it relates to seat belt use. In general, most governments, health promotion and prevention planners, and educators accept self-reports of seat belt use, but bias in these reports is problematic and caution in their use and interpretation is encouraged. The purpose of this study was to examine the validity of the BRFSS by comparing its measure of seat belt use with the measure of seat belt use obtained by National Highway Traffic Safety Administration's (NHTSA, 2004) National Occupant Protection Use Survey (NOPUS).

Research Questions

The purpose of this study was to explore the following questions when estimating safety belt use in states:

1. Does BRFSS differ from NOPUS?
2. Is there regional variation in the differences between BRFSS and NOPUS?
3. Do BRFSS and NOPUS data differ significantly depending on whether the safety belt law is primary or secondary, or none?

Hypotheses

1. There is no significant difference (alpha = .05) between subjective (i.e., self-reported) BRFSS 2002 and objective NOPUS 2002 measures of seat belt use in binary response (observation) form (i.e., "always use" or "never use" and "wearing" or "not wearing" respectively).
2. There is no significant difference (alpha = .05) within the four U.S. census regions (Northeast, South, Midwest, West) with regard to the BRFSS 2002 subjective (i.e., self-report) measure of seat belt use in binary response form (i.e., "always use" and "never use").
3. There is no significant difference (alpha = .05) between the two types of state legislated seat belt enforcement (primary or secondary) with regard to the BRFSS 2002 subjective (i.e., self-report) measure of seat belt use in binary response form (i.e., "always use" and "never use").

Significance of the Study

The BRFSS has many uses including planning of public health programs and facilities that could be improved by identification and attenuation of self-report error. For a number of years, researchers have indicated the need for further study on the BRFSS. This study could be instrumental for those persons involved in health promotion and prevention and education programs, particularly as it relates to injury prevention. The data provided in this study could be valuable in planning seat belt use programs by broadening the knowledge base related to the use of seat belts in geographic regions and information for states with different seat belt use legislation. This study could further inform officials at all levels of government.

In addition, policy makers, state health agencies, community health centers, and other public health leaders might be informed by the results of the study. The BRFSS data provide longitudinal state-by-state comparisons and are often used by media and state health departments

to inform the public about health risks. The BRFSS is adaptable for use in any health field. Once the system's data are collected, the results can be used to publish scientific articles in professional journals, educate the public, benefit health research, and improve public health strategies.

This was a timely opportunity to reexamine the validity of the BRFSS measurement for seat belt use. Since Nelson's study in 1996 (Nelson, 1996b), the United States experienced two national events that transformed the nation and changed how its inhabitants viewed personal safety and homeland security. "Where were you when the world stopped turning on that September morn?" These are the words country music singer Alan Jackson sang to help Americans cope with hurt they felt on the morning of September 11, 2001. Nearly everyone remembers where they were when Pearl Harbor was bombed and where they were when President John F. Kennedy was assassinated; now, everyone remembers where they were when New York City's twin towers burned and fell to the ground.

As a result of the terrorist attack in New York City, President George W. Bush coined the phrase "homeland security" when he announced on June 6, 2002, that he would create a new cabinet department for domestic defense. As this new department set national color-coded risk levels and urged Americans to buy duct tape and plastic sheeting to ward against the release of weapons of mass destruction, personal safety was on the forefront of everyone's mind.

Dale Earnhardt, Sr., a National Association for Stock Car Auto Racing (NASCAR) legend, died in a crash on the last lap of the Daytona 500 Race on February 18, 2001 (Aumann, 2003). NASCAR has led the automotive industry with safety equipment and standards for seat belt use, roll bars, and roof flaps; yet, a racing icon was dead and millions of fans became reminded very quickly of the seat belt issue. Millions of mourners cried out when hearing of Earnhardt's death. Automobile safety was once again news. Did these two events influence citizens' behavior enough so that more seat belts were attached?

Observational studies are expensive to conduct and it is difficult to generalize unless the

sample is large enough. It is customary for the "gold standard" in one's field to be tested and retested. This secondary analysis could provide additional information needed for public health planners to test its gold standard: the Behavioral Risk Factor Surveillance System.

Limitations

This study was limited to data collection by the BRFSS. Limitations of the BRFSS data might have affected the outcome of this study, specifically:

1. The BRFSS uses a lengthy interview format.
2. Low socioeconomic status groups are underrepresented in BRFSS data. Of those represented, it is important to note that persons of low socioeconomic status are often not in good health, the prevalence of disease is greater; and they are less likely to have telephones in their households.
3. Telephone surveys may have higher levels of noncoverage than in-person interviews, because about 2% of United States households cannot be reached by telephone (See Appendix C). A number of studies have shown that the telephone and no telephone populations are different with respect to demographic, economic, and health characteristics. Telephone coverage is lower for population subgroups such as Blacks in the South, persons with low incomes, persons in rural areas, persons with fewer than 12 years of education, persons in poor health, and heads of households under 25 years of age.
4. The BRFSS survey includes the over-samples of those with phones and over-samples of older females.
5. Telephone surveys are limited to those persons who have home telephone service. With the rise of cellular phone use among Americans, there may be selection bias in the sample (Centers for Disease Control and Prevention, 2004).

Definitions of Terms

For the purpose of this study, the following definitions of terms were applied:

1. *Behavioral Risk Factor Surveillance System (BRFSS)* is the largest continuously conducted telephone health survey in the world that assesses and monitors the health risk of adults for personal and lifestyle behaviors on an annual basis (Centers for Disease Control and Prevention, 2004).
2. *Centers for Disease Control and Prevention (CDC)* are responsible for protecting the public health by preventing and controlling diseases (Centers for Disease Control and Prevention).
3. *Disproportionate Stratified Sample (DSS)* design is commonly practiced in the BRFSS; telephone numbers are divided into two groups, or strata, that are sampled separately (Centers for Disease Control and Prevention).
4. *Epidemiology* is the study of the occurrence, distribution, and causes of disease in humankind (*Mosby's Medical, Nursing, and Allied Health Dictionary*, 1994).
5. *Healthy People 2010* is a national initiative that provides goals for the nation to meet by 2010 (Centers for Disease Control and Prevention).
6. *Prevalence* refers to the proportion of the population that has a particular disease at a specific time. In epidemiology, the number of all new and old cases of a disease or occurrences of an event during a particular period. Prevalence is expressed as a ratio in which the number of events is the numerator and the population at risk is the denominator (*Mosby's Medical, Nursing, and Allied Health Dictionary*).
7. *Primary enforcement* allows police to stop and cite motorists simply for not wearing seat belts (Glassbrenner, 2002a).
8. *Risk factor* causes a person or a group of people to be particularly vulnerable to an unwanted, unpleasant, or unhealthful event (*Mosby's Medical, Nursing, and Allied Health Dictionary*).

9. *Secondary enforcement* is defined as occurring when motorists must be stopped for another reason in order to receive a seat belt citation (Glassbrenner).

Organization of the Study

The study is organized into five chapters. Chapter 1 included the introduction, statement of the problem, research questions, hypotheses, significance of the problem, limitations of the study, definitions of terms, and organization of the study.

Chapter 2 presents the background and review of the literature related to the problem statement. Included are an introduction, history of the seat belt, chronological overview and the development of surveillance systems, an explanation of Healthy People 2010, and the history, design, data collection, and data management for the BRFSS and the NHTSA. In addition, the effects of measurement error will be discussed.

Chapter 3 contains the methodology and procedures of the study. Included are an introduction, study design, origin of other variables, data collection and management, and a statistical analysis.

Chapter 4 presents the results of the statistical analysis between the self-reported seat belt use BRFSS data and the observed seat belt use data from NOPUS. Chapter 5 contains the findings, summary, and recommendations of the study.

CHAPTER 2

REVIEW OF LITERATURE

Introduction

This chapter presents a review of the literature including a history of the seat belt, a general background of surveillance, and an explanation of Healthy People 2010 and its objectives for national seat belt use. In addition, the history, survey design, data collection, and possible sources of bias for the Behavioral Risk Factor Surveillance System (BRFSS) and the National Highway Traffic Safety Administration's (NHTSA) Moving Traffic Study will be discussed.

History of the Seat Belt

Whether by invention or sheer accident, one could move larger and larger loads with the use of wheels. One can only imagine the relief human beings realized when they first increased their work capacity by attaching some sort of conveyance to two wheels. Their first joy was no doubt dashed with the necessity of stopping their new invention.

Henry Ford is called the father of the automobile, but he is noteworthy for focusing his genius on the assembly line process to produce cars as inexpensively and as quickly as possible. A French engineer named Nicolas Cugnot is credited with developing a steam-powered military tractor in 1769 that propelled itself along at two and one half miles per hour, stopping every quarter hour to build up more steam. Ironically, Cugnot is believed to be the first person to wreck an automobile when he ran one of his tractors into a stone wall (*EzResult*, 2003).

Most drivers of automobiles assume that racecar drivers developed the seat belt, but this is not true. In fact, physicians began installing seat belts in their own cars in the 1930s and they consequently hold that honor. Nevertheless, it is difficult to find a single history of seat belts,

although it is clear that officials adapted seat belt use for other forms of transportation faster than the automobile industry did.

Orville and Wilbur Wright, credited with the invention of the airplane in 1903, while standing on the sand at the Outer Banks, might have thought, among other things, that their new invention would make warfare impossible because airplanes could fly over troop deployments and relay such information to their battle headquarters. One can imagine their dismay when the airplane became a vital component of World War I, with its famous "aces" and dogfights. While the airplane was thrust into aerial battles, pilots quickly learned that some form of a belt was needed to keep the pilot and his assistant attached to the airplane. A timeline of aerial history would show a lag of fewer than 20 years from the invention of the airplane to the advent of seat belts for the pilot. The reasons for a time lag of decades for the adoption of seat belts for automobiles are many and complex, especially when one considers that stagecoaches dashing across the American West employed seat belts to ensure that drivers and passengers did not become separated from the coach while the frenzied horses struggled to put distance between the coach and its attackers. Even sailors were quick to attach a line--arguably a safety belt--to themselves and their ship so they did not go for a premature swim during a storm or even normal sailing. However, automobile drivers and their industry resisted such a commonsense approach for securing themselves in place. Seat belts did not start gaining acceptance until military and civilian aviators began adapting them to early airplanes.

The San Diego Aerospace Museum (2003) noted that W. D. Billingsley, a renowned pilot, died on June 20, 1912, when he was ejected during the crash of his plane. A passenger, J. H. Towers, was thrown from his seat, but he survived when he was lucky enough to grasp and hang onto a wing strut while the plane careened into the Chesapeake Bay. Safety belts and harnesses for pilots and passengers were designed and adopted after Glenn Curtis interviewed Towers in the aviation press (San Diego Aerospace Museum).

Automobile racers developed many features that were adapted to civilian automobiles,

but physicians were credited with being among the first to equip their personal cars with seat belts in the 1930s. They began urging manufacturers to provide belts in all new cars, thus beginning the battle between belt users and those who eschew them.

There are always trendsetters, and this proved true with automobiles as a few hundred safety-minded citizens installed the belts into their own cars. These belts were manufactured by Chute, Davis Aircraft and American Safety Equipment, Ray Brown Automotive, and Superior Industries and were heavily used by racecars, rally cars, and other competition vehicles during that time (Automotive Occupant Restraints Council, 2003).

Other groups slowly got involved. In 1953, the Colorado State Medical Society published a policy supporting the installation of lap belts in all automobiles. In 1954, the Sports Car Club of America required competing drivers to wear lap belts and the American Medical Association's House of Delegates voted in favor of supporting the installation of lap belts for all automobiles (Willis, 2003).

Policy and legislation for the adoption of seat belts advanced on several fronts in 1955. First came an amendment to the California Vehicle Code requiring state approval of seat belts before their sale or use. The National Safety Council, American College of Surgeons, and the International Association of Chiefs of Police also voted to support installation of lap belts in all automobiles. Lastly, for that year, the Society of Automotive Engineers appointed a Motor Vehicle Seat Belt Committee (National Safety Council, 2003; Willis, 2003).

Swedish automaker Volvo was the first manufacturer to offer seat belt systems as standard equipment in its automobiles on a safety first theme, backed by a substantial amount of crash testing that provided inescapable proof that use of a seat belt during an automobile accident would reduce both fatalities and serious injuries (Bisnar & Chase, 2003). Ford Motor Company in 1955 also announced that a "safety package" including seat belts, padded dashboard, and sun visors would be offered as an option for its 1956 model (Automotive Occupant Restraints, 2003). Unfortunately, they did not catch on with the public.

When famed actor James Dean perished in a crash of his sports car in 1955, a new period of public awareness was launched about seat belt use in automobiles and their possible advantages (Bisnar & Chase, 2003). A rush of companies moved into the seat belt business including manufacturers of automotive hardware, wheels, mirrors, luggage racks, seat covers, and cargo straps with anticipation that there would be great consumer demand for these safety options; however, the "safety package" never succeeded as forecast, leaving a surplus of unsold safety belts in inventories. Most companies got out of the business as hurriedly as they got in, selling safety belts for as little as $1.00 each (Bisnar & Chase).

In 1956, the automobile industry offered its consumers safety options on some models. Volvo marketed the two-point cross-chest diagonal belt as an accessory, while Ford and Chrysler offered lap belts in front as an option on some models. Ford also began a two-year ad campaign based on safety, focusing heavily on belts (National Safety Council, 2003; Willis, 2003).

In 1957, Volvo provided anchors for two-point diagonal belts in front and the Special Subcommittee on Traffic Safety, U.S. House of Representatives opened hearings on the effectiveness of seat belts in automobiles. Nils Bohlin, a design engineer with Volvo in Sweden, patented the three-point safety belt in 1958 (National Safety Council, 2003; Willis, 2003). This device comprised two straps, a lap strap and a shoulder strap. Volvo also anchored for the two-point diagonal belts in the rear. In 1959, legislators in New York considered and rejected a bill to require seat belts in new cars sold in the state. In 1960, New York once again considered and rejected the seat belt bill. In 1961, the Society of Automotive Engineers (SAE) issued a standard for U.S. seat belts. New York, as well as Wisconsin, required seat belt anchors at front outboard seat positions (effective January 1, 1962). The Standards Association of Australia also issued a standard for safety belts and harness assemblies (Bisnar & Chase, 2003).

The year 1962 brought a sweeping trend with six states requiring front outboard seat belt anchors. Seat belt anchors in front outboard became the standard in the United States that year. More attention was drawn to this campaign as the Association for Aid to Crippled Children and

Consumers Union sponsored a landmark conference on *Passenger Car Design and Highway Safety* with occupants' protection as the sole theme (National Safety Council, 2003; Willis, 2003). In 1963, Volvo introduced the three-point belt in front as the standard in the USA. Twenty-three states had laws requiring belts in front, which were proven most effective. The SAE issued a revised standard and the U.S. Congress passed P.L. 88-201 allowing the Commerce Department to issue mandatory standards for seat belts sold in interstate commerce to keep motor vehicle accidents to a minimum as a result of the mounting number of casualties, thought to be avoidable through seat belt use, on public roads and highways (Bisnar & Chase, 2003).

In 1964, about half of the states required seat belt anchorages at front outboard with most U.S. manufactures providing lap belts at front outboard seat positions (National Safety Council, 2003; Willis, 2003). The U.S. Commerce Department also proposed and adopted a variety of regulations governing seat belt adoption, use, and testing, that were largely adopted from standards that had previously been issued by the SAE (Bisnar & Chase, 2003). In 1966, Congress passed the National Traffic and Motor Vehicle Safety Act, which formally established Federal Motor Vehicle Safety Standards providing minimum legally acceptable requirements for the manufacturing of vehicular components, including seat belts and seat belt buckles. This legislation also made the installation of seat belts mandatory by U.S. automakers (Bisnar & Chase).

Use of lap and shoulder belt systems was prompted after more regulatory changes were made because of heightened public safety concerns in the late 1960s (Bisnar & Chase, 2003). Fear over the potential for a lap belt itself to cause serious lower extremity and abdominal injuries during an accident sparked these changes. The integrated restraints were theoretically designed to distribute the accident-restraining forces of the belt system along the body rather than focusing them solely along the pelvis, raising the potential for abdominal injuries caused by the lap belt alone (Bisnar & Chase).

In 1972, NHTSA began rulemaking that lead to occupant seating protection in school buses (National Safety Council, 2003; Willis, 2003). Automakers in the late 1970s were required by the federal government, in order to compel higher public use of seat belt systems, to install automatic restraint systems involving the use of shoulder harnesses on rails and slots that would automatically slide into place when the occupant started the vehicle (Bisnar & Chase, 2003). Many users failed to employ the complicated systems under the flawed conviction that they were automatically and fully restrained (Bisnar & Chase). When these occupants were involved in accidents in which their automatic shoulder harness alone was in place, they were subjected to more serious injuries than they likely would have suffered had they been wearing only a lap belt (Bisnar & Chase). This resulted in NHTSA enacted regulations requiring placards to be placed on the automatic shoulder harness systems warning that they were not to be used without the lap belt. Because of these problems, the U.S. automaker manufacturers were permitted to discontinue manufacturing these automatic shoulder restraint systems (Bisnar & Chase).

During the mid-1980s, while the automatic restraint systems were being tested in production, crash researchers were leading to the conclusion that an inflatable air bag could supplement vehicle occupant protection in an accident if used as a supplement to seat belts and shoulder harnesses (Bisnar & Chase, 2003). In 1985, New York made belt use mandatory, front and rear, with rear for persons older than 10 years of age (National Safety Council, 2003; Willis, 2003). In 1987, New York continued its proactive approach to safety and became the first state in the nation to require seat belts on large school buses with New Jersey following its lead in 1992 (National Safety Council; Willis). Inclusion of this system (airbags in addition to seat belts) in new vehicles began to become mandatory in certain passenger vehicles during the early 1990s and was gradually phased in for other types of vehicles.

In 1998, the NHTSA sent a report to Congress announcing a two-year research project to develop the next generation of occupant protection systems for school buses with the expectation

of completion by July of 2000 (National Safety Council, 2003; Willis, 2003). In 1999, legislators in Florida, Louisiana, and California enacted laws requiring improved occupant restraint systems on large school buses with each state waiting for NHTSA to complete the study before finalizing the exact system to use (National Safety Council; Willis). In the year 2000, the Minnesota State Legislature brought passage of the Education Omnibus Bill that included language authorizing seat belt installation in new school buses, mandating education of proper use, model training, and liability issues (National Safety Council; Willis). The state of California in 2001 extended implementation that required lap/shoulder belts on all new school buses purchased after January 1, 2002, with retrofitting not being permitted for buses previously procured. Finally, in 2002, NHTSA (2004) published the study concerning the next generation of occupant protection in school buses that was initiated and ordered in 1998.

Surveillance

Public health surveillance was originally established to monitor infectious diseases. However, over the last few decades, surveillance has grown to include not only the monitoring of chronic diseases but surveillance of injury control (Halperin, Baker, & Monson, 1992; Rothman & Greenland, 1998). Langmuire (as cited in Halperin et al.), the father of epidemiology, defined surveillance as an active and continuous process and explained, "Surveillance means the continued watchfulness over the distribution and trends of incidence through the systematic collection, consolidation, and evaluation of morbidity and mortality reports and other relevant data for the purposes of prevention of disease injury" (p. 5). Halperin et al. went on to say more about surveillance activities, "Unless these data are provided to those who set policy and implement programs, their use is limited to archival and academic pursuits and are appropriately considered to be health information rather that surveillance data" (p. 6).

When *The Future of Public Health* (Institute of Medicine, 1988) and its recommendations went public, public health surveillance was minimal; in fact, only half of the

states collected morbidity data and even fewer conducted health interview surveys. The Institute of Medicine's landmark publication recommended that assessment be a core function of public health agencies at all levels of government. Although there were concerns about the use of self-reported surveillance data, information gained from these types of surveillance systems were seen as a reality check for public health officials. Since 1988, the Centers for Disease Control's Behavioral Risk Factor Surveillance System has grown into the word's largest telephone surveillance system (Nelson et al., 2001).

In a recent study published in the *Journal of the American Medical Association*, Nelson et al. (2002) used the BRFSS to provide a comprehensive overview of state trends in health risk factors during the 1990s. In the study, Nelson and his colleagues painted a gloomy picture of adults and their health risk factors. Commenting on the study, McGinnis (2002) in an editorial stated that the recent study by Nelson and colleagues "reveals the spotty nature of accomplishments . . . as well as insights on performance in achieving the health goals established in Healthy People 2000, the United States' prevention initiative" (p. 2711). McGinnis added, "If Healthy People provided a vision, Nelson and colleagues provide what amounts to a reality check" (p. 2711).

Healthy People 2010

Healthy People 2010 (Centers for Disease Control and Prevention, 2004) is a comprehensive, nationwide health promotion and disease prevention initiative whereby the collaboration of public health practitioners, health care providers, and government agencies identified health objectives for the nation in the 21st century. The two overarching objectives for Healthy People 2010 are: (a) to increase quality and years of healthy life, and (b) to eliminate health disparities.

The nation's progress for these health goals is monitored through 467 objectives in 28 focus areas. Many objectives focus on interventions designed to reduce or eliminate illness,

disability, and premature death among individuals and communities. Others focus on broader issues, such as improving access to quality health care, strengthening public health services, and improving the availability and dissemination of health-related information. Each objective has a target for specific recommendations to be achieved by the year 2010 (Centers for Disease Control and Prevention, 2004).

To guide progress toward the achievements of the two overarching goals, 10 leading indicators have been identified that reflect major public health concerns in the United States and were chosen based on their ability to motivate action, the availability of data to measure their progress, and their relevance as broad public health issues. For each of the leading health indicators, specific objectives derived from Healthy People 2010 will be used to track progress. The leading 10 indicators are physical activity, overweight and obesity, tobacco use, substance abuse, responsible sexual behavior, mental health, access to health care, environmental quality, immunization, and injury and violence (Centers for Disease Control and Prevention, 2004).

Dramatically affecting the years of potential life lost, unintentional injuries were the fifth leading cause of death for U.S. citizens. In 1960, the CDC reported more than 93,803 deaths from unintentional injuries; of these deaths, 41% were associated with motor vehicle crashes. The CDC also reported that most often these vehicle crashes were predictable and preventable. In 1997, 100,292 Americans died from unintentional injuries (Centers for Disease Control and Prevention, 2004). NHTSA (2004) reported that ejection from the vehicle was one of the most injurious events that could happen to a person in a crash. In fatal crashes, 75 % of passenger car occupants who were totally ejected were killed. According to NHTSA, about 20,000 front-seat passenger occupants are killed annually on U.S. roads as the result of car crashes. Another 300,000 suffer injuries serious enough to require hospital treatment. Air bags and safety belts used together reduce the risk of serious and fatal injuries by 40% to 55% (NHTSA).

It is widely accepted that increased use of safety belts and reductions in driving while impaired are two of the most effective means to reduce the risk of death and serious injury of

occupants in motor vehicle crashes (Centers for Disease Control and Prevention, 2004; NHTSA, 2004). NHTSA reported that 11,889 lives in 2000 alone were saved by seat belt use, but that injuries from traffic crashes were the leading cause of death for people between the ages of 1 and 42 (as cited in Ad Council, 2003).

By increasing the goal to use safety belts to 92%, Healthy People 2010 hopes to reduce the risk of death and serious injury of occupants in motor vehicle crashes (Centers for Disease Control and Prevention, 2004). According to the NHTSA (2004), seat belt use reached only 75% in 2002. "More than 4,000 lives would be saved," said U.S. Secretary of Transportation Norman Y. Mineta, "if safety belt use were to increase from 75% to 90%" (Intelligent Transportation Society of America, 2003).

National Highway Traffic Safety Administration

History

Although some form of motor-vehicle safety efforts initiated as soon as motor vehicles began crashing, it was not until 1966 that federal legislators recognized the problem. With the passage of the Highway Safety Act and the National Traffic and Motor Vehicle Safety Act, the National Highway Safety Bureau (NHSB) was created, which later became the National Highway Traffic Safety Administration, under the U.S. Department of Transportation (NHTSA, 2004).

NHTSA (2004) is responsible for reducing deaths, injuries, and economic losses resulting from motor vehicle crashes. To help accomplishment its mission, NHTSA investigates safety defects in motor vehicles, sets and enforces fuel economy standards, helps states and local communities reduce the threat of drunk drivers, promotes the use of safety belts, child safety seats and air bags, and conducts research on drivers' behavior and traffic safety (Ad Council, 2003).

In 1966, the NHSB led by Dr. William Haddon (as cited in Lee & Estes, 2001) a public

health physician recognized and applied principles of public health and epidemiology to motor-vehicle-related injury prevention. In doing so, motor-vehicle safety became a 20th Century public health achievement (Pickett & Hanlon, 1990). This systematic approach allowed Haddon to assess vehicle and highway design before, during, and after injury-producing crashes and then define the interaction between host (human), agent (motor vehicle), and environmental (highway) factors (as cited in Lee & Estes). Some improvements were made to roads (environment) by requiring better delineation of curves (edge and center line stripes and reflectors), use of breakaway signs and utility poles, improved illumination, addition of barriers separating oncoming traffic lanes, and guardrails. Changes in driver and passenger (host) behavior also reduced motor-vehicle crashes and injuries. Enforcing traffic safety laws, reinforced by public education, led to safer behavior choices (Lee & Estes). Under Haddon's leadership, built-in safety features such as headrests, energy absorbing steering wheels, shatter-resistant windshields, and safety belts became standardized. Sadly, usage of seat belts was not standardized or uniform across the nation (Centers for Disease Control and Prevention, 2004). According to Pickett and Hanlon (1990),

> In terms of life lost, injuries are considerably more costly than either heart disease or cancer. Injuries are very common in childhood and often rob society of several decades of life and are among the most expensive of all social problems. (p. 361)

It costs far less to prevent a health problem than to treat one after it has developed.

In 2003, the CDC (Centers for Disease Control and Prevention, 2004) reported that unintentional injury was the leading cause of death among persons of ages 1 to 34 years in the United States and the fifth leading cause of death among all races, among all ages, and between both sexes. Among persons of ages 1 to 65 years, motor-vehicle-related injuries led all causes for deaths. The risk of injury is so great that most persons will sustain a significant injury at some time during their life; these injuries are not random accidents but, rather, most injuries are predictable and preventable (Centers for Disease Control and Prevention).

Because motor vehicle crashes remain as the leading cause of injury-related deaths in the

United States, most states have passed legislation that provides for some type of enforcement for seat belt use. As of December 2001, 49 states had a safety belt law. Eighteen states had primary enforcement laws and the remaining 31 states had secondary enforcement laws (Glassbrenner, 2002a). NHTSA reported seat belt use continued to be higher in states that can enforce belt laws more strictly (NHTSA, 2004).

NOPUS Moving Traffic Study

The National Occupant Protection Use Survey (NOPUS) under the direction of the National Highway Traffic Safety Administration (NHTSA, 2004) is conducted annually to provide an observed assessment of the nation's seat belt use and demographic detail that the agency uses to target seat belt use campaigns. The NOPUS is the only probability-based observational survey of seat belt use in the United States and is conducted in two separate studies: (a) the Moving Traffic Study, and (b) the NOPUS Controlled Intersection Study. This study focused on the Moving Traffic Study Survey.

NOPUS Moving Traffic Study Survey Design

Glassbrenner (2002a) described the NOPUS survey design:

> The NOPUS uses a multi-stage probability sample, selected in 1994, to ensure efficient collection of national representative data. This approach used a three-stage cluster design. The first stage of the sample selection, counties were grouped by region (Northeast, Midwest, South, West), level of urbanization (metropolitan or not), and level of belt use (high, medium, or low). Fifty counties of groups of counties (called primary sampling units or PSUs) were selected from these strata based on the estimated annual vehicle miles traveled. In the next stage, within each PSU a probability sample of road segments were selected from two categories: major roads and local roads. Road segments are typically a few miles in length, varying between about a tenth of a mile and 30 miles, and may only represent a small portion of the roadway (e.g. on an interstate). There may be a small number of intersections and ramps on any given segment. A direction of travel and a time-period long enough to permit observation for both studies were selected randomly for each segment. (All the time periods were between 8 a.m. and 6 p.m., Sunday through Saturday. Data collection takes 30 minutes for the Moving Traffic Study. The Moving Traffic Study was conducted near the selected intersection for the noninterstate segments, in the chosen direction of travel, during the chose time-

period. At interstate sites, either the moving vehicle observation method was conducted on the segment or the exit ramp method at the selected ramp. (pp. 13-14)

NOPUS Moving Traffic Study Data Collection

Glassbrenner (2002a) described the data collection method:

> Use is assessed by visible observation. At non-interstate highway sites, teams of two observers observe traffic from the side of each selected roadway for 30 minutes. They use hand-held clicker counters, similar to those used to estimate attendance at large events, to count belted and unbelted motor vehicle occupants in a way that permits counting them even in fast-moving traffic. Only shoulder belt use of drivers and right front passengers are observed, due to the difficulty of observing use for other seating positions and belt types in a moving vehicle. Use is observed only in passenger vehicles that do not have commercial or government markings. For instance, ambulances, police cars, taxis, buses, and passenger vehicles that have commercial writing on them (such as "Steve's Painting") are excluded. In heavy traffic, use is observed in only one lane and inflated to reflect all lanes. Data are collected at certain interstate highways from moving vehicles. At other interstate sites, use is observed at the selected exit ramp using the same methodology as for the noninterstate sites. Approximately 150,000 drivers and 50,000 passengers of motor vehicles were observed. (p. 17)

In summary Glassbrenner (2002a) explained that NOPUS data collectors observed the following:

> Belts
> Observe shoulder belt use:
>
> of driver and right front passengers
> in passenger vehicles with no commercial or government markings
> from roadsides, ramps, and moving vehicles
> during daylight hours.
>
> Observers are trained in techniques to collect these data as accurately as possible. Belt use can be difficult to assess in fast-moving vehicles, when an occupant's shirt and belt are close in color, or through sun glare off a windshield or moving windshield wipers. Vehicle type (passenger car, van or SUV, and pickup truck) must be categorized quickly from sight, and collectors must be able to manipulate multiple clicker buttons, each dedicated to a particular vehicle type, seating position, and belted status, quickly. Data collectors receive training each year, whether they are collecting for the first time or have participated for several years, to ensure the highest quality possible. (p. 17)

Sources of Possible Bias

Estimates from the Moving Traffic Study survey measure shoulder belt use among

drivers and right front passengers of passenger vehicles during daylight hours in June. Furthermore, the use on some interstates was observed at exit ramps. Although these restrictions were made in order to make data collection feasible, they might result in slight overestimates or underestimates of use and this bias cannot be quantified. Fatality data from NHTSA's Fatality Analysis Reporting System indicate that use might be lower at night, and data from NHTSA's Crashworthiness Data System indicate it might be lower among lap belt users (NHTSA, 2004)

NHTSA's (2004) surveys probably overestimate actual use, because data are generally obtained during daylight hours on weekdays, and these are not necessarily the times when persons at increased risk for not wearing safety belts are traveling in motor vehicles. In addition, NHTSA data are obtained on shoulder belt use only and could miss individuals using lap belts only.

Behavioral Risk Factor Surveillance System

History

The BRFSS is an on going data collection program designed to measure behavioral risk factors in the adult population 18 years of age or older living in households. The BRFSS was introduced in 1984, with 15 states collecting surveillance data on risk behaviors through monthly telephone interviews (Centers for Disease Control and Prevention, 2004). By 1994, the BRFSS had become a nationwide system (see Appendix A).

The objective of the BRFSS is to collect uniform, state-specific data on preventive health practices and risk behaviors that are linked to chronic diseases, injuries, and preventable infectious diseases in the adult population. The BRFSS questions focus on health behaviors related to several leading causes of death and disease. The interviewer obtains self-reported information from respondents on a variety of health related behaviors and risk factors including seat belt use (Centers for Disease Control and Prevention, 2004).

Design of the BRFSS

The BRFSS is the largest continuously conducted telephone health survey in the world. It enables the Centers for Disease Control and Prevention, state health departments, and other health and education agencies to monitor risk behaviors related to chronic diseases, injuries, and death and it is an effective tool in preventing disease and promoting health.

The BRFSS has a modest history. In its earliest beginnings, 29 states from 1981 to 1983 conducted point-in-time surveys to determine the feasibility of behavioral surveillance at the state level. All states agreed to address these topics and ask questions that served as the core component of the questionnaire. Since its inception, the BRFSS was designed to allow states to add questions of their own choosing to their individual surveys (Centers for Disease Control and Prevention, 2004).

On the point-in-time surveys, data were collected on six individual-level risk factors associated with the leading causes of premature mortality among adults: cigarette smoking, alcohol use, physical inactivity, diet, hypertension, and safety belt use. Since the early 1980s, the BRFSS data have been used to identify emerging health issues, document health trends, compare health behaviors across states, and measure progress toward health goals. Data gathered through the BRFSS provide important information for the development of public health programs (Centers for Disease Control and Prevention, 2004).

In 1993, the survey was redesigned with certain questions to be asked every year (fixed core) and others asked every second year (rotating core). As part of the 1993 redesign, up to five "emerging" core questions for newly arising topics were included each year for all 50 states, the District of Columbia, and Puerto Rico and annual point-in-time surveys in the Virgin Islands and Guam (Centers for Disease Control and Prevention, 2004). Total sample size exceeds 100,000 (see Appendix B).

The questionnaire has five sections: (a) fixed core, (b) two rotating cores, (c) optional modules, (d) emerging care, and (e) state-added questions. On the fixed core, questions are

asked about health status, health insurance, routine checkups, diabetes, smoking, pregnancy, women's health, HIV/AIDS, and demographics. Rotating core questions asked on odd-numbered years pertain to: hypertension, injuries, alcohol use, vaccinations, colorectal screening, and cholesterol. Questions asked on even-numbered years include: physical activities, fruit and vegetable consumption, and weight control. Based on need, states can select from a list of standardized questions, known as optional modules, on topics such as: diabetes, sexual behavior, folic acid, quality of life, and family planning. Emerging core questions focus primarily on "late breaking" health issues such as: the terrorist attack in New York City on September 11, 2001, or the Flooding of Carter County, Tennessee, in 1998. State-added questions are those health issues states want to explore but are not covered in the survey. Recently, the Arkansas BRFSS asked, "Do you have one or more smoke detectors installed in your house?" Respondents in Kentucky were asked, "Prior to the change in the regulation for operating and riding as a passenger on a motorcycle, how often did you and/or other individual(s) wear protective headgear (helmet)?" (Centers for Disease Control and Prevention, 2004).

Data Collection

The BRFSS is a telephone survey developed jointly by CDC and state health departments and an ongoing data collection program designed to measure behavioral risk factors in the adult population 18 years of age or older living in households in the United States. Today, the CDC reports that states' officials make calls seven days a week. Each state completes between 125 and 625 interviews a month, with more than 150,000 completed interviews each year (Centers for Disease Control and Prevention, 2004).

Because approximately half of all deaths in the United States are caused by health risk behaviors, the objective of the BRFSS is to collect uniform, state-specific data on preventive health practices and risk behaviors that are linked to chronic diseases, injuries, and preventable infectious diseases in the adult population. Currently, data are collected monthly in 54 reporting

areas: all 50 states, the District of Columbia, and Puerto Rico and annual point-in-time surveys in the Virgin Islands and Guam (Centers for Disease Control and Prevention, 2004).

The health departments manage the BRFSS field operations with guidelines provided by the CDC. These health departments participate in developing the survey instrument and conduct the interviews either in-house or through use of contractors. People of ages 18 or older are randomly called and asked to take part in the survey. They remain completely anonymous. Questions focus on health behaviors related to several leading causes of death and disease: using condoms to prevent the spread of AIDS, taking medication for high blood pressure, smoking or using tobacco, getting a mammogram, not exercising on a regular basis, and, seat belt use (Centers for Disease Control and Prevention, 2004).

The data are then transmitted to the CDC's National Center for Chronic Disease Prevention and Health Promotion's Behavioral Surveillance Branch for editing, processing, weighting, and analysis. An edited and weighted data file is provided to each participating health department for each year of data collection, and the CDC prepares summary reports of state-specific data. Because it would be impossible to phone every household in the state each year, BRFSS relies on a sample of the population. Most states use the Disproportionate Stratified Sample Method (Centers for Disease Control and Prevention, 2004). This is where phone numbers are randomly selected throughout the state. Business and nonworking numbers are omitted. Individuals of age 18 years and older are randomly selected from each household called. In a Disproportionate Stratified Sample design, telephone numbers are divided into two groups, or strata, which are sampled separately. One group, the high-density stratum, contains telephone numbers that are expected to contain a large proportion of households. The other group, the low-density stratum, contains telephone numbers that are expected to contain a small proportion of households. Whether a telephone number goes into the high-density or low density stratum is determined by the number of listed household numbers in its hundred block. A hundred block is a set of one hundred telephone numbers with the same area code, prefix, and

first two digits of the suffix and all possible combinations of the last two digits. Numbers that come from hundred blocks with one or more listed household numbers (1 + blocks, or banks) are put in the high-density stratum. Numbers that come from hundred blocks with no listed household numbers (0 blocks, or banks) are put in the low-density stratum. Both strata are sampled to obtain a probability sample of all households with telephones. The high-density stratum is sampled at a higher rate than the low-density stratum (that is, disproportionately) to obtain a sample that contains a larger proportion of household numbers than would be the case if all numbers were sampled at the same rate (Centers for Disease Control and Prevention, 2004).

In most cases, each state constitutes a single stratum. In order to provide adequate sample sizes for smaller geographically defined populations of interest, however, 25 states sampled disproportionately from strata defined to correspond to sub-state regions. To ensure data quality, interviewers are specially trained to ask questions exactly the same way with each call. The BRFSS relies on Computer Assisted Telephone Interview (CATI) software to manage telephone dialing and data collection. The CATI standardized interview takes from 10 to 20 minutes. Responses are entered directly into the computer by interviewers (Centers for Disease Control and Prevention, 2004). The sampling method used assures comparability of data across states and over time.

Sources of Possible Bias

Telephone surveys are less expensive to conduct than in-person interviews, but because persons with low socioeconomic status are less likely to have a telephone, they tend to be underrepresented in the BRFSS sample population. In addition, the rise of cellular telephone use affects the BRFSS sample population. Therefore, households with only cellular telephones are excluded from the BRFSS sample population. It is important to note that those persons of low socioeconomic status are often not in good health, the prevalence of disease is greater, and they are less likely to have telephones in their households. Telephone coverage is lower for

population subgroups such as Blacks in the South, persons with low incomes, persons in rural areas, persons with fewer than 12 years of education, persons in poor health, and heads of households under 25 years of age. According to the Centers for Disease Control and Prevention (2004), the percentage of households with telephones range from 80% to 97%. In summary, the BRFSS survey includes the over samples of those with phones, over samples of older females, and small-sample sizes at local levels.

Effects of Measurement Error

Although self-reported data can result in underrepresentation or overrepresentation compared with other data sources, it is the fundamental underpinning of all social science research. Granted, there are many possible sources of error that can result in incorrectly interpreted research; however, most studies must rely on self-reported data because objective data are expensive to obtain or the data simply do not exist. Bias is inherent in all research and can be defined as any influence, condition, or set of conditions that singly or together distort the data from what may have been obtained under the conditions of pure chance (Leedy, 1993). There are two types of measurement error: (a) random error, and (b) systematic error. Bowling (1997) summarized the types of bias that is inherent in research:

> Whether the threat to validity is intentional or unintentional, self-reported information may result in biased answers, which most often results in inaccurate measures. Self-reports are subject to acquiescence response (yes-saying) which occurs when the respondent will more frequently endorse a statement than disagree with its opposite. Faulty logic of the research produces assumption (conceptual) bias. Failure to discard an unusual value results with mishandling of outliers. Design bias can occur where there is a faulty design, methods, sampling procedures and/or group assignment procedures. Inappropriate analysis can also result in design bias. Evaluation apprehension happens when the respondent generates anxiety by virtue of being tested. The interviewer can bias unconsciously or consciously the respondent to answer in a certain way. Changes in the measurement process can cause measurement decay. Mood bias occurs when the person's current mood fluctuates and over or underrepresent levels of functioning. Non-response effect bias is due to the differences in those who choose to respond and those who choose not to respond. Observer bias is the difference between the true situation and that recorded by the observer. Publication bias occurs when publishers are unwilling to publish results that do not achieve statistical significance in relation to the hypothesized

> association. Random measurement error means error due to chance. People act differently when they know they are being studied and this can cause error. This type of bias is called reactive effects (awareness of being studied) and Hawthorne effect (guinea pig). Difficulty in remembering events or retrieving selected memories cause recall (memory) bias. Telescoping refers to the allocation of events, characteristics, or behaviors to an earlier or later time period that the one in which they actually occurred. Reporting bias occurs when the respondent fails to reveal the information. Response style bias is similar to yes-saying bias, but response bias can be controlled for somewhat by alternating wording response. Other biases exist and include sampling bias, selection bias, social desirability bias (desire to look good), systematic error, and total survey error. Sampling bias happens when not all members of the population of interest have a calculable change of being selected. Selection bias occurs when characteristics of the sample differ from those of the wide population. Systematic errors are those errors that are inherent in a study. Total survey error equals the sum of all errors from the sampling method and data collection procedures. (p. 135)

Methodological Studies

Researchers have conducted validity studies on self-reported seat belt use. In the past, researchers generally looked at the frequency of seat belt use. They simply wanted to know if one wore a seat belt or not. Thereafter, researchers clarified what it meant to be a seat belt user. Current research focuses on factors that influence seat belt use.

Surveillance is but one approach for assessing trends and seat belt use is only one area that the BRFSS and other surveys monitor. Telephone surveys are cost effective and provide an opportunity for statewide comparisons. The BRFSS is widely accepted as the "gold standard" by program planners to tailor prevention programs and awareness campaigns at all levels of government, although researchers caution its use because of the inherent bias of self-reporting.

The seat belt became standard equipment in 1968 in motor vehicles. In 1984, New York was the first state to pass legislation that made seat belt use mandatory. Since then, federal regulations required motor vehicle manufacturers to install automatic restraints in new passenger cars, starting with 10% in the 1987 models, 25% in 1988 models, 40% in 1989 models, and 100% in 1990 models (Williams, Wells, Lund, & Teed, 1989).

Although seat belts have been standard equipment in American motor vehicles for more than 30 years and are widely accepted as lifesavers, many Americans admit to not using them and are frequently observed not wearing them (Begg & Langley, 2000; Boehm et al., 1992; 1986; Centers for Disease Control and Prevention, 2004; Garbacz, 1990; Glassbrenner, 2002b; Goldbaum, Remington, Powell, Hogelin, & Gentry, 1986; Hunter, Stutts, Stewart, & Rodgman, 1988; Hunter, Stutts, Stewart, & Rodgman, 1990; Li, Kim, & Nitz, 1999; McKnight & Dawson, 1996; Nelson, 1996b; Nelson et al., 2002; Parada, Cohn, Gonzalez, Byrd, & Cortes, 2001; Streff & Wagenaar, 1989; Stulginskas, Verreault, & Pless, 1985; Waller & Barry, 1969; Williams et al., 1989; Williams, Wells, Lund, & Teed, 1990).

Seat belt effectiveness is defined as for every 100 unbelted motor vehicle occupants seriously injured or killed in crashes, 40 to 50 would not have been seriously injured or killed if they were wearing a seat belt at the time of their crash (Evans, 1986; Kahane, 2000; NHTSA, 2004). Williams et al. (1990) concluded in their seat belt study that seat belts "together with airbags and lap/shoulder belts, provide the most effective restraint protection available" (p. 1515).

Although many researchers have concluded that self-reported seat belt use is exceedingly higher than observed seat belt use is, it has been difficult to quantify actual seat belt use because of the differing approaches for data collection and the inherent bias for both approaches. An early seat belt study by Waller and Barry (1969) compared observed seat belt use and self-reported seat belt use and ascertained seat belt use frequency by asking respondents, "Do you use the seat belts in local travel?" and "Do you use the seat belt on long trips?" Respondents had three options for responding to their frequency of seat belt use: (a) always (b) sometimes, and (c) don't use. Waller and Barry found that of those of who answered 'always' for town travel, only 77% were observed wearing seat belts at the time of the study. Among respondents who reported 'always' wearing seatbelts when driving on the highway, only 46% were observed wearing seatbelts on the highway.

Other studies that compared observed seat belt use with self-reported seat belt use left researchers with the information that self-reported seat belt use far exceeded observed seat belt use (Begg & Langley, 2000; Centers For Disease Control and Prevention, 2004; Dee, 1998; Hunter et al., 1988; McKnight & Dawson, 1996; Nelson, 1996a; Parada et al., 2001; Robertson, 1992; Robertson, O'Neill, & Wixom, 1972; Streff & Wagenaar, 1989; Stulginskas et al., 1985; Wagenaar, Streff, Molnar, Businski, & Schultz, 1987; Williams et al., 1989).

Robertson et al. (1972) compared observed seat belt use and self-reported seat belt use in three communities and concluded that sex, age, reported driving patterns, drives to and from work, self-reported drinking and driving, reports of self-injury, or having a friend killed in a crash were unrelated to seat belt use.

Wagenaar et al. (1987) compared observed seat belt use and self-reported seat belt use. Their interviews measured sociodemographic, situational, attitudinal, normative, and behavioral characteristics related to seat belt use and they concluded that seat belt use was lower among males, individuals with lower socioeconomic status, those of minority ethnic background, below the age of 30, alcohol drinkers, drivers in urban environments, and married individuals below the age of 25.

The Centers for Disease Control and Prevention (2004) compared self-reported BRFSS data with state observation data for 15 states in 1987. The median BRFSS estimates were 8 percentage points higher than observation study estimates when safety belt use was defined as "always use" and 21.5 percentage points higher when defined as "always or nearly always use" seat belts. In one study, self-reported seat belt use was found to be so inflated that it was recommended that seat belt rates be discounted by 12 percentage points (Streff & Wagenaar, 1989) and yet in another study, seat belt usage had to be discounted up to 20 percentage points (Robertson, 1992).

Robertson (1992) compared 1988 BRFSS estimates for safety belt use to observational studies conducted in cities within 13 states. Median BRFSS estimates were 21.5 percentage

points higher than the observational study when seat belt use was defined as "always or nearly always use."

By the late 1980s, researchers began looking seriously at what defined seat belt use. Streff and Wagenaar (1989) examined observed drivers wearing or not wearing their seat belts and then asked them, Do you: (a) always, (b) most of the time, (c) sometimes, (d) seldom, or (e) never wear your seat belt. Streff and Wagenaar concluded that self-reports could not be taken as an accurate measure of actual belt use because respondents reported using their seat belts far more than what had been observed. In contrast, Garbacz (1990) reported a strong fit between observed use and that reported by BRFSS respondents and concluded that BRFSS data were a good substitute for observational data.

Nelson (1996b) compared 1992 and 1993 BRFSS (self-reported) data and 1992 and 1993 NOPUS (observational) data and found self-reports were substantially higher in southern states and in states with the lowest levels of observed use. However, taken together, self-reported estimates were only 2% to 5% higher than observed estimates. Nelson concluded that correlations between self-reported and observational data were high and self-reported data were valid and useful.

The Centers for Disease Control and Prevention (2004) used self-reported seat belt use for 1992 and 1993 to determine seat belt prevalence across the nation. Officials found that the percentage of adults who reported they 'always' wore a safety belt while driving or riding in a car varied more than threefold among states. In 1992, South Dakotans reported they 'always' wore a seat belt 25.2% of the time, as did 88.4% of respondents in Hawaii. In 1993, South Dakota's seat belt use rate increased to 25.9% and Hawaiians reported increasing their use to 89.8%. Although on the surface it appeared people were wearing their seat belts in larger numbers across the U.S. (Nelson et al., 2002), other studies showed a much different picture for the country. Glassbrenner (2002a) reported in her observational study that seat belt use continued to be higher in states that can enforce seat belt laws more strictly. She reported that

seat belt use increased in all 50 states but use rates ranged from 52.3% in West Virginia to 91.1% in California. It is interesting to note that use rates varied among states that had primary laws and secondary laws. Nelson (1996b) reported that in states that had primary laws, the usage rate was 78% and in those states with secondary laws, it decreased to 67%.

McKnight and Dawson (1996) looked at the traditional questions asked of respondents about their seat belt frequency use and decided to change the wording of the seat belt use question. They asked persons to describe their frequency of seat belt use as: (a) always, (b) nearly always, (c) sometimes, (d) seldom, or (e) never. McKnight and Dawson found that when combined, those respondents who answered "always" and "nearly always" was close to that reported in two independent self-report based studies: the Kentucky Behavioral Risk Factor Surveillance System and the Kentucky Health Interview and Examination Study. McKnight and Dawson reported that the 44.7% of those who self-reported using a seat belt 100% of the time was closer to the 41% of Kentuckians observed to wear seat belts in the same year. They concluded that health surveyors accept nothing less than "always" wearing seat belt to define a seat belt user.

Dee (1998) compared seat belt use before and after seat belt laws were in effect and how legislation and enforcement affected use. Comparing self-reported and observed seat belt use, Dee found that introduction and enforcement status of mandatory seat belt laws significantly affected belt use. Dee said the question is not the "accurate snapshot of use in a state at a given moment. Instead, it is whether changes in self-reported use within a state accurately track changes in actual behavior" (p. 6). Dee concluded that the strong correlation between the self-reported and observed seat belt use validated the self-report method and accurately tracked changes in actual behavior.

The Centers for Disease Control and Prevention (2004) found that in 1997 more than 30% of adult Americans reported not 'always' wearing a safety belt while driving or riding in a car. Parada et al. (2001) looked at the validity of self-reported seat belt use among low belt users

in El Paso including Hispanic and non-Hispanic drivers. They found that 75% of the drivers reported they always use a seat belt, whereas only 62.5% of the drivers were observed wearing their seat belts; however, the desire to over-report was consistent between the two populations. They concluded that the magnitude of inflation might have been greater in populations with low belt use.

While researchers concentrated on what defines seat belt use, another body of information centered on characteristics of seat belt users and offered another approach to understanding the dynamics of seat belt use. Seeking to learn commonalities among seat belt wearers, researchers have focused on seat belt wearers, nonusers, and non-respondents. In an early study by Waller and Barry (1969), these researchers looked more closely at the nonrespondents. Because Waller and Barry had linked the driving records of those drivers observed in traffic, they held data that could be investigated--the nonrespondents. Nonrespondents were those observed but who had chosen not to participate in the survey. Waller and Barry linked those drivers to their driving records and concluded two characteristics were significant about nonrespondents. Nonrespondents had poorer driving records and they were more likely to have older cars.

Similar to Waller and Barry (1969), who found no differences among age, sex, or belt usage in new cars, Goldbaum et al. (1986) looked at seat belt use across the country from 1981 to 1983 before any states had mandatory seat belt use laws. They found that 75.9% of the adult U.S. population reported not using their seat belts and that men and women, equally, were just as likely not to use them. They found that Blacks were least likely to wear seat belts and Hispanics were most likely to wear them. Failure to use seat belts decreased with increasing age and seat belt users had higher levels of education than those who did not use seat belts. Goldbaum et al. concluded that certain groups have the highest failure rates: Blacks, young adults, persons with no more than a high school education, and persons who engage in other risky behaviors, such as drunk driving.

Hunter et al. (1988) looked at characteristics of belt users and nonusers and found that socioeconomic status and income were more consistent than age, sex, or education levels. Consistent with previous studies, using safety belts "all the time," Shinar, Schechtman, and Compton (2000) found that use of safety belts increased with age and education, but not with income.

In a 1996 study conducted by the CDC, researchers found the median prevalence was more than 13 percentage points lower for men than for women in 1992 (55% vs. 68.4%) and 1993 (54.5% vs. 68.1%) (Centers for Disease Control and Prevention, 2004). These findings were comparable to the results found by Goldbaum et al. (1986).

Are there factors that can predict seat belt use? Do normative social pressure factors influence people and their use of seat belts? Jonah and Dawson (1982) found a strong association with attitudes toward seat belts influences and reported seat belt use. Boehm et al. (1992) researched normative pressure and individual response to risk and concluded that normative social pressure can be used to increase the protective behavior of individuals faced with risk of death or injury in cars.

Other research specifically investigated predictors of safety belt use among crash-involved drivers and front seat passengers in Hawaii (Li et al., 1999). Li and colleagues found, like other observational surveys, that young male drivers were less likely to wear their seat belts. In addition, they found alcohol involvement had the strongest negative association with safety belt use. Time of day and area of crash showed strong and significant associations with seat belt use. Motorists were less likely to wear safety belts when driving during the night or driving in areas outside predominantly urban Honolulu; also, safety belt use decreased on weekends and increased during rainy days.

Jacobsen, Kreuter, Luke, and Caburnay (2001) compared the prevalence of a protection health behavior, seat belt use, in movies and reality. In their study of 211 movies randomly selected from top-grossing releases seat belt use in movies did not reach 10% until 1987 and

peaked that year at 32%. Since then, seat belt use in movies has ranged from 10% to 30%. The authors defined seat belt use as front seat occupants who wore a seat belt every time they appeared in a moving vehicle.

Fhaner and Hane (1973) summarized that the absolute frequency of use has been remarkably constant whereas seat belt use relative to the number of belts available has actually decreased. They concluded that campaign efforts to generate seat belt use seem to have been small or none at all.

Federal legislation affected seat belt use. Researchers have found that people behave differently when a choice becomes a law to be obeyed. Williams et al. (1989) conducted an observational seat belt study for automatic restraints on six large-volume automobile manufacturers in Chicago, Los Angeles, Philadelphia (no mandatory seat belt use law existed), and Maryland/Virginia's suburbs of Washington, DC at 64 sites for each metropolitan area. They found that metropolitan areas that did not have mandatory use laws in place experienced the lowest use rate and that automatic belts were used more often than manual belts.

Hunter et al. (1990) compared observed seat belt use with self-reported seat belt use. They found nonusers had 35% more accidents and 69% more violations than users. They concluded that drivers most likely to increase their belt wearing because of a law included females, nonwhites, and those with fewer prior traffic violations.

Escobedo et al. (1992) assessed rates and trends in safety belt use by presence and type of safety belt law using data from states participating in the 1984 through 1989 BRFSS. They found states that had a primary law had greater and more rapid increases in safety belt use rates than did states with laws requiring an offense to occur (secondary law).

Rivara, Thompson, and Cummings (1999) compared the effectiveness of primary and secondary enforced seat belt laws and concluded that states with a mandatory use law had a significant impact on increasing seat belt use, decreasing fatalities to occupants of motor-vehicle crashes, and decreasing rates of severe nonfatal injuries.

Steptoe et al. (2002) conducted a 10-year international study on seat belt use, attitudes, and changes in legislation. Surveying college students in 13 European countries, these researchers hypothesized that changes in legislation would impact seat belt use over time and above any secular trend through time. They found that self-reported seat belt use increased from 63% to 73% in male students and from 66% to 77% in female students over the decade. They summarized by stating, "Legislation has a substantial impact on the use of vehicle seat belts" (p. 254).

CHAPTER 3

METHODOLOGY AND PROCEDURES

Introduction

This chapter includes the study design, hypotheses, the data needed, location of the data, and a description of how the data were secured and analyzed. The purpose of this study was to examine the validity of the Behavioral Risk Factor Surveillance System (BRFSS) by comparing its measure of seat belt use with the measure of seat belt use obtained by National Highway Traffic Safety Administration's (NHTSA, 2004) National Occupant Protection Use Survey (NOPUS).

Since 1984, the Centers for Disease Control have conducted the BRFSS in the United States, making it the largest telephone health survey in the world (Nelson et al., 2001). However, is the BRFSS valid? Does the survey measure what it sets out to measure? Do the responses to questions represent results that are true?

Every year each state health department measures behavioral risk factors in the adult population 18 years of age or older living in households in the United States. The survey is conducted in each state seven days a week. Each state completes between 125 to 625 interviews a month, providing a national study of more than 150,000 interviews each year (Centers for Disease Control and Prevention, 2004).

Study Design

A historiography, survey design, data collection methods, and sources of possible error for the two types of data collection can be found in the review of the literature. The data for this study were gathered during 2002 by the BRFSS (Centers for Disease Control and Prevention, 2004). Data analysis included testing significance of difference for two independent samples for

collection method, region, and type of enforcement. Table 1 provides a description of the tables and the types of analyses used for each item.

Table 1

Descriptions of Tables and Types of Analysis

Table #	Name	Type of Analysis
3	Significance Difference Between Self-Reported and Observed Seat Belt Use and Type of Data Collection	*z* test for two independent proportions
4	Significance of the Difference Within Self-Reported and Observed Seat Belt Use for the Midwest Region	*z* test for two independent proportions
5	Significance of the Difference Within Self-Reported and Observed Seat Belt Use for the Northeast Region	*z* test for two independent proportions
6	Significance of the Difference Within Self-Reported and Observed Seat Belt Use for the South Region	*z* test for two independent proportions
7	Significance of the Difference Within Self-Reported and Observed Seat Belt Use for the West Region	*z* test for two independent proportions
8	Significance of the Difference Between Self-Reported and Observed Seat Belt Use for Primary Enforcement	*z* test for two independent proportions
9	Significance of the Difference Between Self-Reported and Observed Seat Belt Use for Secondary Enforcement	*z* test for two independent proportions

I obtained all technical information and survey data from the CDC's web site (Centers for Disease Control and Prevention, 2004). The 2002 survey data and statistical information were downloaded and saved on a floppy disk. In 2002, the CDC supported 18 core sections and 17 optional modules. The following core sections were supported by the BRFSS: Health Status, Health Care Access, Exercise, Fruits and Vegetables, Asthma, Diabetes, Oral Health, Immunization, Tobacco Use, Alcohol Consumption, Seat Belts, Demographics, Family Planning, Women's Health, Prostate Cancer Screening, Colorectal Cancer Screening, HIV/AIDS, and Firearms (Centers for Disease Control and Prevention).

The following optional modules were supported by the BRFSS: Diabetes, Hypertension Awareness, Cholesterol Awareness, Physical Activity, Healthy Days, Qualify of Life, Health Care Coverage and Utilization, Adult Asthma History, Childhood Asthma, Heart Attack and Stroke, Cardiovascular Disease, Weight Control, Folic Acid, Tobacco Indicators, Other Tobacco Products, Arthritis, and Effects of September 11th Attacks (Centers for Disease Control and Prevention, 2004).

I created a subset of the 2002 survey data extracting only the variables of interest. I collapsed and recoded the states into four regions: Northeast, Midwest, West, and South (see Appendix E).

In this study, I defined a seat belt user as one who reported "always" and collapsed the remaining responses (any response other than always) and defined those persons as "non-users."

As cited from the BRFSS questionnaire (Centers for Disease Control and Prevention, 2004), the interviewee is asked:

Q. "How often do you use seatbelts when you drive or ride in a car?

A. Respondents can reply: Always, nearly always, sometimes, seldom, or never."

NOPUS survey data were obtained from the U.S. National Highway Traffic Safety Administration's Moving Traffic Study conducted in 2002 (unpublished data).

I created a subset of the data only choosing variables of interest: PCDN passenger car drivers not belted, PCDY passenger car drivers belted, region, and primary enforcement state.

Origin of Other Variables

I obtained information from the National Highway Traffic Safety Administration (NHTSA, 2004) regarding 2002 state safety belt laws for the 50 states, and type of law for each state including primary enforcement, secondary enforcement, or no existing law. Primary enforcement allows police to stop and cite motorists simply for not wearing seat belts. Secondary enforcement means that motorists must be stopped for another reason in order to

receive a seat belt citation (See Appendix D).

Research Questions

A measure is considered valid if it measures what it was intended to measure, but it is well documented that self-reported seat belt use is much higher than the observed measure (Begg & Langley, 2000; Centers For Disease Control and Prevention, 2004; Dee, 1998; Hunter et al., 1988; McKnight & Dawson, 1996; Nelson, 1996b; Parada et al., 2001; Robertson, 1992; Robertson et al., 1972; Streff & Wagenaar, 1989; Stulginskas et al., 1985; Wagenaar et al., 1987; Williams et al., 1989).

The purpose of this study was to validate the BRFSS when estimating safety belt use in the United States. The following questions were examined:

1. Does BRFSS differ from NOPUS?
2. Is there regional variation in the differences between BRFSS and NOPUS?
3. Do BRFSS and NOPUS data differ significantly depending on whether the safety belt law is primary or secondary, or none?

Hypotheses

1. There is no significant difference (alpha = .05) between subjective, (i.e., self-reported) BRFSS 2002 and objective NOPUS 2002 measures of seat belt use in binary response (observation) form (i.e., “always use” or “never use” and “wearing” or “not wearing” respectively).
2. There is no significant difference (alpha = .05) within the four U.S. census regions (Northeast, South, Midwest, West) with regard to the BRFSS 2002 subjective (i.e., self-report) measure of seat belt use in binary response form (i.e., “always use” and “never use”).
3. There is no significant difference (alpha = .05) between the two types of state

legislated seat belt enforcement (primary, secondary, or none) with regard to the BRFSS 2002 subjective (i.e., self-report) measure of seat belt use in binary response form (i.e., "always use" and "never use").

Summary

This chapter provided an introduction to the research project, study design, variables, the research questions, and an explanation of the descriptive analysis employed. In addition, the chapter presented the hypotheses, data, location of the data, and a description of how the data were secured and analyzed. Chapter 4 presents the results of the statistical analysis between the self-reported seat belt use BRFSS data and the observed seat belt use data from NOPUS.

CHAPTER 4

RESULTS

The purpose of this study was to examine and compare the differences between the subjective self-reported 2002 Behavioral Risk Factor Surveillance System telephone survey and the objective observational 2002 National Occupant Protection Use Survey (NOPUS).

Self-reported seat belt use data were obtained from the Centers for Disease Control's 2002 BRFSS survey (Centers for Disease Control and Prevention, 2004) and observed seat belt use data were obtained from the National Highway Traffic Safety Administration's 2002 NOPUS (NHTSA, 2004) (see Appendix F).

This chapter presents the results of the statistical analysis between the self-reported seat belt use BRFSS data and the observed seat belt use data from NOPUS, self-reported and observed seat belt use in four geographic regions, and the use of seat belts in regions with mandatory use laws.

Analysis of the Hypotheses

Data were analyzed using SAS 8e. The *z* test for two independent proportions was used to statistically analyze the significance of the difference between the self-reported BRFSS seat belt measurement and the observed NOPUS seat beat use measurement. An alpha level of .05 was used for all statistical tests. Confidence intervals were developed at 95%.

Eighteen states have enacted a primary enforcement law and 31 states have enacted a secondary enforcement law, which are designated in Table 10. Primary enforcement allows police officers to stop and cite motorists simply for not wearing seat belts. With secondary enforcement, motorists must be stopped for another reason in order to receive a seat belt citation (Glassbrenner, 2002a).

The geographical regions were defined and classified based on the U.S. Census Bureau. As shown in Table 2, the BRFSS data set was recoded to reflect the following geographical regions by state:

Table 2

Four Geographical Regions

Northeast	Midwest	South	West
ME	MI	WV	AK
VT	OH	MD	WA
NH	IN	DE	OR
RI	IL	VA	CA
CT	WI	KY	NV
NY	MN	TN	ID
PA	IA	NC	UT
NJ	MO	SC	AZ
	KS	GA	NM
	NE	FL	CO
	SD	AL	WY
	ND	MS	MT
		AR	HI
		LA	
		OK	
		TX	
		DC	

Null Hypothesis 1

Null hypothesis 1 stated there would be no difference between the self-reported BRFSS measurement for seat belt use and observed seat belt use measurement obtained by NOPUS. Table 3 illustrates the significance difference for self-reported seat belt use and observed seat belt use. The null hypothesis was rejected because the revealed significance of the difference was less than the alpha level of .05 using a two-tailed probability model. The difference between

the two populations is .0212 (.0181, 0.243). The significance of the difference revealed by the *z* test for two independent proportions was 13.283 ($p < .001$). There were 245,376 BRFSS respondents who replied to the seat belt module. More than 77% respondents reported they always use a seat belt when they drive or ride in a passenger car. During the 2002 NOPUS survey, 93,188 drivers were observed in a passenger car; approximately 79% of these drivers were observed using a seat belt. The analysis shows a 95% certainty that the true population proportion of seat belt users in the NOPUS survey is between 1.8% and 2.4% higher than the proportion of seat belt users in the BRFSS survey.

Table 3

Significance Difference Between Self-Reported and Observed Seat Belt Use and Type of Data Collection

	NOPUS (Observed Seat Belt Use)				BRFSS (Self-reported Seat Belt Use)					
	Yes		No		Yes		No			
	f	%	*f*	%	*f*	%	*f*	%	*z*	*p*
Seat Belt Use	73987	79.4	19201	20.6	189610	77.27	55766	22.73	13.283	<.001
Total	93188				245376					

$\alpha = .05$

As shown in Table 3, the proportion of observed seat belt users is greater than the proportion of self-reported seat belt users.

Null Hypothesis 2

Null hypothesis 2 stated there would be no difference among the four geographical census regions (Midwest, Northeast, South, and West) with regard to the self-reported seat belt use measurement from the BRFSS and observed seat belt use measurement from the NOPUS.

The significance of the difference within self-reported and observed seat belt use for the Midwest region is illustrated in Table 4.

In the Midwest, the null hypothesis was rejected because the significance of the difference was less than the alpha level of .05 using a two-tailed probability model. The level of significance given by the *z* test for two independent proportions revealed a significance difference of 7.393 ($p<.004$). The difference between the two proportions is .0273 (.0202, .0344). One can be 95% certain that the true population proportion of seat belt users in the NOPUS survey is between 2% and 3% higher than the proportion of seat belt users in the BRFSS survey.

Table 4

Significance of the Difference Within Self-Reported and Observed Seat Belt Use for the Midwest Region

	NOPUS (Observed Seat Belt Use)				BRFSS (Self-reported Seat Belt Use)					
	Yes		No		Yes		No			
REGION	*f*	%	*f*	%	*f*	%	*f*	%	*z*	*p*
Midwest	15112	74.3	5234	25.7	37545	72.54	14934	28.46	7.393	<.004
Total	20346				52479					

α=.05

The significance of the difference within self-reported and observed seat belt use for the Northeast region is illustrated in Table 5.

In the Northeast, the null hypothesis was rejected because the revealed significance level was less than the alpha level of .05 using a two-tailed probability model. The level of significance given by the *z* test for two independent proportions revealed a significance of difference of 5.279 ($p<.001$). The difference between the two proportions is .0202 (.0126, .0278). Thus, there is a 95% certainty that the true population proportion of seat belt users in the BRFSS survey is between 1% and 3% higher than the proportion of seat belt users in the NOPUS survey.

Table 5

Significance of the Difference Within Self-Reported and Observed Seat Belt Use for the Northeast Region

	NOPUS (Observed Seat Belt Use)				BRFSS (Self-reported Seat Belt Use)					
	Yes		No		Yes		No			
Region	*f*	%	*f*	%	*f*	%	*f*	%	*z*	*p*
Northeast	12669	72.9	4719	27.1	39450	74.88	13237	25.12	5.279	<.001
Total	17388				52687					

α=.05

The significance of the difference within self-reported and observed seat belt use for the South region is illustrated in Table 6.

In the South, the null hypothesis was rejected because the revealed significance of difference was less than the alpha level of .05 using a two-tailed probability model. The

significance of difference by the *z* test for two independent proportions revealed a *z*-score of 2.86 (p<.0042). The difference between the two proportions is .0075 (.0024, .0126). There is a 95% certainty that the true population proportion of seat belt users in the NOPUS survey is between .2% and 1% higher than the proportion of seat belt users in the BRFSS survey.

Table 6

Significance of the Difference Within Self-Reported and Observed Seat Belt Use for the South Region

	NOPUS (Observed Seat Belt Use)				BRFSS (Self-reported Seat Belt Use)					
	Yes		No		Yes		No			
Region	*f*	%	*f*	%	*f*	%	*f*	%	*z*	*p*
South	24636	81.8	5484	18.2	65078	81.04	15227	18.96	2.86	.0042
Total	30120				80305					

α=.05

The significance of the difference within self-reported and observed seat belt use for the West region is illustrated in Table 7.

In the West, the null hypothesis was rejected because the significance of difference was less than the alpha level of .05 using a two-tailed probability model. The level of significance indicated by the *z* test for two independent proportions (22.896) is p <.001. The difference between the two proportions is .0694 (.0638, .075). There is a 95% certainty that the true population proportion of seat belt users in the NOPUS survey is between 6% and 8% higher than the proportion of seat belt users in the BRFSS survey.

Table 7

Significance of the Difference Within Self-Reported and Observed Seat Belt Use for the West Region

	NOPUS (Observed Seat Belt Use)				BRFSS (Self-reported Seat Belt Use)					
	Yes		No		Yes		No			
Region	*f*	%	*f*	%	*f*	%	*f*	%	*z*	*p*
West	21570	85.1	3764	14.9	41193	78.20	11483	21.80	22.896	<.001
Total	25334				52676					

$\alpha = .05$

Null Hypothesis 3

Null hypothesis 3 stated there would be no difference between the self-reported seat belt use measurement from the BRFSS and the observed seat belt use measurement from the NOPUS with regard to primary enforcement states.

The significance of the difference between self-reported and observed seat belt use for primary enforcement regions is illustrated in Table 8.

In regions with primary enforcement laws, the null hypothesis was rejected because the revealed significance of difference for type of enforcement was less than alpha level of .05 using a two-tailed probability model. The level of significance of difference given by the *z* test for two independent proportions revealed a significance difference of 4.84. The difference between the two proportions is .0098 (.0058, .0137). There is a 95% certainty that the true population proportion of seat belt users in the NOPUS survey is between .5% and 1% higher than the proportion of seat belt users in the BRFSS survey.

Table 8

Significance of the Difference Between Self-Reported and Observed Seat Belt Use for Primary Enforcement

	NOPUS (Observed Seat Belt Use)				BRFSS (Self-reported Seat Belt Use)					
	Yes		No		Yes		No			
	f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*z*	*p*
Primary Enforcement (Yes)	41611	85.5	7071	14.5	75351	84.5	13825	15.50	4.84	<.001
Total	48682				89176					

α=.05

The significance of the difference between self-reported and observed seat belt use for regions with secondary enforcement laws is illustrated in Table 9. In regions with secondary enforcement, the null hypothesis was rejected because the revealed significance of difference for type of enforcement was less than alpha level of .05 using a two-tailed probability model. The level of significance of difference given by the *z* test for two independent proportions revealed a significance difference of 0.152. The difference between the two proportions is .0004 (.0044, .0051). There is a 95% certainty that the true population proportion of seat belt users in the NOPUS survey is between .4% and .5% higher than the proportion of seat belt users in the BRFSS survey.

Table 9

Significance of the Difference Between Self-Reported and Observed Seat Belt Use for Secondary Enforcement

	NOPUS (Observed Seat Belt Use)				BRFSS (Self-reported Seat Belt Use)					
	Yes		No		Yes		No			
	f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*z*	*p*
Primary Enforcement (No)	32376	72.7	12130	27.3	104651	72.71	39281	27.29	0.152	<.879
Total	44506				143932					

α=.05

Summary

Chapter 4 presented the frequencies of each response, the significance difference between self-reported seat belt use and observed seat belt use, and tested three null hypotheses through the use of the *z* test for two independent proportions. Archival data was obtained from the Centers of Disease Control's 2002 BRFSS and the National Highway Traffic Safety Administration's 2002 NOPUS (unpublished microdata). The research hypotheses were tested in the null format at the .05 level of significance. All hypotheses were rejected in the null format. Chapter 5 contains the findings, summary, and recommendations of the study.

CHAPTER 5

FINDINGS, SUMMARY AND RECOMMENDATIONS

Chapter 5 contains the findings based on the analysis of the data, a summary of the study, and recommendations based on the findings of this study.

Findings

This study provided a comparison of the subjective self-reported BRFSS survey and the objective observational NOPUS survey.

Research hypotheses in Chapter 1 were tested in the null format at the .05 level of significance using a two-tailed test. The *z* test for two independent proportions was used to determine the significance of the difference. All three hypotheses were rejected.

There was a difference between data collection methods, there was a significance of difference across geographical regions, and there was a significant difference in seat belt use between states with mandatory use laws and those without. Because the data for this study were analyzed using significance of the difference techniques, it would be inappropriate to suggest the reasons or characteristics why Americans use or do not use a seat belt.

It has been well documented that the best protection while driving or riding in a motor vehicle is to belt oneself with a safety restraint. According to the NHTSA (2004), the fatality rate per million vehicle miles traveled has declined by more than 70% from 1966 to 2001. The most injurious event than can happen to a person in a crash is to be totally ejected from a motor vehicle. NHTSA reported that of those who were ejected from the vehicle, 73% were killed.

It has been hypothesized that self-reported seat belt use measures are unreliable (Begg & Langley, 2000; Centers for Disease Control and Prevention, 2004; Dee, 1998; Hunter et al., 1988; McKnight & Dawson, 1996; Nelson, 1996b; Parada et al., 2001; Robertson et al., 1972;

Robertson, 1992; Streff & Wagenaar, 1989; Stulginskas et al., 1985; Wagenaar et al., 1987; Williams et al., 1989).

This study determined that survey participants in three geographical regions (Midwest, South, and West) were observed using seat belts more often than were the self-reported respondents for the same regions. The Northeast is the only region where the observed seat belt user measurement is less than the self-reported seat belt use measurement. States in the West geographic region had the widest margin for seat belt use between observed seat belt use and self-reported seat belt use.

The findings of this study did not support Evans' (2003) hypothesis that validity of self-reported measurements should be used with caution because of the public's tendency to over report and under report certain health behaviors. However, public health officials and program planners often have to rely on the self-reported data because in some cases, the information needed is not there or it is too expensive and too time consuming to obtain in the traditional manner.

Many researchers, like Evans (2003), have misgivings about using self-reported data like the BRFSS; however, without time and resources, self-reported information may be the only source of obtaining the information needed. Evans said in a recent interview, "I find self-reporting disturbing. . . . Self-reporting gives valuable information about what people say, but it does not provide information about what they do. What they [respondents] say has to be evaluated very carefully" (p. 1).

This study supports research findings that Americans are using restraint devices in passenger cars at a higher rate than in previous years (Centers for Disease Control and Prevention, 2004; Glassbrenner, 2002b; Nelson et al., 2002; Waller & Barry, 1969). Approximately 77% of the BRFSS respondents reported that they always used a seat belt while driving or riding in a car; whereas, 79% of NOPUS subjects were observed using a restraint device.

This study supports research findings that indicate the self-report category of "always" should be used as a direct indicator of actual constraint use (seat belt use should be classified as "always.") (McKnight & Dawson, 1996; Nelson, 1996b; Nelson et al., 2002; Streff & Wagenaar, 1989). BRFSS and NOPUS survey data revealed a closer relationship with each other than ever before.

The measured rate of seat belt use in states with mandatory use laws has been the subject of many research investigations (Dee, 1998; Escobedo et al., 1992; Glassbrenner, 2002b; Parada et al., 2001; Rivara et al., 1999; Steptoe et al., 2002). It has been consistently shown that states that have primary enforcement laws have higher seat belt usage rates than other states and this was replicated in the study.

Summary

Statement of the Problem

The BRFSS, the world's largest telephone survey system, employs a self-report approach to collecting data, whereby measures are subject to several forms of error (Begg & Langley, 2000; Centers for Disease Control and Prevention, 2004; Dee, 1998; Hunter et al., 1988; McKnight & Dawson, 1996; Nelson, 1996a; Parada et al., 2001; Robertson et al., 1972; Robertson, 1992; Stone et al., 2000; Streff & Wagenaar, 1989; Williams et al., 1989). The purpose of this study was to examine the validity of the BRFSS by comparing its measure of seat belt use with the measure of seat belt use obtained by National Highway Traffic Safety Administration's (NHTSA, 2004) National Occupant Protection Use Survey (NOPUS).

Significance of the Problem

While the BRFSS has many uses, including planning of public health programs and facilities, it could be improved by identification and attenuation of self-report error. For a number of years, researchers have indicated the need for further study on the BRFSS. This study

could be instrumental for those persons involved in health promotion and prevention and education programs, particularly as it relates to injury prevention. The data provided in this study could be valuable in planning seat belt use programs by broadening the knowledge base related to the use of seat belts in geographic regions and information for states with different seat belt use legislation. This study could further inform officials at all levels of government. In addition, policy makers, state health agencies, community health centers, and other public health leaders might be informed by the results of the study.

The BRFSS data provide longitudinal state-by-state comparisons and are often used by media outlets and state health departments to inform the public about health risks. The BRFSS is adaptable for use in any health field. Once the BRFSS data are collected, the results can be used to educate the public, benefit health research, and improve public health strategies.

Population

1. The study was limited to the 2002 BRFSS telephone survey respondents and the 2002 NOPUS observational survey participants.
2. BRFSS responses were defined and classified as "always" users and "not always" users of seat belts while riding or driving in a passenger car. This definition has been shown to provide the best estimate similar to those measures obtained from the NOPUS survey.
3. States were collapsed and recoded into four regions based on the U.S. Census Regions in the BRFSS data set.
4. States were recoded as a primary enforcement state or not a primary enforcement state in the BRFSS data set.
5. Statistical procedures were applied to the data obtained:
    a. A *z* test for two independent proportions was used to determine the significance of the difference for all hypotheses.
    b. For statistical analysis, the null format for each hypothesis was tested. The null

hypothesis stated that no difference existed between the BRFSS (telephone self-reported survey) and the NOPUS (observational survey). The results were summarized, analyzed, and interpreted by the researcher.

6. Findings and recommendations were formulated and generalized to the population.

Instrumentation

The seat belt module from the 2002 BRFSS was extracted from the data for analysis. Each participant responded to the following Likert-type scale for the seat belt module: "How often do you use seat belts when you drive or ride in a car?"

1--Always

2--Nearly Always

3--Sometimes

4--Seldom

5--Never

In this study, BRFSS respondents were defined and classified as seat belt users if they responded "always" when asked how often they used a seat belt while driving or riding in a passenger car. Any other response was classified as nonuser.

NOPUS participants were defined and classified as seat belt users if they were observed using a seat belt at the time of the survey. Drivers of passenger cars who were not belted at the time of the observation were defined and classified as not wearing a seat belt.

The geographical regions were defined and classified based on the U.S. Census Bureau. As shown in Table 10, the BRFSS data set was recoded to reflect the type of seat belt enforcement law and geographical regions by state.

Table 10

Four Geographical Regions and Type of Enforcement

Northeast	Midwest	South	West
ME	MI*	WV	AK
VT	OH	MD*	WA
NH**	IN*	DE	OR*
RI	IL	VA	CA*
CT*	WI	KY	NV
NY*	MN	TN	ID
PA	IA*	NC*	UT
NJ*	MO	SC	AZ
	KS	GA*	NM*
	NE	FL	CO
	SD	AL*	WY
	ND	MS	MT
		AR	HI*
		LA*	
		OK*	
		TX*	
		DC*	

*Denotes Primary Enforcement Law

**No mandated use law

Mandatory use laws were obtained from the National Highway Traffic Safety Administration (NHTSA, 2004). Each state was classified as "1" Primary Enforcement or "2" Not a Primary Enforcement in each data set. Statistical analysis was conducted in SAS Version 8e.

Chapter 4 described the frequencies of each response, the significance of the differences between observed and self-reported seat belt use, and testing of three null hypotheses through the use of the *z* test for two independent proportions.

Recommendations

The results of the study show that a significant difference existed between the self-reported BRFSS survey and the observational survey by NOPUS. The following recommendations are made as a result of the data analysis:

1. More studies like this are needed to reliably establish the relationship between the results from the objective NOPUS observation survey and the subjective BRFSS telephone survey.
2. Reasons for the significance of the differences cannot be determined from these data analyses but factors to be studied may include characteristics or barriers from specific groups, particularly from respondents who replied "sometimes" in the BRFSS. It would be beneficial for BRFSS to expand its seat belt module to include an investigation of what the barriers of use are for restraint devices.
3. This study could be replicated using other products (either WesVar or SUDAAN) that take complex sample designs into account.

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APPENDICES

APPENDIX A

Year State Began Using Behavioral Risk Factor Surveillance System Telephone Survey

1984		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AZ	OH	DC	AL	ME	CT	OR	CO	AK	KS	AR	WY
CA	RI	FL	HI	MD	IA	PA	DE	NJ	NV		
ID	SC	GA	MA	MI	OK	VA	LA				
IL	TN	KY	MO	NE			MS				
IN	UT	NY	NM	NH			VT				
MN	WV	ND		SD							
MT	WI			TX							
NC				WA							

Source: Centers for Disease Control and Prevention (2004)

APPENDIX B

BRFSS Five Sections and Topics, 2001

Fixed Core (all years)	Rotating Core I: Odd-numbered years (1993, 1995, 1997, 1999, 2001, 2003)	Rotating Core II: Even-numbered years (1994, 1996, 1998, 2000, 2002	Optional Modules	Emerging Core (Late breaking health issues)
Health Status	Hypertension	Physical Activities	Diabetes	Terrorism
Health Insurance	Injuries	Fruit and Vegetable Consumption	Sexual Behavior	Floodings
Routine check up	Alcohol Use	Weight control	Family Planning	
Diabetes	Vaccinations		Health Care Coverage	
Smoking	Colorectal Screening		Health Care Utilization	
Pregnancy	Cholesterol		Preventive Counseling Services	
HIV/AIDS			Cardiovascular Disease	
Demographics			Arthritis	
			Quality of Life	
			Hypertension Awareness	
			Cholesterol Awareness	
			Colorectal Cancer Screening	
			Fruit and Vegetable Consumption	
			Exercise	

Source: Centers for Disease Control and Prevention
Note: Questions in each topic can be viewed by accessing http://www.cdc.gov (March 2003)

APPENDIX C

2000 Telephone Coverage

Estimated Percentages of Households With and Without Telephones by State, 2001

State	Telephone Households	Percent Telephone Household	Non-Telephone Household	Percent Non-Telephone Household	Total
Total United States	100,644,480	94.49	5,871,294	5.51	106,510,746
Alabama	1,613,909	91.83	143,528	8.17	1,757,437
Alaska	215,639	96.09	8,764	3.91	224,403
Arizona	1,743,650	94.33	104,760	5.67	1,848,410
Arkansas	961,007	91.63	87,771	8.37	1,048,778
California	11,820,000	96.18	475,022	3.87	12,290,000
Colorado	1,587,682	95.68	71,632	4.32	1,659,314
Connecticut	1,245,040	95.52	58,438	4.48	1,303,478
Delaware	286,697	97.64	6,933	2.36	293,630
District of Columbia	228,382	95.69	10,284	4.31	238,666
Florida	5,761,540	91.95	504,126	8.05	6,265,666
Georgia	2,878,808	92.26	241,409	7.74	3,120,217
Hawaii	386,897	94.11	24,207	5.89	411,103
Idaho	463,126	93.46	32,427	6.54	495,553
Illinois	4,151,297	91.79	371,405	8.21	4,522,702
Indiana	2,212,993	93.81	146,131	6.19	2,359,124
Iowa	1,098,310	96.77	36,651	3.23	1,134,961
Kansas	1,002,665	92.62	79,911	7.38	1,082,576
Kentucky	1,494,004	93.50	103,857	6.50	1,597,862
Louisiana	1,580,545	93.21	115,111	6.79	1,695,655
Maine	499,626	98.02	10,079	1.98	509,705
Maryland	1,982,015	95.99	82,858	4.01	2,064,873
Massachusetts	2,333,293	95.89	100,130	4.11	2,433,423

Michigan	3,603,384	95.08	186,577	4.92	3,789,960
Minnesota	1,810,724	96.94	57,126	3.06	1,867,850
Mississippi	967,309	87.83	133,992	12.17	1,101,300
Missouri	2,094,736	97.14	61,680	2.86	2,156,416
Montana	345,525	95.10	17,793	4.90	363,318
Nebraska	636,869	97.16	18,593	2.84	655,461
Nevada	682,837	95.62	31,291	4.38	714,128
New Hampshire	482,825	98.10	9,337	1.90	492,162
New Jersey	2,923,632	95.33	143,154	4.67	3,066,786
New Mexico	615,375	91.78	55,107	8.22	670,482
New York	6,723,145	95.06	349,047	4.94	7,072,192
North Carolina	2,790,267	93.16	204,733	6.84	2,994,999
North Dakota	240,980	94.91	12,919	5.09	253,898
Ohio	4,211,761	95.45	200,747	4.55	4,412,508
Oklahoma	1,256,564	93.07	93,613	6.93	1,350,177
Oregon	1,290,404	94.70	72,238	5.30	1,362,642
Pennsylvania	4,549,039	97.10	135,825	2.90	4,684,864
Rhode Island	382,492	95.73	17,071	4.27	399,563
South Carolina	1,477,303	92.91	112,772	7.09	1,590,074
South Dakota	280,421	95.66	12,724	4.34	293,145
Tennessee	2,091,189	91.96	182,731	8.04	2,273,919
Texas	7,092,901	93.15	521,209	6.85	7,614,110
Utah	691,313	96.24	27,030	3.76	718,343
Vermont	247,257	97.11	7,363	2.89	254,620
Virginia	2,622,031	94.53	151,709	5.47	2,773,740
Washington	2,152,959	95.81	94,125	4.19	2,247,084
West Virginia	701,128	92.86	53,905	7.14	755,033
Wisconsin	1,952,798	96.08	79,760	3.92	2,032,558
Wyoming	180,187	93.91	11,690	6.09	191,878

Source: Centers for Disease Control and Prevention (2004)

APPENDIX D

Key Provisions of Safety Belt Use Laws

State	Effective (1)	Enforcement	Fine	Seats	Vehicles Exempted (2)
AL	07/18/92	Primary	$25	Front	Designed for more than 10 passengers; model year before 1965.
AK	09/12/90	Secondary	$15	All	School bus.
AZ	01/01/91	Secondary	$10	Front	Designed for more than 10 passengers; model year before 1972.
AR	07/15/91	Secondary	$25	Front	School bus, church bus, public bus; model year before 1968.
CA	01/01/86	Primary	$20	All	None.
CO	07/01/87	Secondary (3)	$15	Front (3)	Passenger bus, school bus.
CT	01/01/86	Primary	$37	Front	Truck or bus over 15,000 lbs.
DE	01/01/92	Secondary	$20	Front	Postal service vehicles.
DC	12/12/85	Primary	$50 (4)	All	Seating more than 8 people.
FL	07/01/86	Secondary	$30	Front	School bus, public bus, truck over 5,000 lbs.
GA	09/01/88	Primary	$15	Front	Designed for more than 10 passengers; pickup.
HI	02/16/85	Primary	$20	Front	Bus or school bus over 10,000 lbs.
ID	07/01/86	Secondary	$ 5	Front	Over 8,000 lbs.
IL	07/01/85	Secondary	$25	Front	None.
IN	07/01/87	Primary	$25	Front	Truck, tractor, RV.
IA	07/01/86	Primary	$25	Front	None.
KS	07/01/86	Secondary	$10	Front	Designed for more than 10 people; truck over 12,000 lbs.
KY	07/13/94	Secondary	$25	All	Designed for more than 10 people.
LA	07/01/86	Primary	$25	Front	Designed for more than 10 people; model year before 1981.
ME	12/27/95	Secondary	$60	All	Manufactured without seat belts.
MD	07/01/86	Primary	$25	Front	Historic vehicle.
MA	02/01/94	Secondary	$25	All	Truck over 18,000 lbs.; bus and taxi operators.
MI	07/01/85	Primary	$25	Front	Taxi, bus, school bus.
MN	08/01/86	Secondary	$25	Front	Farm pickup truck.
MS	03/20/90	Secondary	$25	Front	Farm vehicle, bus.
MO	09/28/85	Secondary	$10	Front	Designed for more than 10 people, truck over 12,000 lbs.

State	Effective (1)	Enforcement	Fine	Seats	Vehicles Exempted (2)
MT	10/01/87	Secondary	$20	All	None.
NE	01/01/93	Secondary	$25	Front	Model year before 1973.
NV	07/01/87	Secondary	$25	All	Taxi, bus, school bus.
NH —					
NJ	03/01/85	Primary	$42	Front	None.
NM	01/01/86	Primary	$25 (4)	All	Over 10,000 lbs.
NY	12/01/84	Primary	$50	Front	Bus, school bus, taxi, emergency vehicle.
NC	10/01/85	Primary	$25	Front	Designed for more than 10 people.
ND	07/14/94	Secondary (5)	$20	Front	Designed for more than 10 people.
OH	05/06/86	Secondary	$25	Front	None.
OK	02/01/87	Primary	$20	Front	Farm vehicle, truck, truck tractor, RV.
OR	12/07/90	Primary	$75	All	Newspaper, mail, meter, transit vehicle.
PA	11/23/87	Secondary	$10	Front	Truck over 7,000 lbs.
RI	06/18/91	Secondary	$50	All	None.
SC	07/01/89	Secondary	$10	All	School bus, public bus; vehicle with no belts in rear.
SD	01/01/95	Secondary (5)	$20	Front	Bus, school bus.
TN	04/21/86	Secondary	$10	Front	Over 8,500 lbs.
TX	09/01/85	Primary	$50	Front	Designed for more than 10 people, truck over 15,000 lbs.
UT	04/28/86	Secondary (6)	$45	All	None.
VT	01/01/94	Secondary	$10	All	Bus, taxi.
VA	01/01/88	Secondary	$25	Front	Designed for more than 10 people, taxi.
WA	06/11/86	Secondary	$71	All	Designed for more than 10 people.
WV	09/01/93	Secondary	$25	Front	Designed for more than 10 people.
WI	12/01/87	Secondary	$10	All	Taxi, farm truck.
WY	06/08/89	Secondary	$25 (7)	All	Designed for more than 11 people, bus.
PR	01/19/75	Primary	$50	All	None.

(1) Effective date of first belt law in the state. (2) Most states exempt vehicles not manufactured with seat belts. (3) Primary enforcement for all positions

if driver is under 17 years. (4) Plus 2 points on license. (5) Primary enforcement for all positions if driver is under 18 years. (6) Primary enforcement for

all positions if driver is under 19 years. (7) Fine for driver is $25; fine for passengers over 12 years is $10.

Total states with safety belt use laws: 49 plus DC and Puerto Rico.

Source: National Highway Traffic Safety Administration (2004)

APPENDIX E

Census Regions and Divisions of the United States

Region I: Northeast

Division 1:
Connecticut
Maine
Massachusetts
New Hampshire
Rhode Island
Vermont

Division 2:
New Jersey
New York
Pennsylvania

Region 2: Midwest

Division 3:
East North Central

Indiana
Illinois
Michigan
Ohio
Wisconsin

Division 4:
West North Central

Iowa
Kansas
Minnesota
Missouri
Nebraska
North Dakota
South Dakota

Region 3: South

Division 5:
South Atlantic

Delaware
District of Columbia
Florida
Georgia
Maryland
North Carolina
South Carolina
Virginia
West Virginia

Division 6:
East South Central

Alabama
Kentucky
Mississippi
Tennessee

Division 7:
West South Central

Arkansas
Louisiana
Oklahoma
Texas

Region 4: West

Division 8:
Mountain

Arizona
Colorado
Idaho
New Mexico
Montana
Utah
Nevada
Wyoming

Division 9:
Pacific

Alaska
California
Hawaii
Oregon
Washington

APPENDIX F

NOPUS and BRFSS Safety Belt Use Rates in the United States, 2002

Jurisdiction	NOPUS (Observational Survey)	BRFSS (Self-report Survey)	Type of Enforcement
Alabama	79	83	P
Alaska	66	69	S
Arizona	74	80	S
Arkansas	64	65	S
California	91	92	P
Colorado	73	79	S
Connecticut	78	82	P
Delaware	71	80	S
District of Columbia	85	87	P
Florida	75	83	S
Georgia	77	83	P
Hawaii	90	89	P
Idaho	63	65	S
Illinois	74	74	S
Indiana	72	77	P
Iowa	82	76	P
Kansas	61	67	S
Kentucky	62	74	S
Louisiana	69	79	P
Maine	*	73	S
Maryland	86	87	P
Massachusetts	51	72	S
Michigan	83	84	P
Minnesota	80	76	S
Mississippi	62	73	S
Missouri	69	67	S
Montana	78	68	S
Nebraska	70	69	S
Nevada	75	79	S
New Hampshire	*	64	**
New Jersey	81	82	P
New Mexico	88	87	P
New York	83	80	P
North Carolina	84	87	P
North Dakota	63	52	S
Ohio	70	76	S
Oklahoma	70	77	P

Oregon	88	88	P
Pennsylvania	76	68	S
Rhode Island	71	75	S
South Carolina	66	75	S
South Dakota	64	55	S
Tennessee	67	81	S
Texas	81	86	P
Utah	80	72	S
Vermont	85	76	S
Virginia	70	78	S
Washington	93	86	S
West Virginia	72	74	S
Wisconsin	66	66	S
Wyoming	67	58	S

*An asterik indicates that the state did not conduct a survey that met NHTSA criteria.
**No law mandating the use of seat belts by adults.
2002 Centers for Disease Control and Prevention BRFSS Survey (2004) and
2002 National Highway Traffic Safety Administration NOPUS Survey (2004)

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American Red Cross, Instructor Candidate Training, 1997

American Heart Association, CPR and Emergency Cardiac Care Instructor, 1998

National Safety Council, HeartSaver FACTS Instructor, 1999 to present

American Heart Association, Basic Life Support Instructor Trainer, September 1999

American Heart Association, AED Instructor-Trainer, March 1999

American Heart Association, HeartSaver AED Instructor, March 1999

American Red Cross, Instructor, Responding to Emergencies, 1998 to present

American Heart Association, Regional Faculty, 2001 to present

Professional Memberships:

Graduate and Professional Students Association (GPSA), 1993, 1999

Tennessee Public Health Association (TPHA), 1995 to present

Society for Public Health Education (SOPHE), 1995 to present

Tennessee Society for Public Health Education (TSOPHE), 1995 to 2001
Elected Historian, 2000-2001

American Public Health Association (APHA), 1996 to present