UNDERSTANDING DRIVER AND OCCUPANT DYNAMICS IN RURAL TRAFFIC SAFETY

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ABSTRACT

The goal of this study was to contribute localized information for decision-making to allocate traffic safety resource in the Northern Rocky Mountain Region states of Montana, North Dakota, South Dakota, and Wyoming. The rural nature of the region differentiates its driving environment from other more populated U.S. regions. Analysis of Fatality Analysis Reporting System (FARS) data shows that while this region shares many traffic safety issues with its urban counterparts, the policies, educational initiatives, and enforcement activities may be better designed by considering local decision criteria. It seems evident that several shared traffic safety priorities in the region, including driver drinking and speeding, offer great opportunity for peer-learning and for leveraging resources to more effectively address this critical personal safety and public mobility issue.

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INTRODUCTION

Creating a safer transportation system is among the strategic goals at the U.S. Department of Transportation and many state agencies. Safe travel is an essential public good influenced by a wide array of policies, investments, and individual choices. Yet, in comparison to many other developed nations, the U.S. lags in its efforts to ensure a safe driving environment (Figure 1). Consensus on enhanced traffic safety as a mission is effortlessly reached. Agreement on the priorities, programs, goals, and responsibilities underlying this mission, however, are not so easily reached. With the creation of the National Highway Safety Board, the United States initiated its public goods context for addressing occupant safety as a health issue. Car manufacturers were forced to prioritize occupant safety in vehicles that had previously been designed primarily to maximize mobility through speed and reliability. More recently, safety features have become a prominent aspect in road design and the driving environment. Car manufacturers have even begun to compete based on their vehicles' safety features. National highway transportation legislation and state-based programs have also directed resources toward a driving safety in their competition for quality-of-living offerings to residents and businesses.

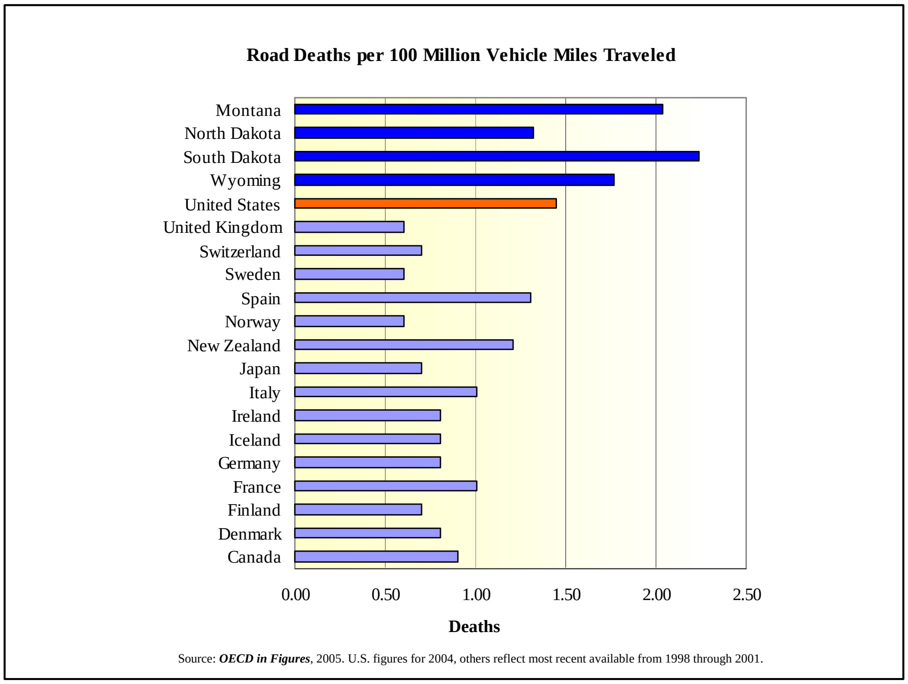


Figure 1 Regional and International Traffic Fatality Rates

While significant strides have been made in designing vehicles to protect occupants and to institutionalize safety in roadway design, a final front in the traffic safety mission, occupant behavior, has continued to be somewhat of an enigma. And until the driving experience is fully automated, it seems drivers and occupants are central in addressing this safety issue (Figure 2). The United States operates much like 50 nations with regard to the occupant aspects of traffic safety. While the federal government has had some success in enticing and coercing states to invest resources and enact legislation in occupant safety issues such as driver driving and seatbelts, gains have been somewhat stagnant during recent years. The objective of this research is to foster a greater understanding of this dynamic in traffic safety for the Northern Rocky Mountain Region.

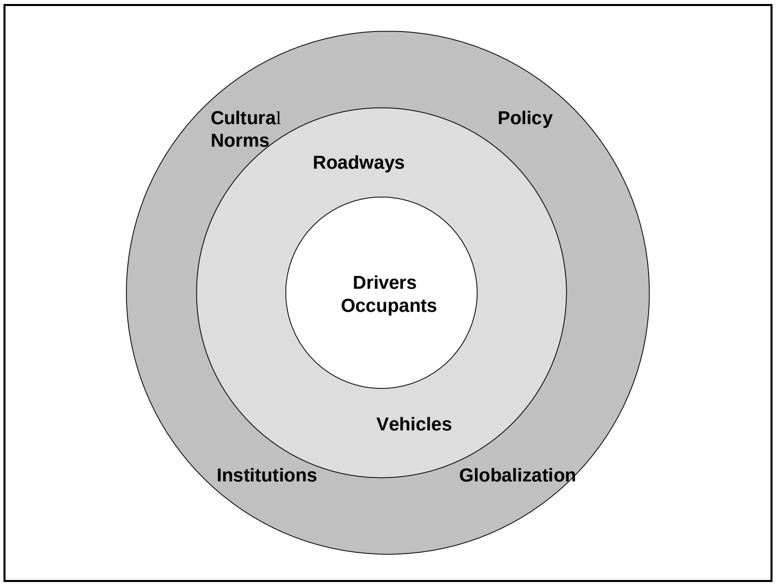


Figure 2 Traffic Safety Dynamics

The Rural Transportation Safety and Security Center (RTSSC) at North Dakota State University was created as a resource for regional pursuit of a safer, more secure transportation system. Traffic safety is an important aspect of the region’s transportation system given its contribution to quality of life, resource demands, and victim costs (UGPTI, 2006). This research consolidates some existing knowledge regarding traffic safety and develops new information relevant to understanding and addressing prominent traffic safety issues in the Northern Rocky Mountain Region (NRMR).

The NRMR initially has been defined as the focal geographic scope for the RTSSC activities based on shared socio-economic and travel characteristics such as low-density population, energy and agriculture industries, tourist travel, and extensive rural roads systems. It covers the northern four-states in the Federal Transportation Region 8, which includes Montana, North Dakota, South Dakota, and Wyoming (Figure 3). Discussions with stakeholders affirm that existing relationships and previous activities will be beneficial in pursuing safety initiatives for this four-state area as a unit. The driver behavior focus in this research is based on a Center-sponsored conference, current state highway safety initiatives, and stakeholder discussions. While there are many ongoing initiatives and a breadth of research literature directed at driver behaviors, a lack of substantial progress in achieving recent national goals, such a primary seatbelt law and graduated drivers licenses (GDLs), suggests that more information is needed to affect traffic safety and incident rates through driver behavior initiatives.

Figure 3 Federal Transportation Region 8

This paper is comprised of four sections. The first section establishes a basic premise for discussing traffic safety based on the rural and urban delineation in roadways and population geographies. Next, a review of traffic safety statistics and highway safety plans are presented for a more localized view of traffic safety situations and approaches for the NRMR member states. Exploratory analysis of traffic fatalities is presented in section three. The final section includes a summary and recommendations for traffic safety research and activities for the NRMR.

It is common sense to take a method and try it. If it fails, admit it frankly and try another. But above all, try something.

Franklin D. Roosevelt

DOES ONE SIZE FIT ALL?

Traffic safety broadly encompasses many factors such as road design, equipment characteristics, driver behaviors, emergency services, and weather conditions associated with personal and commercial mobility. A breadth of existing research is available in the field of traffic safety through academic and advocacy group publications. This paper does not attempt cover all the aspects of traffic safety, but rather draws together resources specifically selected to illuminate the driver factor in road traffic safety for the Northern Rocky Mountain Region (NRMR). A first step in this research is to statistically justify land-use and geographically specific traffic safety research. The rural and geographic delineations are underlying ideals in establishing the RTSSC to provide a local perspective for road safety research and technology transfer.

Rural/Urban

The definition of rural is far from concise (Rural Policy Research Institute, 2006; National Center for Education Statistics, 2006; Zhang, et al., 2002; Plessis, et al., 2002). The definitions of rural and urban are typically associated with population levels and population densities. The chosen definition may be selected based on a specific hypothesis, relevant jurisdictional boundary, or an industry norm. Rural and urban designations routinely used by the U.S. Department of Transportation (U.S. DOT) in planning and administration of surface transportation programs are based on population densities and clusters. Specifically, the U.S. DOT relies on U.S. Census Bureau (Census) designations of urban areas (UZA) and urban clusters (UC).

Urban areas include core census block groups or blocks that have population densities of at least 1,000 people per square mile, and surrounding census blocks that have an overall density of at least 500 people per square mile (U.S. Census Bureau, 2006). An urban cluster consists of a central core and adjacent densely settled territory that together contains between 2,500 and 49,999 people. Typically, the overall population density is at least 1,000 people per square mile. According to the Census, rural areas are generally defined as those areas and places outside urban areas. The critical urban/rural designation for FHWA administration purposes is generally UZAs with 200,000 residents or more for transit programs and designations of MPOs for planning activities (Federal Highway Administration, 2006). The UZA and UC designations are recognized because they are used in functional road definitions in the criteria for some programmatic activities. Given the wholly rural nature of the NRMR, it seemed important to go beyond these broad rural-urban designations to gain additional insight into traffic safety in terms of local and regional funding and planning.

Because of the nature of the data available regarding demographics, economics, and traffic accidents, it is desirable to distinguish the geography at the county level. The USDA Economic Research Service (ERS) provides an alternative for identifying rural and urban areas based on the size of their metro area and their metro area adjacency. The rural-urban continuum codes (commonly known as the Beale codes) delineate counties as metropolitan and non-metropolitan. The non-metropolitan includes both small urban areas and those rural in nature. Then using population levels, metro-county adjacency, and commuting patterns, county are grouped into nine categories (Table 1).

In addition to the FHWA UZA definitions, combinations of the ERS definitions in Table 1 are used. This additional county-level layer of rural/urban designation is valuable because traffic issues, public safety, and planning activities involve funding, resource allocations, and relationships that extend beyond federal funding and programs. It seems likely that the geographic economic and social relationships underlying these rural-urban continuum codes, are quite relevant. The definitions used in this research are metropolitan and nonmetropolitan. Two groups of metropolitan counties define major and small metropolitan areas. Major metropolitans are those counties in rural-urban continuum codes 1 and 2, as defined in Table 1. Small metropolitan counties are those in codes 3, 4, and 6. Nonmetropolitan counties are defined by combining codes 5 and 7. The nonmetropolitan and rural counties –defined as codes 8 and 9 – may be combined as appropriate. Although this is not a perfect system, the county does provide a common geographic dominator for joining many information sources that is relevant for planning and in socio-economic relationships. In addition, summaries can be created and weighted based on county data and joined to information that is available at the state or region level. An illustration of the county classifications is included in Figure 4.

Table 1 Rural-Urban Continuum Codes

Metro Counties:	
1	Counties in metro areas of 1 million population or more
2	Counties in metro areas of 250,000 to 1 million population or more
3	Counties in metro areas of fewer than 250,000
Nonmetro Counties:	
4	Urban populations of 20,000 or more, adjacent to a metro area
5	Urban populations of 20,000 or more, not adjacent to a metro area
6	Urban populations of 2,500 to 19,999, adjacent to a metro area
7	Urban populations of 2,500 to 19,999, adjacent to a metro area
8	Completely rural or less than 2,500 urban population, adjacent to a metro area
9	Completely rural or less than 2,500 urban population, not adjacent to a metro area

Source: Economic Research Service, 2006

Socio-Economic Geography and Traffic in the NRMR

The Northern Rocky Mountain Region includes approximately 390 thousand square miles that contain no major metropolitan counties (Figure 4). It houses fewer than 3 million residents, and comprises the four states that have the lowest population densities among the 48 contiguous states. Average age of residents is 36.5, compared to 35.3 years for the national average. Considering U.S. Census age groups, the region is in the 75th percentile for residents in the 18 to 24 and over 65, which are age groups generally associated with higher traffic safety risk.

Per capita income for the NRMR averaged $31,900 in 2005, which is 7% below the national average. State-level per capita incomes ranged from a high of $37,270 in Wyoming to a low of $28,900 in Montana. Although the per capita income information is typically used only in international studies of traffic safety, it provides one indicator for resources available for traffic safety initiatives at the local level.

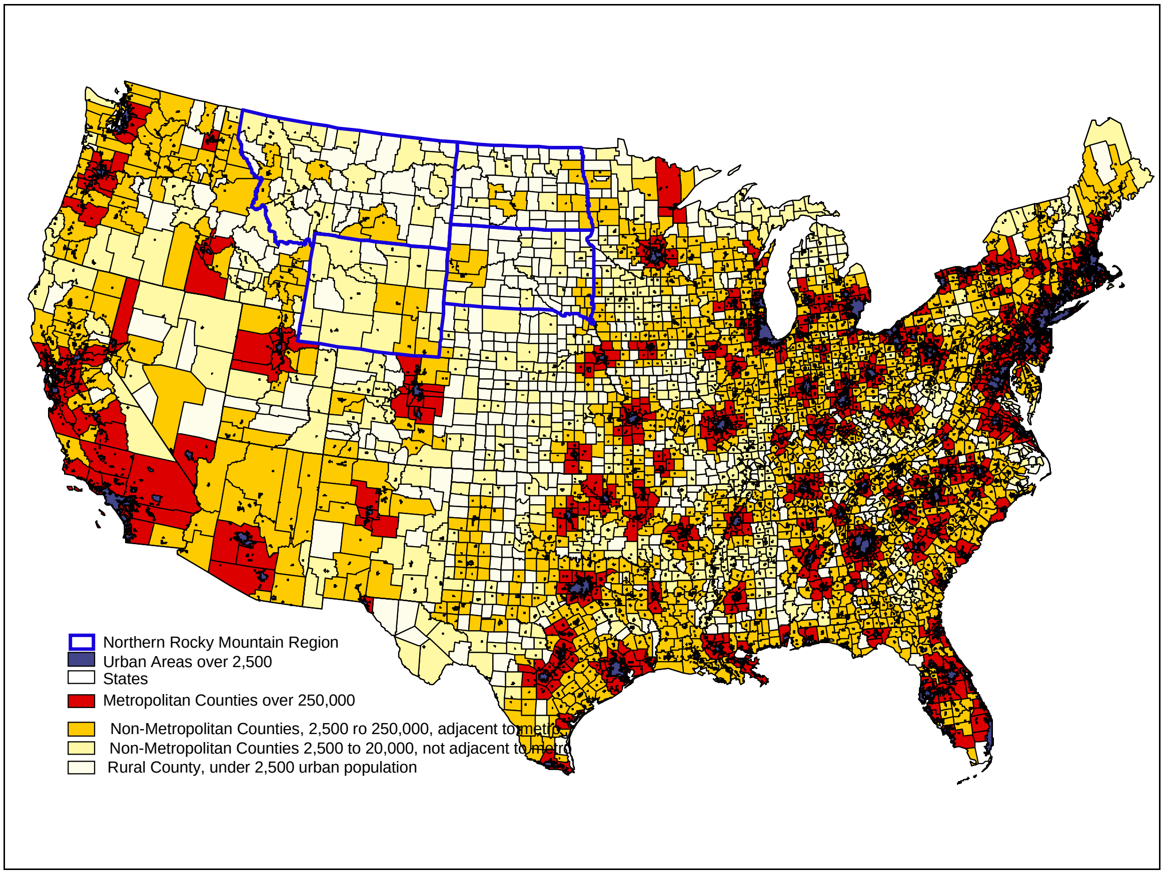


Figure 4 County Geography, Based on Rural-Urban Continuum Codes

Among the 48 states, the more aggregate gross state product numbers may offer some insight into the resources available for state-funded traffic safety initiatives (Figure 5). The gross state product ranges from $31,060 million in South Dakota to $28,900 million in Montana for 2005. Considering the resources available for traffic safety, these numbers convert to between 478 and 138 million dollars per lane mile among the states. The NRMR has 207 million dollars per lane mile, which is a mere 11% of the median for all 48-states of 1,840 million dollars per lane mile. Thus, coordinating and leveraging resources available for transportation safety within the NRMR is critical.

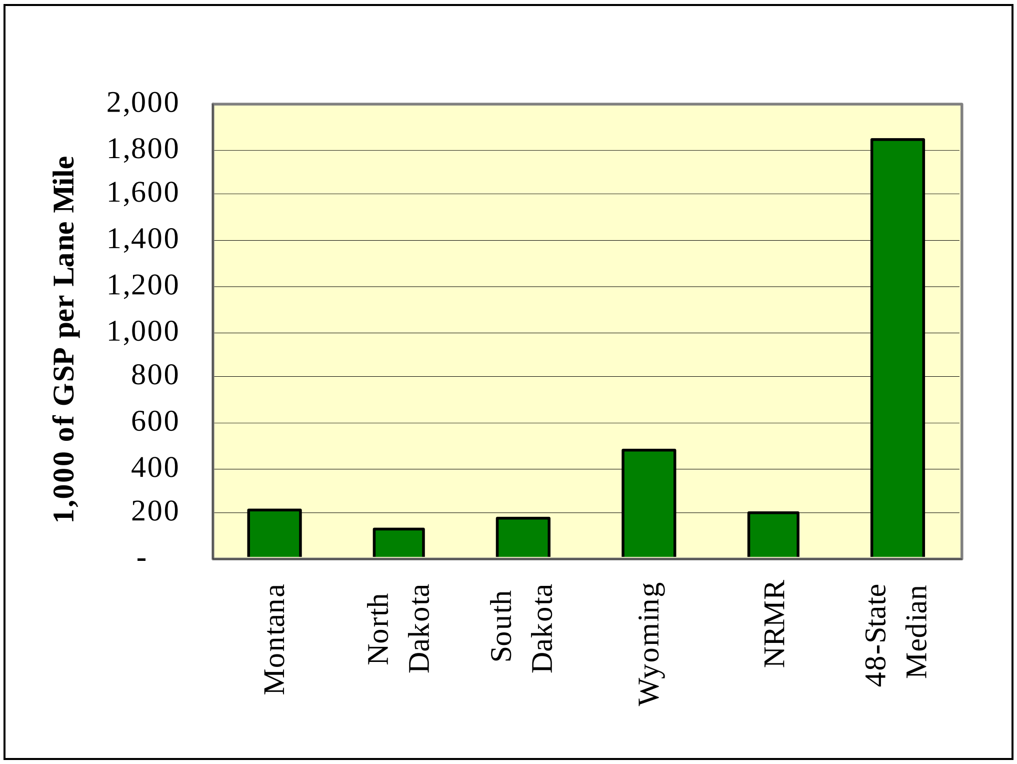


Figure 5 Gross State Product per Lane Mile, 2005

The states in the region do receive valuable federal dollars for pursuing light passenger vehicle traffic safety through primarily the FHWA and NHTSA programs. Under FHWA's mission, to "Improve Mobility on our Nation's Highways through National Leadership, Innovation, and Program Delivery," its program funds distributed to states are heavily directed toward safety enhancements in roadways infrastructure and operations. Funding is dispersed based largely on the federal funds road formula (CBO, 2006; GAO, 2006). NHTSA's mission is to "Save lives, prevent injuries and reduce economic costs due to road traffic crashes, through education, research, safety standards and enforcement activity" (NHTSA, 2007). Funding pools, such as grant programs listed in Appendix 1, are designed to encourage states to work on enhancing traffic safety by influencing user behavior through policy and education. The grant money available to individual state DOTs varies among the programs and depends on factors such as legislation and population. A moderate positive correlation is found between NHTSA SAFETEA-LU funds in 2006 and the average fatality rating calculated for the 48 states as the average of fatality rates per vehicle miles traveled (VMT), population, and licensed drivers (Pearson Corr.= -0.46, ∝.000). Each state in the NRMR receives more funding per licensed driver than the median for the 48 states (Figure 6). In 2006, the NHTSA funds per licensed driver in the 48 contiguous states range from $1.42 to $28.69 with a median of $3.50. Among the states, Wyoming has a substantially higher NHTSA funding level because it has neither a primary seatbelt law nor an open container law. Because these two high-priority pieces of traffic safety legislation have not been adopted, a portion of the state's infrastructure funds is re-directed to the NHTSA programs for education, enforcement, and legislation related to these initiatives.

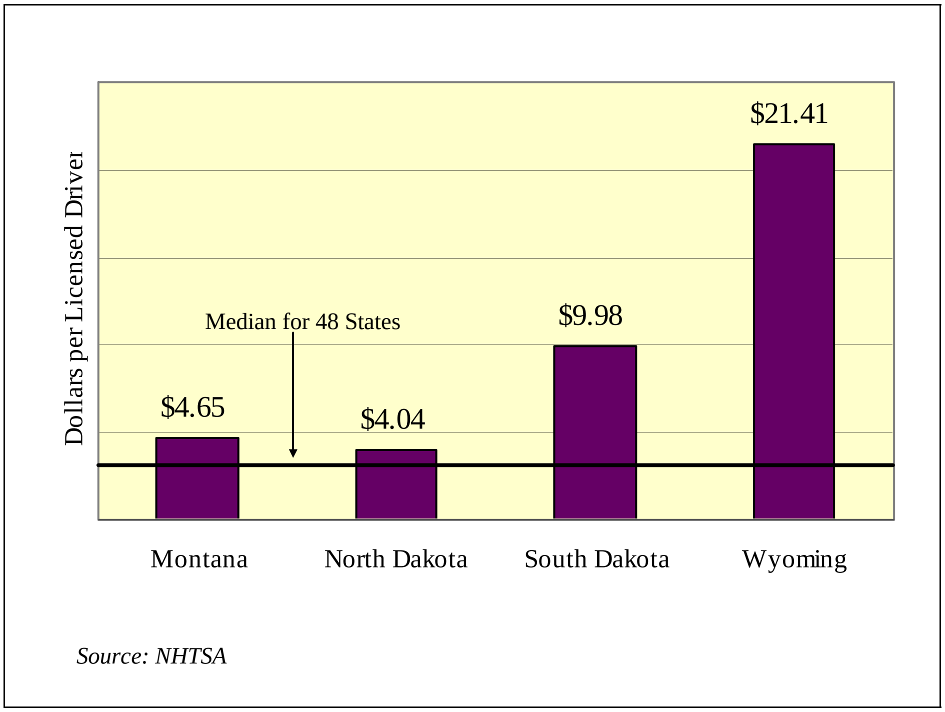
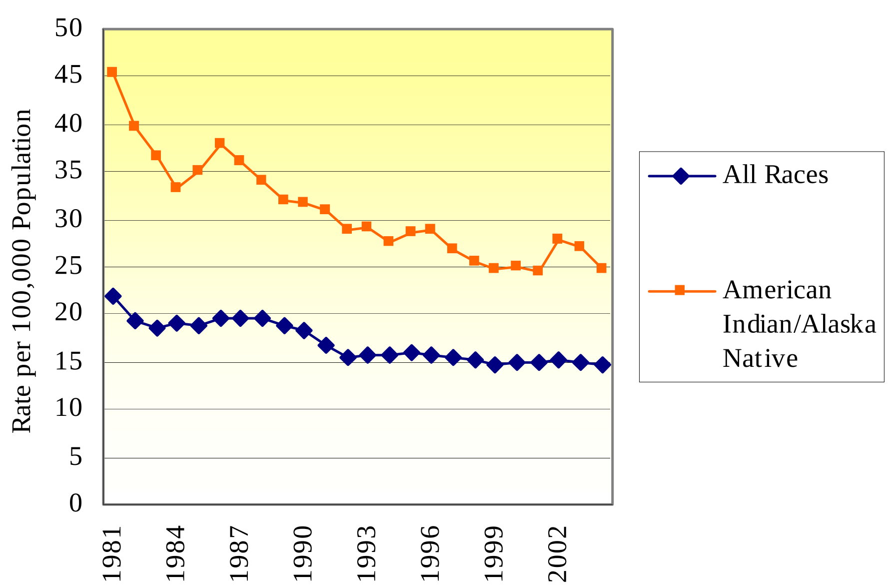


Figure 6 NHTSA Funds Received per Licensed Driver, 2006

Beyond the rural nature of this region, another distinction in traffic is the prevalence of Indian reservation populations in the NRMR. The U.S. Census reports that the American Indian and Alaska native population accounts for less than 1% of U.S. population. In contrast, the Native American population accounts for 5.8% of the NRMR population. Individual state Native American population representation ranges from 8.3% in South Dakota to 2.3% in Wyoming. Approximately 6.2 and 4.9% of the populations in Montana and North Dakota, respectively, are Native American.

Many tribes have identified traffic safety as a primary health risk for their populations. In 2000, the national average mortality rate from motor vehicle crashes for Native Americans was 27 deaths per 100,000 population − nearly twice the national average for all races of 15 per 100,000 population (Center for Disease Control, 2006). Considering a high-risk driver group from 16 to 20 years, the Native American death rate from motor vehicle crashes it 37 deaths per 100,000 population compared to an average 24 for the nation. All these numbers are significantly larger than the national average mortality among all residents for other unintentional death causes such as firearms, drowning, and fire, which are 0.27, 1.13, and 1.06 per 100,000, respectively.



Source: Centers for Disease Control,

Figure 7 Native American Traffic Deaths

Given the rural nature of the NRMR, it is expected that residents do more driving in their day-to-day travel for work and services than the average U.S. driver. A weak negative correlation is found between VMT and population density for the U.S. 48 contiguous states (Pearson Corr.= -0.35, ∝.000). Approximately 37,000 million vehicle miles are traveled each year in the NRMR, for an average of 13,000 per capita. This VMT per capita is 23% above the average VMT of 10,600 for the 48 states. The Region's VMT level is in the 75th percentile among a distribution for the 48 contiguous states.

Based on U.S. DOT statistics, approximately 70% of the NRMR travel is rural in nature. This level is much higher than the national rural share of VMT which is about 56%. All travel is nonmetropolitan and rural based on the geographic coding detailed in the previous section. Previous analysis suggests that rural travel does harbor distinct traffic safety issues (The Road Information Program, 2005; U.S. Department of Transportation, 2005). This research will use statistical methods to affirm these distinctions and discuss the challenges and opportunities for affecting traffic safety in NRMR nonmetropolitan and rural areas.

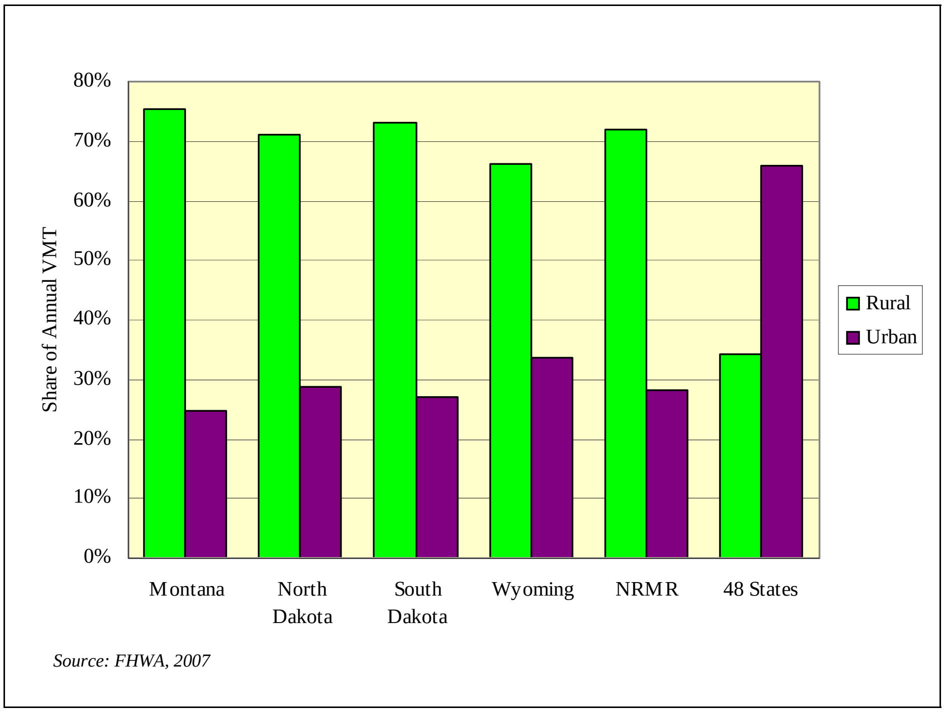


Figure 8 NRMR Vehicle Miles Traveled, by State

CAN WE MAKE DRIVING SAFER?

A look at traffic safety trends in other countries and selected states within the United States provides strong evidence that the NRMR states can improve driving safety (Figure 1). To provide a perspective of regional traffic safety, Figure 9 illustrates the average fatality rate by state considering an average of three commonly used indicators which standardize fatality rates by population, licensed drivers, and VMT. These fatality rates indicate that the NRMR is a relatively dangerous traffic zone. Montana, South Dakota, and Wyoming all fall into the 75th percentile for the distribution of the fatality rate among the 48 states.

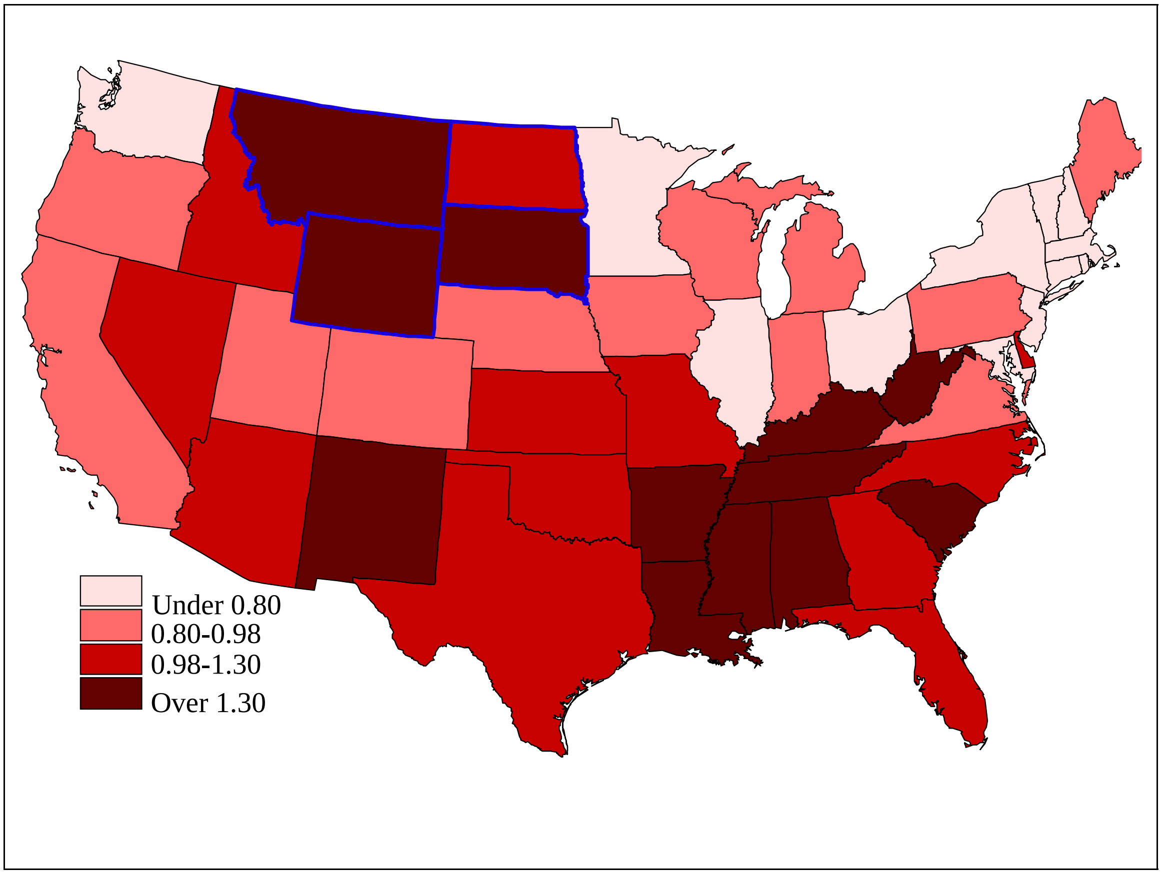


Figure 9 Average Fatality Rate by State 2005

Given the long history of the federal highway safety program driver initiatives and the cultural differences among states, it is important to view the efforts currently in the forefront for making improvements in the driver behaviors in the context of the local culture, institutions, and initiatives. The most recent federal surface transportation bill, the Safe Accountable, Flexible, and Efficient Transportation Act: A Legacy for Users (SAFETEA-LU), provides an excellent platform for encouraging states and locales, such as metropolitan planning organizations (MPOs), to focus resources on safer driving. The legislation requires state and local departments of transportation and MPOs to consider safety as one of eight planning factors. Each state is required to compose a Strategic Highway Safety Plan (SHSP). The SHSP requires states to integrate systematic safety planning into their programs and decision-making processes. States are encouraged to enhance transportation safety through a data-driven process of prioritization, goals, and assessment conducted in partnership with other stakeholders (FHWA, 2006b)

The SHSP is a component in the larger safety effort described by the FHWA Transportation Safety Program (TSP). The TSP provides a longer-term and broader context for ongoing activities related to transportation safety. The "TSP achieves road safety improvements through small quantum changes, targeted at the whole network. The short-term objective is to integrate safety considerations into the transportation planning process at all levels, specifically the SHSP, Statewide Transportation Improvement Programs (STIP) and the Transportation Improvement Programs (TIP) developed by the State Departments of Transportation (DOTs) and Metropolitan Planning Organizations (MPOs) respectively. This step should be followed by consideration of safety objectives in the longer range, 20-year plans that the state DOTs and MPOs are required to prepare and update periodically" (FWHA, 2006c).

SHSP Priorities and Strategies Synthesis

The Federal Highway Safety Improvement Program (HSIP) has been evolving for several decades. The purpose of the HSIP has always been to achieve a significant reduction in traffic fatalities and serious injuries on public roads. The passage of the SAFETEA–LU has brought a new requirement for this program for States in the form of the SHSP. According to the FHWA (2006b): " The purpose of a SHSP is to identify the State's key safety needs and guide investment decisions to achieve significant reductions in highway fatalities and serious injuries on all public roads. … The SHSP allows all highway safety programs in the State to work together in an effort to align and leverage its resources and positions the State and its safety partners to collectively address the State's safety challenges on all public roads."

The SHSP is to be developed as a public/private stakeholder cooperative effort in planning and execution of a comprehensive traffic safety plan. The process includes engaging stakeholders, identifying focus areas, selecting goals, and evaluating progress through data-driven criteria. This comprehensive plan integrates the 4Es – engineering, education, enforcement and emergency medical services. Through this coordinated effort, the FHWA expects the SHSP enhance traffic safety by:

- Establishing common statewide safety goals and priorities,
- Strengthening existing partnerships,
- Building new safety coalitions,
- Sharing data, knowledge, and resources,
- Quantifying the existing and needed resources and activities to meet the state's safety goal,
- Avoiding redundant activities and leveraging limited existing resources such as funds, people, and leadership attention, toward common objectives,
- Communicating the impact of investing additional resources for highway safety countermeasures, and
- Incorporating both behavioral and infrastructure strategies and countermeasures to have a greater impact on reducing highway fatalities and serious injuries on all public roads (FHWA, 2006b).

This overview of SHSP requirements and expectations provides a context for understanding current state-led traffic safety efforts in the NRMR. This review of the four rural state's Strategic Highway Safety Plans, or current highway safety working documents, provides an opportunity to identify shared priorities among the states as well as the unique interests of individual states in the region. It is important to point out that this review is not a critique or commentary, but rather a synthesis of the topics and measures included in the plans. It is up to each State to consider the facts and design its own program since states differ in capabilities, resources, experiences, ongoing programs, precluding laws or regulations, and other factors. Understanding commonalities among states is beneficial in drawing conclusions about the uniqueness of rural states' traffic safety issues and needs, and in positioning resources to best serve these interests.

The Plans

The SHSP is to be a shared vision for roadway safety that is developed through ongoing working group and community dialogue. While oversight for the SHSP process is provided by FHWA, each state DOT develops its own strategic approach and plan. The deadline for submitting the final plan to FHWA is October 1, 2007. The SHSPs are at various stages of development and execution among the NRMR states. This final plan should comprise a set of activities designed to reduce fatalities and serious injuries on roadways with action accountability systems and quantitative success measures. Coupling evaluation with action strategies ensures value in systematic evaluation and dynamic planning in understanding issues and learning from experiences.

The document reviewed for Montana is an August 2006 draft of its Comprehensive Highway Safety Plan (CHSP). As with many states, the CHSP is an existing roadways safety partnership platform that will be morphed into the SHSP. The Montana plan describes the ongoing process of identifying safety needs and study areas. It lists 12 emphasis areas and 43 strategies to support the goals implicit in the emphasis areas. Three of the emphasis areas are new and strategies are yet to be developed for them in the ongoing process.

North Dakota's Highway Safety Plan for Federal Fiscal Year 2006 is reviewed (North Dakota Department of Transportation, 2006). This document focuses on the process for selection of the studies that would support the accomplishment of the goals identified in the plan. The report includes supporting data and justification for each of its 10 goal areas and their total of 57 strategies. The bulk of the report is devoted to discussing each goal and describing each supporting study.

As with Montana, South Dakota had not published a SHSP at the time this research was conducted. As a proxy, the South Dakota 2006 Highway Safety Plan is reviewed (South Dakota Department of Public Safety, 2006). This document includes problem identification centered around 11 goal areas and the 71 strategies supporting them. Each of these goal areas is discussed individually and their benefits, performance measures, strategies and action items are listed.

The Wyoming Strategic Highway Safety Program dated September 2006 is reviewed (Wyoming Department of Transportation, 2007). This document is intended to be a high-level coordination document that lays out the general directions and hold the partners responsible for completion of the work, rather than specifying the work that is to be done. It does describe each of the 19 goals along with strategies, supporting activities and responsible partners. The 19 goals are divided into three groups: safety emphasis areas, continuing safety areas, and special safety areas. These plans offer insight regarding priorities, activities, and institutional responsibilities in the NRMR.

Comparison

In 1998, the American Association of State Highway and Transportation (AASHTO) approved its Strategic Highway Safety Plan (AASHTO, 2006). It was developed by the AASHTO Standing Committee for Highway Traffic Safety with the assistance of the Federal Highway Administration, the National Highway Traffic Safety Administration, and the Transportation Research Board Committee on Transportation Safety Management. The plan includes strategies in 22 key emphasis areas that affect highway safety within six focus areas S Drivers, Special Users, Vehicles, Highways, EMS, and Management. Each of the emphasis areas includes strategies with a framework for implementing multifaceted efforts based on traffic safety priorities. This document is a well-recognized model among federal and state transportation officials. It, along with a compendium of supplemental guides and resources, is commonly referenced in conjunction with state SHSPs.

To complete the comparison for the NRMR, each of the four state plans and the AASHTO model are put into a similar format of goals, objectives and strategies. This provides an opportunity to develop a table to illustrate which elements of the model are included in each of the states' plans (Table 2). The composite of all states has comprehensive coverage of all of the AASHTO goals except one, Increasing Safety Enhancements in Vehicles. This goal has much to do with promoting proper use of advanced safety features on vehicles such as anti-lock brakes, reducing CO poisoning. The goal continues to go on to Intelligent Transportation Systems innovations and beyond. Thus, it may be that these strategies are beyond the immediate and pressing safety concerns within the four rural States.

An examination of the commonalities of the states shows definite concentration of the areas of greatest emphasis in the United States: alcohol, occupant restraint, intersection design and operation, traffic records systems, and safe communities (Table 2). One can also add to that the states' emphasis on motorcycle and motor carrier safety as special user groups. They then emphasize rural issues of run-off-the-road crashes, enhanced emergency medical services (EMS), and general driver awareness of safe practices. Among the goals not explicitly addressed by AASHTO, the areas of hazard elimination being joined now by the new program area, high risk rural roads. It is evident that the NRMR states have a strong nexus of shared traffic safety interests, based on the review of safety plans.

Table 2 Four State Highway Safety Strategy Comparison, 2006

AASHTO Goals and Strategies	Montana CHSP	North Dakota SHSP	South Dakota HSP	Wyoming SHSP
Drivers				
Graduated Licensing for Young Drivers	New GDL Enforcement	Support GDL	Evaluate GDL Program	
Ensuring Drivers are Fully Licensed and Competent			√	
Sustaining Proficiency in Older Drivers	√	√	√	
Curbing Aggressive Driving and Speeding		√	√	√
Reducing Impaired Driving	√	√	√	√
Keeping Drivers Alert			√	
Increase Driver Safety Awareness	√	√	√	
Increase Seatbelt Usage and Improving Airbag Awareness	√	√	√	√
Highways				
Reducing Vehicle-Train Crashes				√
Keeping Vehicles on the Roadway	√	√		√
Minimizing the Consequences of Leaving the Road	Road Safety Audits	Roadway Safety Program		√
Improving the Design and Operation of Highway Intersections	Road Safety Audits	√	Traffic Signal Management	√
Reducing Head-on and Across-Median Crashes	High Crash Corridors/ Locations			Narrow Medians

Table 2 continued

AASHTO Goals and Strategies	Montana CHSP	North Dakota SHSP	South Dakota HSP	Wyoming SHSP
Designing Safer Work Zones			ITS to Identify Dangers	√
Special Users/Nonmotorized				
Making Walking and Street Crossing Safer				√
Ensuring Safer Bicycle Travel				√
Vehicles				
Improving Motorcycle Safety and Increasing Motorcycle Awareness	√	√	√	√
Making Truck Travel Safer	√		√	√
Increasing Safety Enhancements in Vehicles				
Emergency Medical Services				
Enhancing Emergency Medical Capabilities to Increase Survivability	√	√	√	
Management				
Improving Information and Decision Support Systems	√	√	√	√
Creating More Effective Processes and Safety Management Systems	√	√	√	√
Others Areas Specified				
Police Traffic Services		√	√	√
Roadway Hazard Elimination	Urban Area Crashes	√		
Native Americans	√			
School Zone Safety				√
High Risk Rural Roads				√
Access Control				√
Animal/Vehicle Collisions				√
Avalanches/Rock Fall				√

Emphasis Areas

Additional focus may be achieved by understanding the highest priorities the states share in their traffic emphasis areas. The top four safety emphasis areas for each state are listed along with their corresponding ranking among the state's individual emphasis areas in Table 3. Impaired driving and occupant protection top the list of traffic safety targets for activities among the four states. Road departure and speed/enforcement issues complete the list of the top four shared emphasis areas.

These safety emphasis areas are selected by states based on study of the data related to traffic safety and stakeholder consensus in the SHSP governing committees. These committees include state DOTs, law enforcement, emergency services, judicial, and other key stakeholder in the traffic safety arena. A champion is selected within each highway safety strategy advisory group. In Montana and North Dakota, the champion for the SHSP is from the Office of Traffic Safety within the respective state DOTs. In South Dakota, based on the HSP, the champion is director of the Office of Highway Safety in the Department of Public Safety. The SHSP champion in Wyoming is the State Highway Safety Engineer in the DOT. These champions are the primary agent in pursuing highway safety initiatives, such as those in Table 2.

Considering these top priorities, many goals and strategies are shared among the four states. Differences may be reflective of existing policy, past experiences, culture, and group composition. For example, Wyoming states that 35% of its fatal crashes in 2004 were alcohol related. Strategies to reduce driving under the influence (DUI) crashes include media campaigns, targeting the 21-34 age group, and legislation education. South Dakota reports 40% of its fatalities were alcohol related in 2004. Mitigation strategies include a media campaign similar to Wyoming's along with strengthening retail compliance checks, retail server training, and enforcement visibility. They also plan to engage local communities by developing safe community coalitions, supporting youth-targeted programs, and encouraging programs that offer alternative transportation choices to DUI. North Dakota traffic fatalities were alcohol related 38% of the time in 2004. North Dakota strategies include a mix of enforcement and education such as retailer compliance checks, visible enforcement, and community action (e.g. MADD and SADD) programs. Approximately 46% of Montana's traffic fatalities were alcohol related in 2004. Montana offers a different approach for reducing DUI fatalities in its state that is based more heavily in enforcement by pursuing stronger penalties for blood alcohol content (BAC) test refusal, developing a DUI offender tracking system, and adding notice into driver's license record for any drug or alcohol offense. While many states share aspects in their strategies to reduce DUI, it is also evident that they have ideas and experiences to share regarding the emphasis they have chosen in mitigation strategies. It may also be beneficial to look beyond the region and nation for successful DUI initiatives to understand if and how those initiatives may be applied locally.

Table 2 NRMR Safety Priorities Among States, Top Four in 2006

Emphasis Area	Average Rank	Montana CHSP	North Dakota SHSP	South Dakota HSP	Wyoming SHSP
Alcohol and Impaired Driving	**1.7**	2	1	1	3
Occupant Protection & Seat Belt Use	**2.0**	1	2	3	2
Run-Off-the-Road Crashes	**2.7**	4			1
Speeding and Enforcement	**2.7**		4	2	4
Older Drivers	**4.5**	3			
Tribal Traffic Safety	**4.5**		3		
Young Drivers	**4.5**		3		
Emergency Response Services	**4.7**			4	

CAN WE DISTINGUISH NRMR TRAFFIC SAFETY?

Traffic safety includes rather static factors such as road and vehicle design, uncontrolled elements including weather and wildlife, and dynamic decision-making processes involving risk perception and driver behaviors. Thus, traffic safety is truly a complex and multifaceted activity. As stakeholders work to enhance the safe driving environment, difficult decisions are made about allocating scarce financial and human resources. These stakeholders depend on a global compendium of experience and research. Previous research has suggested that differences exist in traffic safety issues for rural and urban roadways. Frequencies and means comparisons are used to validate this hypothesis here with regard to crash characteristics, driver characteristics, and driver behavior. The rural-urban designation is considered for the contiguous 48 states based on the roadway type and the socio-economic relationships described in the previous section. In addition, the characteristics of the NRMR are compared to those of other rural regions.

Passenger Vehicle Fatal Crashes

The National Highway Traffic Safety Administration's Fatality Reporting System (FARS) data from 2001 to 2005 are used in this analysis (National Highway Traffic Safety Administration, 2006). More than 500,000 observations are included in this data compilation. The dataset considered in this study is created by limiting fatal accidents to those in the contiguous 48 states involving passenger vehicles, which include cars, sport utility vehicles, and light trucks. Although pedestrian, motorcycle, and commercial vehicle fatality data is included FARS, this study's scope is limited to passenger vehicles to make the analysis and interpretation more manageable. These passenger vehicle fatal accidents account for approximately 85% of the records in the FARS dataset for the five-year study period.

The 449,000 remaining records include information for 172,133 accidents (Table 3). These fatal accidents involved 241,878 vehicles with an average occupancy of 1.78 persons. This analysis generally relies on FARS light passenger vehicle and driver observations to distinguish characteristics of the fatalities. Although information is included on all vehicle occupants and fatalities, statements based on these numbers may skew representation of driver and vehicle statistics through a weighing of occupants. For example, a negative correlation exists between driver age and vehicle occupancy rates (Pearson Corr=-0.08, $\propto$.000). Given this correlation, an issue discussed based on all occupant fatalities may skew the efforts toward younger drivers while the vehicle or driver incident rates may be higher for more experienced drivers.

Table 3 Light Passenger Vehicles in Fatal Crashes, 2001 to 2005

	Number of Accidents	Number of Vehicles	Occupants	Fatalities	Driver Fatalities
48 States	172,133	241,878	449,047	180,461	109,836
NRMR	2,772	3,454	6,334	3,030	1,972

Source: FARS, NHTSA

The crashes resulted in more than 180 thousand deaths in the United States between 2001 and 2005. Approximately 54% of these accidents are single vehicle in the U.S.-48, compared to 66% in the NRMR. The NRMR accounted for 3,030 of the U.S. light passenger vehicle crash fatalities, with the driver most commonly the crash victim. Driver fatalities accounted for about 65% of the light vehicle fatalities in the region, this share is higher than the 60% rate for the 48 U.S states. Approximately 88% of the fatalities in the 48-contiguous states occurred in major metropolitan areas, using the rural-urban continuum definition. Nationwide, nonmetropolitan and rural areas were the locations for 8 and 4%, respectively, of all fatal traffic accidents. A far greater share of fatal crashes accidents is attributed to areas beyond the urban centers in our region. In the NRMR, the nonmetropolitan and rural counties account for a majority of the fatal crashes with shares of 28 and 38%, respectively.

The licensed driver in the fatal crash is a state resident in the state in which the crash occurred 79% of the time in the NRMR, this is significantly lower than the rest of the nation where drivers are residents in 90% of the time (Chi=363.95, $\propto$ =0.0001; n=238,790). The shares are based on a comparison of state listed for the vehicle license and for the driver's license in the crash record. The higher proportion of nonresidents among the fatal driver numbers may be associated with tourism travel that is prominent in the NRMR economy. Among the states, Wyoming has the smallest share of resident fatal crash drivers at 65%. In Montana and South Dakota, the resident share is about 83%. North Dakota fatal crashes vehicles are driven by residents in about 86% of the cases.

Roadways Aspect

With regard to the location of these accidents and the relevance of the FHWA rural roads emphasis, 89% of fatal traffic accidents occurred on rural roads in the NRMR compared to 56% for the nation overall (Figure 10). The share of fatal accidents occurring on High Risk Rural Roads (HRRR or HR^3) is 33% for the NRMR, which is about 18% higher than the 28% share of for the 48-state road system. High risk rural roads are classified as "rural major or minor collectors or rural local roads with a fatal and incapacitating injury crash rate above the statewide average for those functional classes of roadways; or likely to experience an increase in traffic volume that leads to a crash rate in excess of the average Statewide rate" (U.S. Department of Transportation 2006). In its HSIP funds, each state is required to specifically evaluate and address safety issues on its most rural roads.

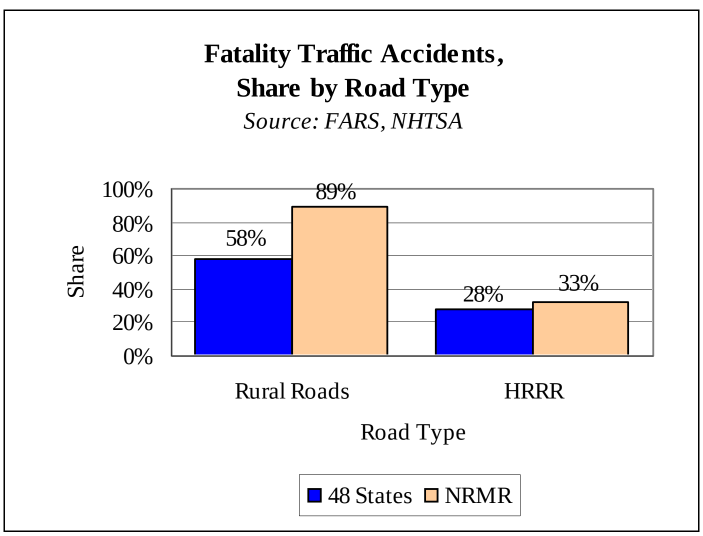
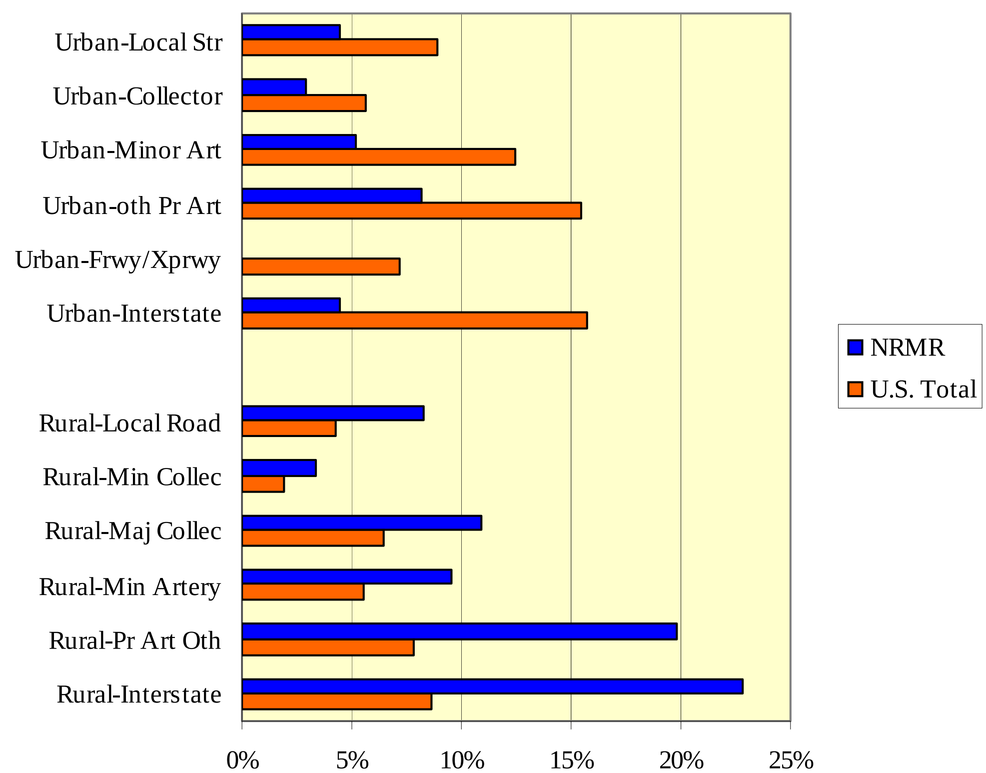


Figure 10 Fatal Accidents on Rural Roadways

Traffic in the NRMR generated approximately 36,151 million vehicle miles in 2005 (Federal Highway Administration 2007). Travel on rural roadways accounted for 78.8% total VMT for the region, compared to 34.7 of U.S. total VMT. Within the NRMR rural roadways, rural interstates have the largest share of total VMT at 22.8%. Rural-principle arterials other is second among the rural roads in activity level with 19.9% of all VMT for the region (Figure 11). The road roadways traffic concentration for the NRMR is evident, both in absolute and relative terms.



Source: FHWA, Highway Statistics

Figure 11 VMT by Functional Road System

Approximately 99% of the U.S. rural-interstates and rural-principle arterial functional road systems, which account for the highest shares of fatalities in the NRMR, are paved (FHWA, 2007). Paved roads are the surface type in 86 and 76% of U.S. and NRMR fatal accidents, respectively. Concrete roads are the surface for the next highest share of accidents in both the United States and NRMR, and slag gravel surfaces third (Table 4). The share of accidents attributed to slag gravel surfaces is much higher in the NRMR. Given the rural nature of this road geography, this is expected.

Table 4 Road Surface Type for Vehicles in Fatal Accidents, 2001 to 2005

	U.S. 48	NRMR
Concrete	9.1%	13.2%
Blacktop	86.0%	75.6%
Brick or Block	0.0%	0.0%
Slag Gravel Stone	1.0%	9.1%
Dirt	0.5%	1.4%
Other	0.1%	0.0%
Unknown	3.2%	0.3%
Total Accidents	241,878	3,454

Source: NHTSA, FARS

The road surface is another recorded road characteristic in the national fatal traffic accidents database. Given its prominence in road surface, blacktop is the dominant road surface for fatal accidents. Approximately 58% of 4 million miles of U.S. roadways are paved (2007, FHWA). Nearly all the 976 thousand miles of urban roadways are paved. The shares for urban and rural road functional systems are 96 and 46%, respectively. Information on VMT by paved and unpaved surface was not available.

Other Non-Driver Factors

Environmental and lighting conditions are also recorded in the fatal accidents records. The weather and illumination may affect driver's vehicle control and visibility. A majority of the accidents in the NRMR, 87.1%, occur during normal climate conditions. Snow conditions are indicated for 5% of the fatal accidents and rain for 3%. The FARS dataset includes five definitions for lighting conditions; these include daylight, dark, and three partial lighting conditions. Dark and partial light categories are combined here to create two conditions, daylight hours and other light hours. Just over half of fatal accidents, 52.1% occur during daylight hours in the NRMR compared to 50% for the U.S.-48. This difference is significant at the 95^{th} percentile (Chi=4.88, $\propto$ =0.0271; n=171,553). Because light and weather may be factors in traffic fatalities, it is important to try to control for these factors is assessing driver behavior and road characteristics.

Fatal Crash Occupants

Occupant characteristics are another factor in understanding the factors involved in fatal accidents. The occupants, including both drivers and passengers, are primary decision-makers in traffic safety. A better understanding of the actions and influences that affect their decision processes is critical in designing educational and enforcement traffic safety activities. Age distribution of fatalities for the NRMR from 2001 to 2005 is similar to that of the other 44 states, with a means of 34.7 and 35.3, respectively. A statistically significant difference is not found ($t=0.67$, $\rho=.50$; $n=422{,}334$). The driver age in fatal accidents does not vary statistically between the NRMR and the other 44 states ($t=1.84$, $\rho=.07$; $n=232{,}257$). The mean age of light passenger vehicle drivers involved in fatal accidents is 39.6 years. Figure 12 illustrates the distribution of drivers by age group.

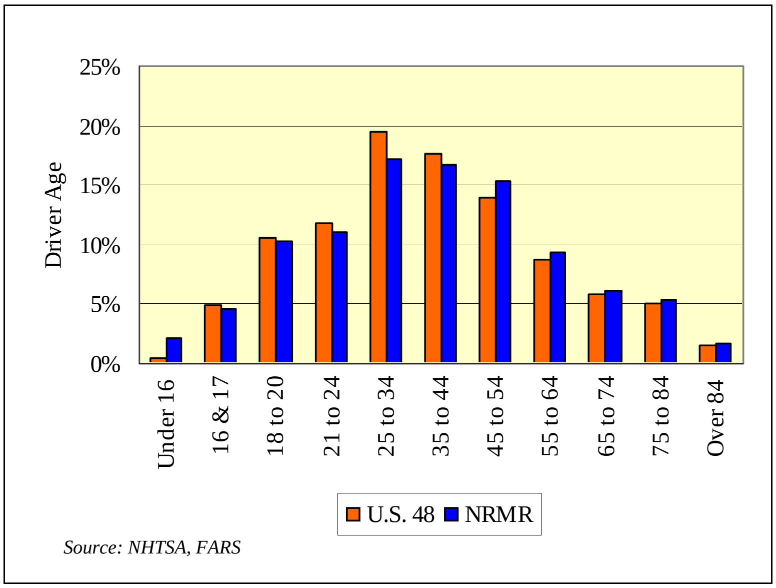
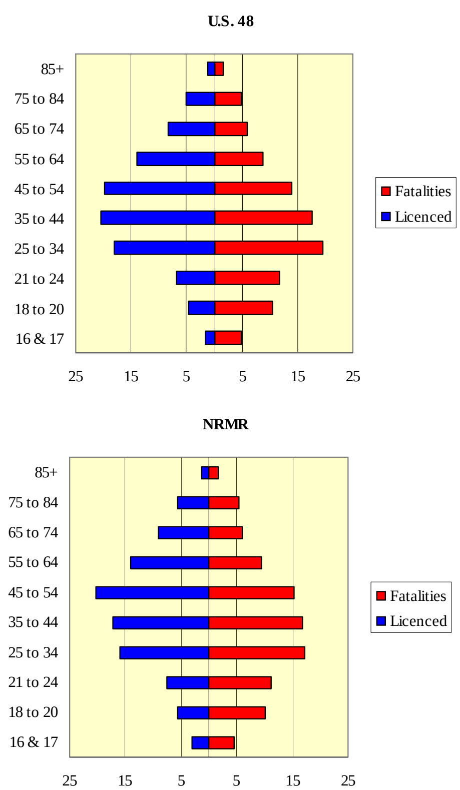


Figure 12 Driver Age for Vehicles Involved in Fatal Accidents

A second view of the distribution of the drive age considers representation of the drive age groups in fatalities relative to their representation as a share of the licensed driver population. For example, 16 and 17 year old drivers account for 1.7% of the U.S. licensed driver population. This age group represents 4.8% of the FARS driver group. The resulting ratio of 2.8 means that this driver age group is over-represented among in fatal accidents, assuming a 1 to 1 ratio is expected between fatality and licensed driver groups. This same calculation produces a ratio of 1.57 for the NRMR. Considering their representation in the driver population the young NRMR licensed drivers are less likely to be involved in fatal accidents than on a national basis. This age group is, however, still identified as higher risk being second only to 18 to 20 year olds — who have a fatality-to-license ratio of 1.83. The pyramid graph depicted in Figure 13 shows the representation of licensed drivers and the driver in fatal accidents by age group. The U.S.-48 state pyramid and the NRMR pyramid show similar distributions, with the younger age groups accounting for the largest disproportionate share of the fatal accidents considering the number of licensed drivers in these age groups. The older drivers also show a disproportionately large representation in the fatalities given the number of licensed drivers. The ratio for the NRMR is lower for all the younger driver age groups than it is for the U.S.-48 state geography. Another population statistic that should be considered for measuring the representation of drivers' age groups is VMT by each age group by this data is not available.

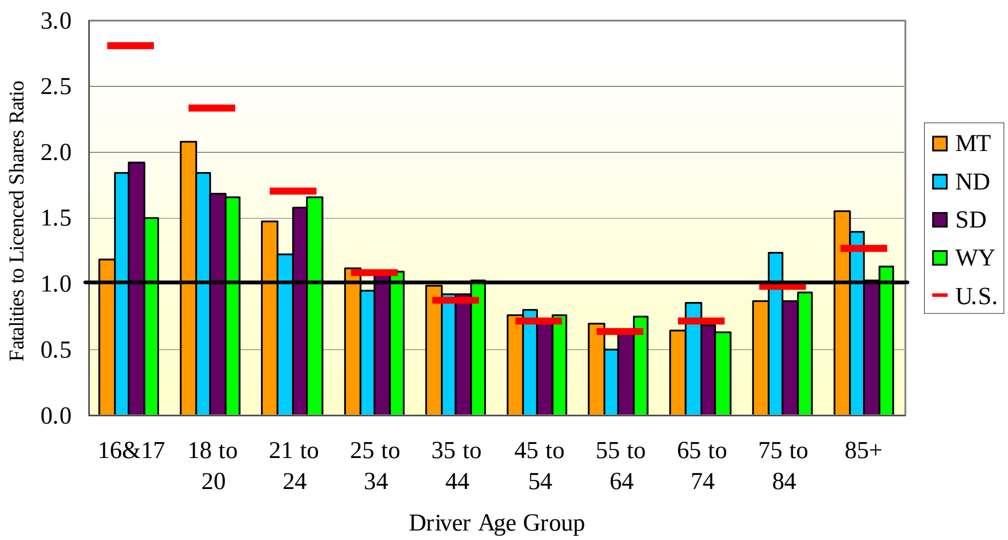


Source: NHTSA, FARS

Figure 13 Age Distribution of Fatal Accident Vehicle Drivers and Licensed Drivers

No significant variation in the driver age is found among the states (f=1.21, ρ=0.3061; n=2,293). The average age of drivers in the light passenger vehicle accidents was 40.3, 41.3, 39.4, and 40.3 respectively for Montana, North Dakota, South Dakota, and Wyoming.

Figure 14 shows the ratio of fatal accident driver age group share to licensed drivers age group share for fatal accidents that occurred between 2001 and 2005 for states in the NRMR. The NRMR is consistently better than the national average for the driver fatal crash rate for age groups under 24 years. The young-driver experience factor is evidenced with ratios well above 1.0 for the groups less than 24 years in both the U.S. and NRMR. The drivers age 35 to 54 in the NRMR have a slightly higher rate than the national average for their age group. Among the driver age groups, potential focus areas or trouble areas are suggested for individual states. For example, North Dakota is consistently above the national average for drivers aged 65 years or more. It should be noted that the population size for the driver age group 85 years and older is under 30 for all states, but these observations were distinguished from the 65 to 74 and 75 to 84 year groups to provide information that is often provided only in aggregate for older drivers.



Sources: FHWA and NHTSA

Figure 14 Driver Age in Fatal Accidents between 2001 and 2005, by State

The gender of fatal accident vehicle drivers also differs for the NRMR compared to the other 44 states. Approximately 70.6% of these drivers are male in the NRMR, compared to 68.8 in the remaining states for fatal accidents between 2001 and 2005. These means do vary significantly (Chi=14.26, $\propto$ = .00; n=241,787), suggesting that driver-based education and policy initiatives in traffic safety may need to be treated differently in the NRMR compared to other regions of the United States. A significant difference was not found among the NRMR states in the gender of fatal accident vehicle drivers (Chi=1.05, $\propto$ =0.369; n=3,403).

In addition to a higher accident rate, considering the fatal accident rate per licensed driver, younger drivers tend to have a higher vehicle occupancy rate. The average occupancy for 16 and 17 year-old drivers involved in fatal accidents is 2.1 in the NRMR and 2.4 for the 48 U.S. states. The average vehicle occupancy for drivers 75 to 84 years is 1.5 in the NRMR and 1.4 for the U.S. 48 states between 2001 and 2005 (Figure 15).

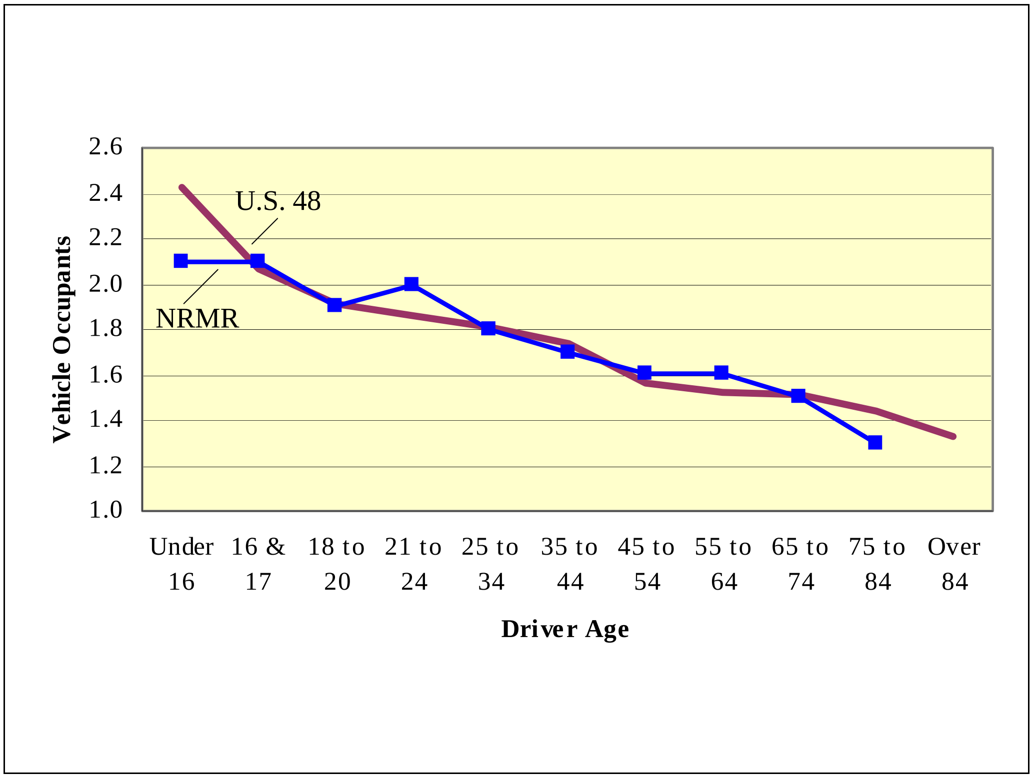


Figure 15 Average Vehicle Occupancy Rate by Driver Age Group, 2001 to 2005

Temporal distribution of fatal accidents is another factor to consider in understanding the nature of these incidents and the effectiveness of mitigation strategies. The accidents cycle in the NRMR does differ from the U.S. 48 considering fatal accidents between 2001 and 2005 (Figure 16). The share of fatal accidents occurring in any one month ranges from 7.1% to 9.0 for other U.S regions, while the NRMR has a much greater variation with a range of 6.0 to 11.2%. The lowest number of accidents occurred in February for all areas. The highest level of reported fatal accidents is during August for the NRMR, while October has the highest frequency for the rest of the United States.

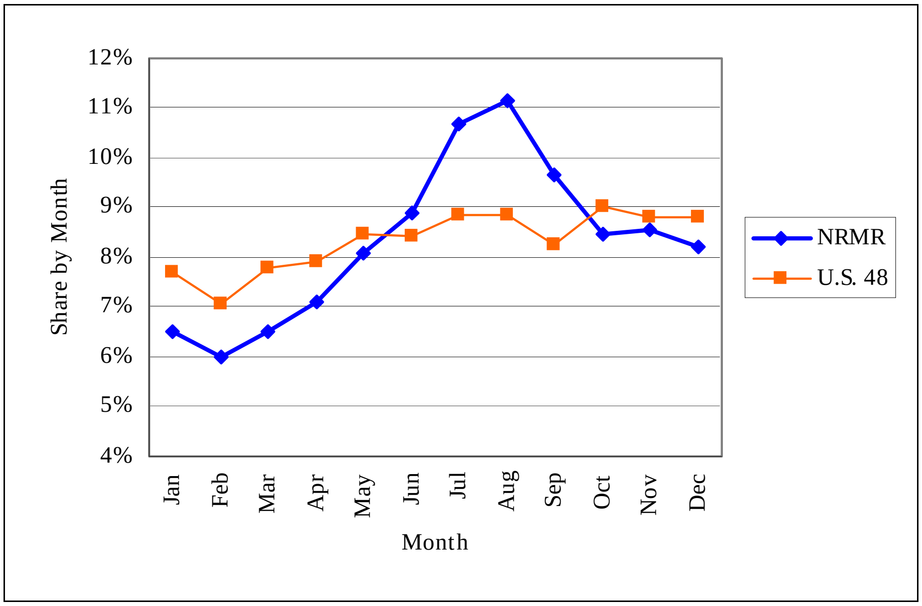
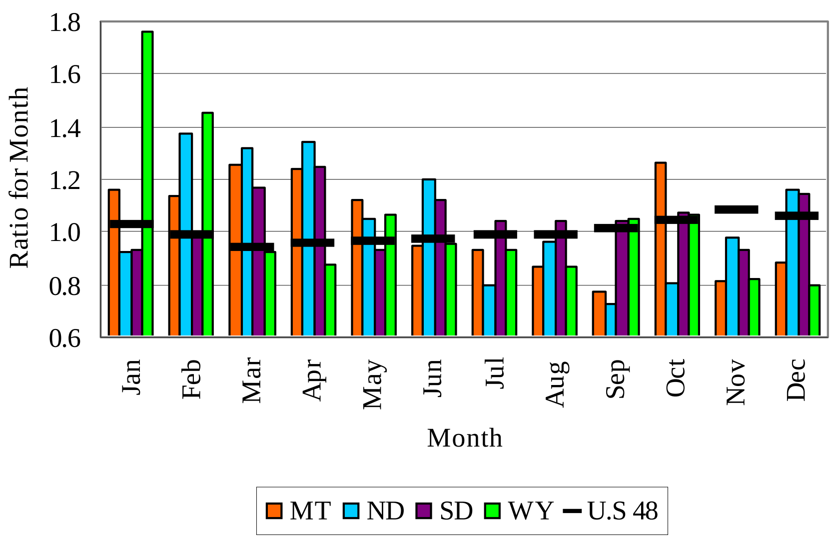


Figure 16 Temporal Distribution of Fatal Accidents, 2001 to 2005

Interesting insight is gained by standardizing these fatal accident numbers by VMT in each individual month. The VMT data is based on information from the ND DOT for its state, and from the FHWA for other states in the region (NDDOT, 2007; FHWA, 2007). The monthly U.S. fatal accident to VMT shares ratio is fairly consistent, ranging from 0.94 in March to a high of 1.08 in November. The November high ratio is calculated by dividing the share of U.S. fatal accidents in that month of 8.8% by the share of annual VMT, which is 8.3%. While September appears to be the most dangerous travel month, based on the number of accidents reported, February proves to be most dangerous for N.D. drivers when miles traveled is taken into consideration (Figure 17). Wyoming has its highest number of accidents during the summer months as does North Dakota. January and February, however, are peak months for accident likelihood when miles traveled is considered.



Sources: NDDOT, FHWA, and NHTSA

Figure 17 Monthly Accident to VMT Shares Ratios, 2001 to 2005

More detail on the rural roads portion of the fatal accidents shows a wide variation among states in the representation of fatal accidents when data is standardized by vehicle miles traveled (VMT) for the various rural roadway types. Rural roadway functional classes include rural-interstate, rural-principle arterial other, rural-minor artery, rural-major collectors, rural-minor collectors, rural-local road. The rural-minor collector roads and the rural minor collectors are the safest rural roadways in the NRMR, considering the ratio of VMT to vehicles in fatal accidents. These roadways represent 22.8 and 3.4% of all road miles in the NRMR. Overall, the rural-local roads have the largest disproportion in the fatal accidents when compared to the share of the system represented by this road function type (Figure 18). These rural roadways account for 8.3% of the rural VMT and are where 14.0% the fatal accident vehicles occur.

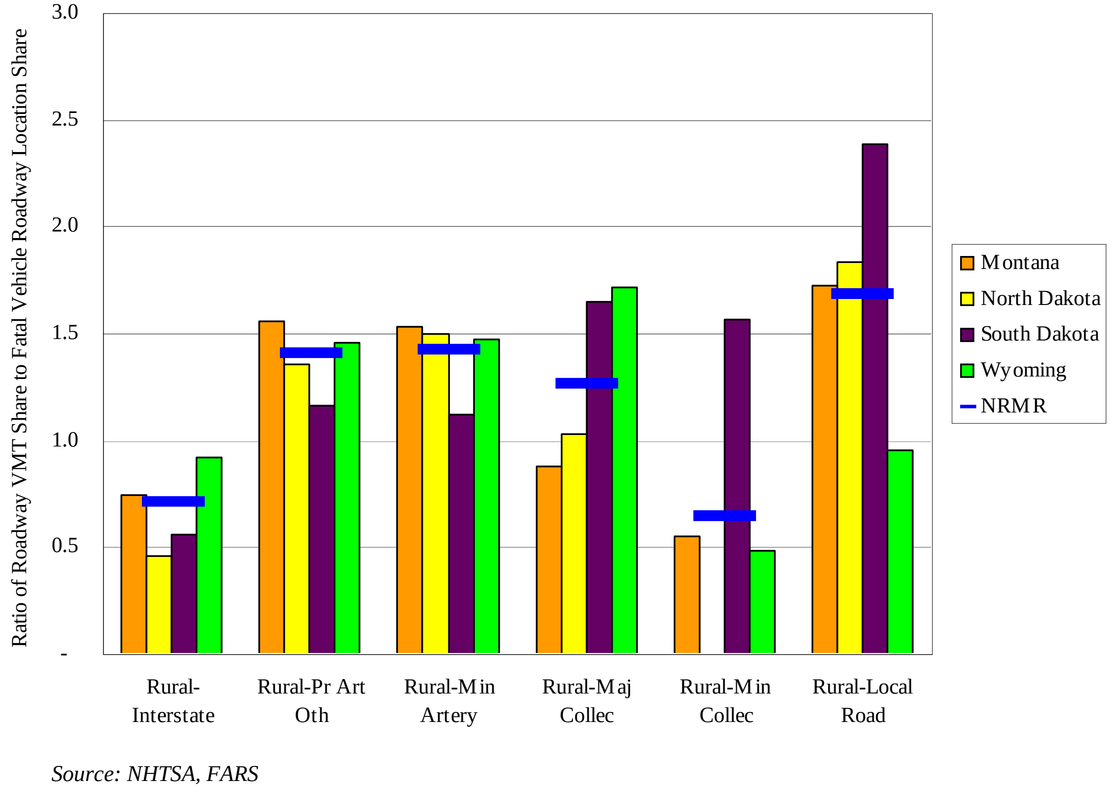


Figure 18 Rural Roadways Fatal Accident Representation

Aforementioned geographic and socio-economic differences between the NRMR and the more urban areas of the U.S. offer a basis for expecting and explaining some differences in traffic characteristics. Several traffic fatality characteristics are used to statistically validate distinctions including road surface, accident month, driver age, and vehicle occupancy. A statistically significant difference is found for many of these characteristics. These findings support previous claims that traffic safety issues and characteristics differ for rural and urban geographies and roadways. In addition, the premise for a need to offer more local and regional focus in traffic safety is supported by differences found between the NRMR and other regions in the United States as well as differences among the NRMR states.

EMPIRICAL ANALYSIS

The fatal accident statistics presented in the previous section create a profile of the fatal traffic accident population. The next step in this study of traffic safety is to highlight occupant behavior factors which are increasingly becoming a focal point in efficiently allocating traffic safety investments in education, infrastructure, and policy. Economically viable vehicle safety enhancements and low-cost road gains do offer some potential for additional engineering-based improvement in traffic safety. However, driver-behavior based solutions are an attractive choice in the traffic safety strategy. Given that a decision to not drink before driving costs $0 and the cost for an interlock device cost about $1,000 per year for those drivers who need "help" deciding, these are favorable alternatives in addressing a cost that is estimated to be $1 million per traffic fatality (El Nasser, 2005; National Safety Council, 2006). This exploratory analysis relies on the FARS file observations for light passenger vehicles from 2001 to 2005 for the NRMR. Considering the previous statistics and the priorities established in the regional SHSPs, this analysis focuses on four topic areas that include driver drinking, restraint, speed, and rollovers.

Driver Drinking

Impaired driving is a significant attribute of fatal crashes in the NRMR. Nationally, approximately one-fifth of all drivers involved in fatal accidents are characterized as drinking. The prevalence of the problem is evident in the 2005 FARS light-passenger vehicle data for the four states highlighted in this report as these four states have the highest shares for drivers who have been drinking. The highest share is North Dakota where 42% are reportedly drivers who have been drinking. Wyoming and Montana are close behind with their levels of drinking drivers at 40 and 38%, respectively. South Dakota has the lowest share among the NRMR states, but is fourth among the 48-states in the drinking driver share (Figure 19).

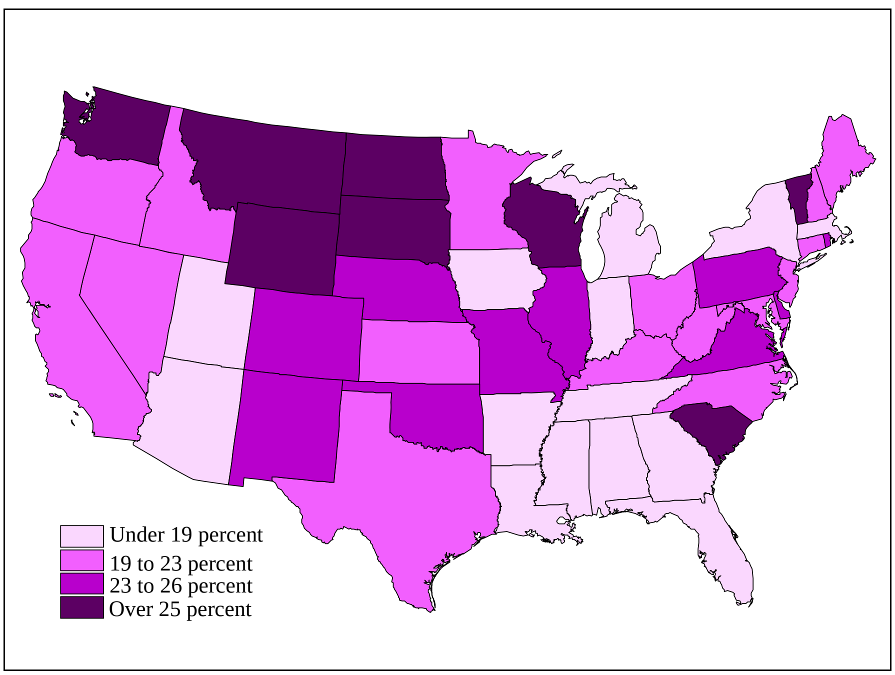


Figure 19 Share of Drivers Drinking in Fatal Crashes, 2005

The drinking driver is associated with other risky behavior such as driving too fast for conditions and not using seatbelts (Figure 20). Rollovers are also more common among drivers who have been drinking than they are in the balance of the fatal crash vehicle driver population. Approximately 67% of drivers involved in fatal crash vehicle rollovers in the NRMR were reported to have been drinking. This share is 42% higher than the share for drivers in the 48-state continuum, which is 39%. Rollover incidents have a moderately positive relationship to driver drinking in Montana, North Dakota, and South Dakota with Pearson Coefficients of 0.307, 0.382, and 0.311, respectively. In Wyoming, the relationship between driver drinking and rollovers is weaker but significant. These relationships provide viable evidence of the likeliness for drinking drivers to be involved in rollovers that may result from their decreased abilities such as reaction times and decision-making.

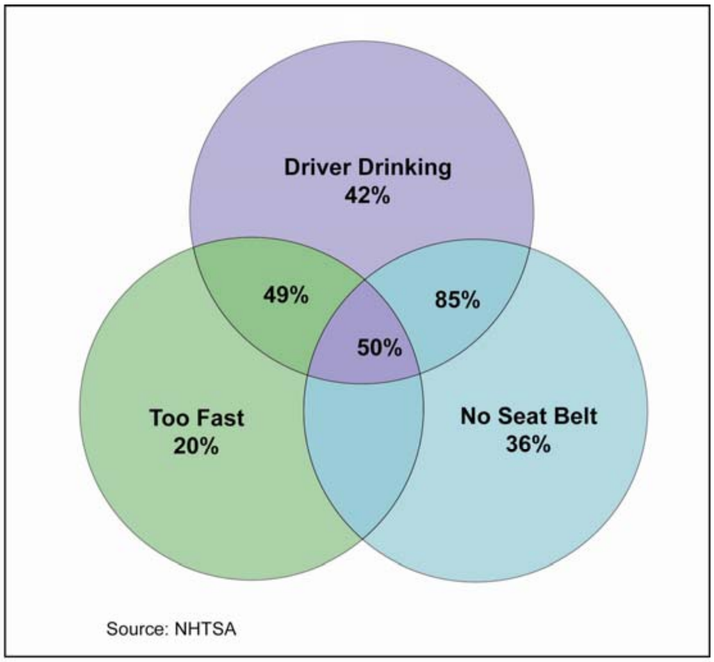


Figure 20 Risky Driver Behavior Incidence in NRMR Fatal Crashes, 2001 to 2005

Drinking drivers also exhibit higher risk behaviors related to personal safety and vehicle operations. The NRMR states are in the 25^{th} percentile for seatbelt usage considering drivers in fatal crashes. Driver seatbelt use in fatal crashes is found to be strongly correlated with observational seatbelt surveys (NHTSA 2001 and 2004) done in the 48 states (Pearson Corr=-0.615, ∝.000; n=48). A moderate negative correlation exists between seatbelt usage and drinking (Pearson Corr=-0.400, ∝.000; n=3,240) – as expected, a drinking driver is less likely to buckle-up.

Drinking drivers also have a greater propensity to speed than non-drinking drivers. A positive relationship exists between drinking and driving too fast with Pearson Correlation coefficient of 0.287 (∝.000; n=3254). This suggests that as drinking and driving is deterred, incidence levels for other traffic fatality risk behaviors may also begin to decline.

Correlation between driver drinking and not using seatbelts was moderate for all states in the NRMR, with Pearson Correlation Coefficients ranging from -0.371 to -0.446. The relationship between driver drinking and going too fast for conditions in fatal crashes is significant in North Dakota and South Dakota, with Pearson Coefficients of 0.341 (n=880) and 0.330 (n=538), respectively. Coefficients for Montana and Wyoming are weaker at 0.278 (n=1,214) and 0.244 (n=775), respectively, but also significant at the 99th percentile. These statistics offer some insight into the DUI problem and its corollary issues for the NRMR.

Restraint

Driver age is a factor that is often considered in identifying driver risk groups for traffic safety policies and education programs in occupant restraint. The composition of the driver population ages in the NRMR was provided in the previous section. A wide array of information in the medical and social sciences has been used to establish some well-recognized beliefs regarding risk behaviors among driver-age groups. The analysis offered in this section identifies and tests hypotheses associated with some common beliefs.

The first hypothesis is that driver age is positively correlated with seatbelt use. For drivers in 2003, a NHTSA report shows young drivers, ages 16 to 24, report the lowest levels of consistent seatbelt usage at 79% (Boyle and Vanderwolf 2004). This compares to a national average of 84% and a high of 90% among drivers aged 65 years and older. Higher usage is associated with female drivers across the population is a second hypothesis. Males reported a higher usage level of 81%, compared to 71% for females in national seatbelt usage. These numbers are based on a national phone survey of motor vehicle drivers. Due to data availability, the correlation between fatal accident seatbelt usage and driver seatbelt usage surveys is used again here. The strong correlation, as previously referenced, allows for seatbelt usage among fatal crash vehicle occupants to be considered as reflective of general population seatbelt usage.

Figure 21 shows seatbelt usage in fatal crashes among NRMR and U.S. drivers by age and gender between 2001 and 2005. Male drivers in the NRMR are consistently less likely to use seatbelt protection compared to average usage for the U.S.-48. Usage rates among NRMR males are 16 to 67% below the national average across the 11 age groups. While NRMR female drivers do fare better than their counterparts in the comparison of seatbelt use across age groups, the rate is consistently below the national average.

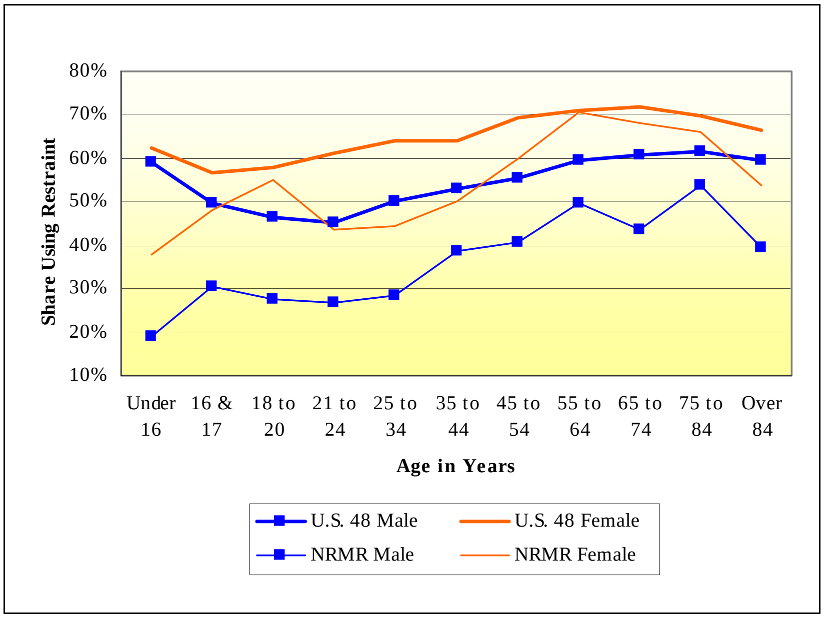


Figure 21 U.S. and NRMR Restraint Use in Fatal Accidents by Gender, 2001 to 2005

As expected, a very significant difference in seatbelt usage among fatal crash occupants, by age and gender, is found comparing the NRMR and other 48 states (females: f=14.66, ρ=0.0001; males: f=26.16, ρ=0.0001). The average usage rate for light-passenger vehicle fatal crash occupants, between 2001 and 2005, is only 42% in the NRMR compared to 57% for the U.S.-48. The usage levels by age group offer insight for occupant restraint programs that target the most at-risk driver populations, considering levels achieved by other states and the potential to make improvements within the various gender-age groups. Compared to the national mean, NRMR males under age 34 and females aged 24 to 34 years seem to offer the greatest potential for improvement. The prospective for gains from increased seatbelt usage are evident in the fatal crash resulting injury statistics provided in Figure 22. NRMR occupants who failed to use restraint systems suffered fatal and incapacitating injuries in 81% of the cases compared to 52% for occupants using proper occupant restraint, considering fatal crash vehicle occupant injuries between 2001 an 2005.

Figure 22 provides an illustration of occupant restraint use decisions and fatal accident outcomes. An initial scan of the figure shows a much lower occupant restraint use in the NRMR. The fatality rate for unrestrained occupants in fatal crashes is more than double that for properly restrained vehicle occupants. For occupants utilizing restraint systems in the NRMR, crashes result in fatal and incapacitating injury for about one in four occupants. Occupants without restraints suffer fatal or incapacitating injuries in about three of four cases. The occupant protection emphasis by traffic safety advocates is well-justified, given these statistics.

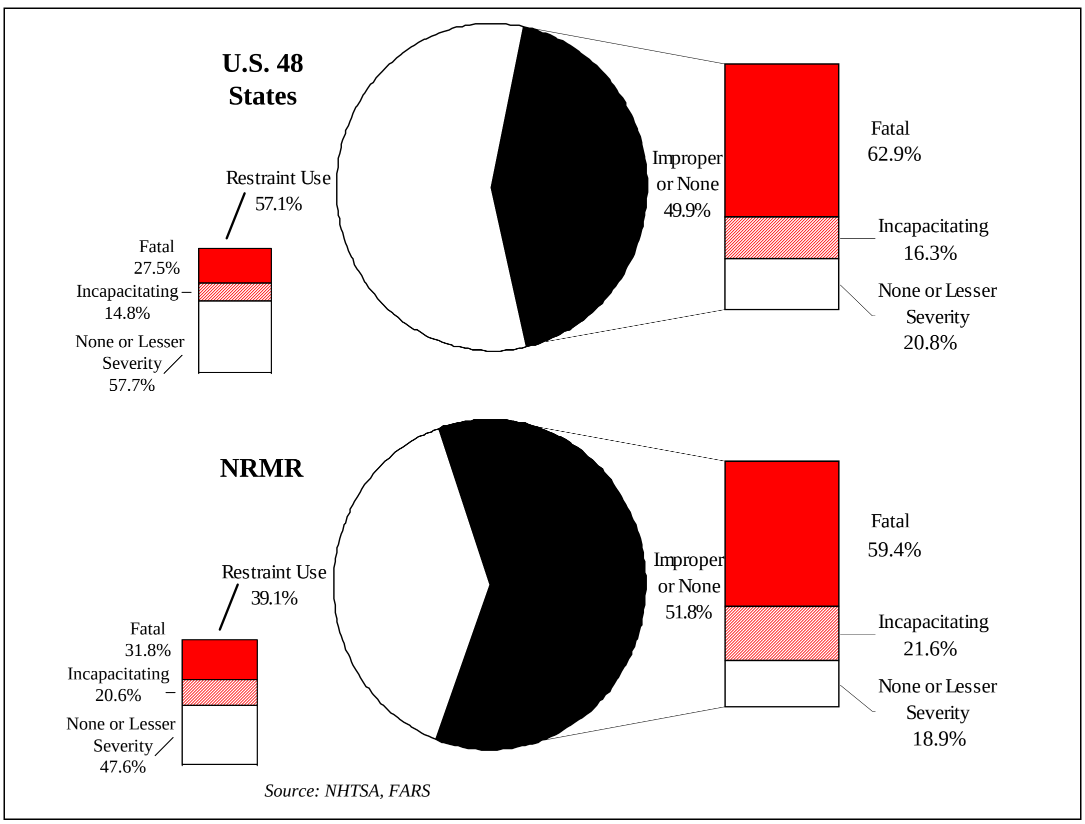


Figure 22 Occupant Restraint Usage and Injuries, 2001 to 2005

Speeding

Speed-related traffic incidents are a concern for U.S. drivers. About one-fifth of all traffic fatalities between 2001 and 2005 involved vehicles being driven too fast, considering the posted speed limited or other factors such as weather that may affect visibility or road surface condition. NHTSA has identified this issue as an evaluation area for their behavioral safety program evaluation (National Highway Traffic Safety Administration, 2004). As with other traffic fatality factors, it is difficult to understand the role of speeding as a driver behavior casual factor in traffic deaths because there is often multiple crash factors along with other driver, road, vehicle, and environmental differences. The exploratory analysis offered here provides insight regarding this risk behavior and the fatal crash vehicle drivers who operated vehicles too fast for conditions.

Considering the prevalence of speeding in the fatal crash data, speeding appears to be a critical issue for most states in the NRMR (Figure 23). The median value among the 48-contiguous states is 22%. While North Dakota falls just below this value at 20% the other three states in the NRMR are in the 75th percentile for the share of fatal accident vehicles reportedly traveling too fast for conditions. Montana has the highest rate with more than 30% of its fatal crash vehicles being driven too fast for conditions. About 26% of the vehicles involved in fatal crashes in South Dakota and Wyoming between 2001 and 2005 reportedly involved driver speeding.

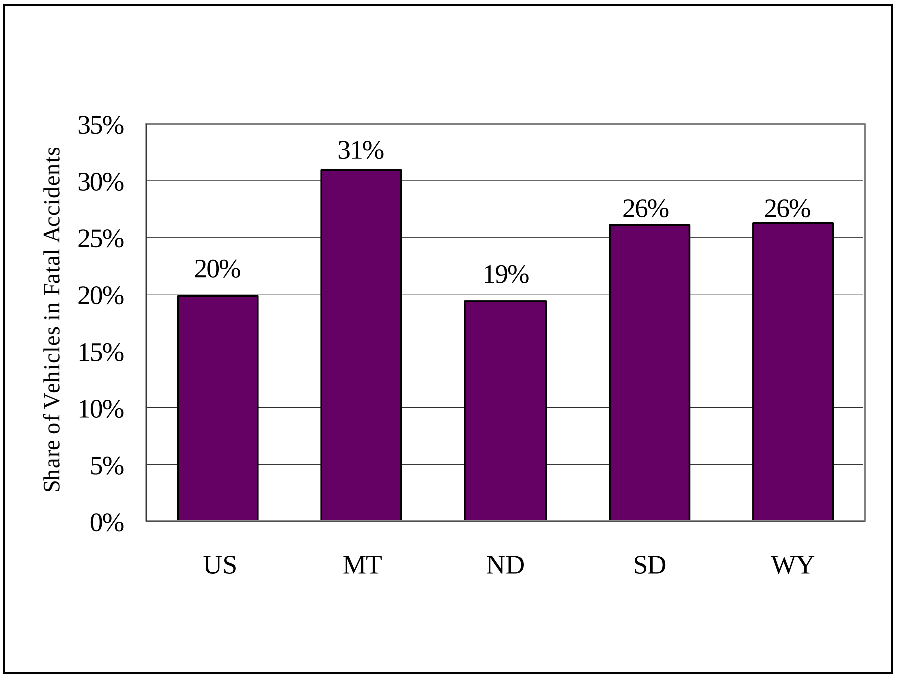


Figure 23 Fatal Crashes Involving Driver Speeding, FARS Data 2001 to 2005

The Pearson correlation coefficients also offer some insight into speeding as a contributing factor considering some other characteristics for fatal crashes (Table 5). Pearson values between 0.30 and 0.49 are viewed as moderate in strength. A moderate negative correlation is found between driver drinking and seatbelt use, suggesting that these two risk behaviors are related. Seatbelt usage is also found to have a significant relationship to speeding. A weak negative correlation is found between driver age and speeding. This provides some evidence to support previous findings that younger drivers are more prone toward risk behaviors (Williams 2001; National Highway Safety Administration 1998). The weak negative significance of the gender attribute is also in agreement with previous literature that suggests males are more likely to engage in risky driving behaviors than females. Although the individual effects of these factors in fatal accidents cannot be determined from correlation coefficients, these relationships suggest that further research is needed to better understanding the causal nature and the factors that influence driver behavior and risk perception.

Table 5 Fatal Crash Factor Correlations for NRMR, FARS 2001 to 2005

	Gender (1=Male, 2=Female)	Seatbelt (0=No; 1=Yes)	Driving Too Fast (0=No; 1=Yes)	Driver Drinking (0=DNo; 1=Yes)
Age Group	-0.0086	0.1586	-0.2252	-0.2093
	0.6158	<.0001	<.0001	<.0001
	3403	3193	3403	3403
Gender		0.1659	-0.0481	-0.1309
		<.0001	0.005	<.0001
		3193	3407	3407
Seatbelt			-0.2106	**-0.4113**
			<.0001	<.0001
			3193	3193
Driving Too Fast				**0.2920**
				<.0001
				3407

Correlations among the factors for individual states in

Table 6 show that the drinking driver is a higher-risk driver given the risky driving behaviors including choosing not to use a seatbelt and driving too fast. Driver drinking has a moderate negative relationship to driver seatbelt use in all four NRMR states, with Pearson correlation coefficients ranging from -0.37 to -0.45. Speeding also has a notable correlation with driver drinker in both North Dakota and South Dakota. Values between +/-0.30 and +/-0.49 are considered to be moderate. The correlation between speeding and driver drinking in Montana and Wyoming are considered to be in the upper range of the low values which are statistically significant values between +/-0.10 and +/-0.29. The only other moderate relationship highlighted in Table 8 is the negative correlation between driver age and driving too fast in North Dakota. This relationship poses a focus for more in-depth analysis that may be used to target education and enforcement efforts aimed at better decision-making regarding driving speeds relative to factors such as posted limits, road surface conditions, and environmental settings.

Table 6 Fatal Crash Factor Correlations for the States, FARS 2001-2005

Montana

	Gender (1=Male, 2=Female)	Seatbelt (0=No; 1=Yes)	Driving Too Fast (0=No; 1=Yes)	Driver Drinking (0=No; 1=Yes)
Age	-0.0080	0.1265	-0.2126	-0.2162
	0.7816	<.0001	<.0001	<.0001
	1214	1131	1214	1214
Gender		0.1680	-0.0447	-0.1092
		<.0001	0.1194	0.0001
		1131	1214	1214
Seatbelt			-0.2272	**-0.4460**
			<.0001	<.0001
			1131	1131
Driving Too Fast				0.2778
				<.0001
				1214

South Dakota

	Gender (1=Male, 2=Female)	Seatbelt (0=No; 1=Yes)	Driving Too Fast (0=No; 1=Yes)	Driver Drinking (0=No; 1=Yes)
Age	-0.0727	0.1588	-0.2318	-0.2163
	0.0312	<.0001	<.0001	<.0001
	877	795	877	877
Gender		0.1011	-0.0281	-0.0856
		0.0043	0.4057	0.0111
		795	880	880
Seatbelt			-0.1617	**-0.3943**
			<.0001	<.0001
			795	795
Driving Too Fast				**0.3306**
				<.0001
				880

North Dakota

	Gender (1=Male, 2=Female)	Seatbelt (0=No; 1=Yes)	Driving Too Fast (0=No; 1=Yes)	Driver Drinking (0=No; 1=Yes)
Age	-0.0066	0.1441	**-0.3066**	-0.2160
	0.8778	0.001	<.0001	<.0001
	538	515	538	538
Gender		0.2745	-0.0508	-0.1814
		<.0001	0.2399	<.0001
		515	538	538
Seatbelt			-0.1989	**-0.4141**
			<.0001	<.0001
			515	515
Driving Too Fast				**0.3408**
				<.0001
				538

Wyoming

	Gender (1=Male, 2=Female)	Seatbelt (0=No; 1=Yes)	Driving Too Fast (0=No; 1=Yes)	Driver Drinking (0=No; 1=Yes)
Age	0.0609	0.2229	-0.1767	-0.1897
	0.0907	<.0001	<.0001	<.0001
	774	752	774	774
Gender		0.1566	-0.0789	-0.1928
		<.0001	0.028	<.0001
		752	775	775
Seatbelt			-0.2570	**-0.3710**
			<.0001	<.0001
			752	752
Driving Too Fast				0.2442
				<.0001
				775

Figure 24 illustrates the share of unbelted drivers who had been drinking by age group. It seems evident that either drivers who drink generally make risky decisions such as foregoing occupant protection alternatives or that decision processes for drivers who may not usually make higher-risk decisions are negatively influenced by alcohol. Overall, approximately 33% of fatal accident drivers are unbelted. The share of unbelted drivers in fatal accidents where the driver is reported to have been drinking is 61%. Considering driver age, the 18 to 24 year age group has the highest proportion of unbelted drivers who were drinking.

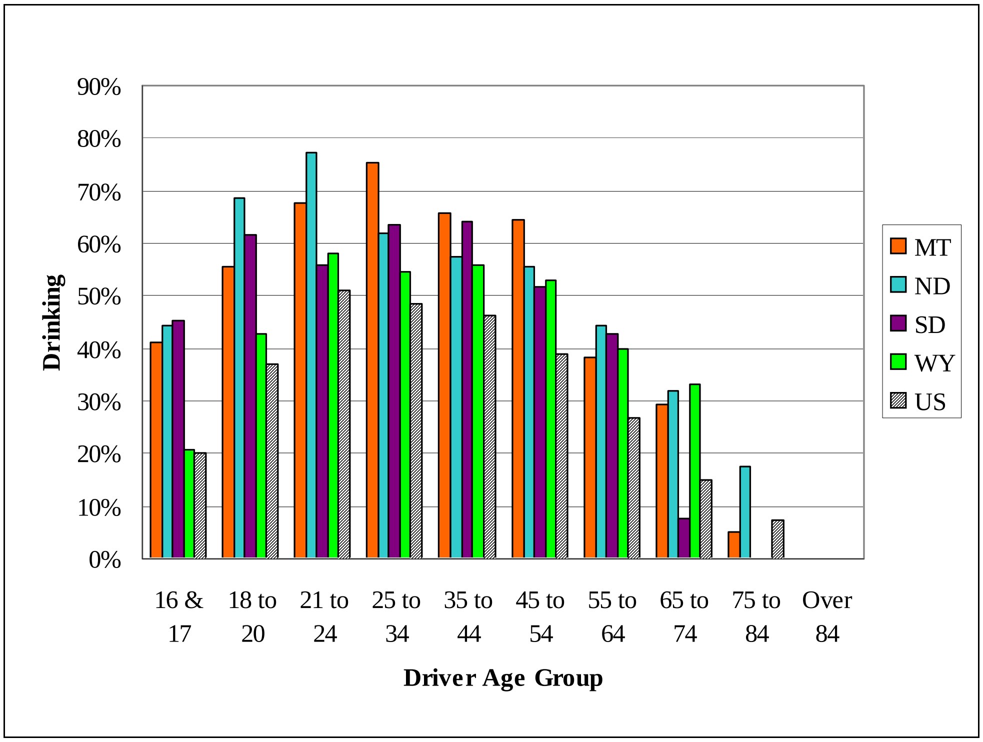


Figure 24 Share of Unbelted Fatal Vehicle Crash Drivers Reported Drinking by State, FARS 2001 to 2005

This age group, based on the fatalities to licensed driver ratios and previous studies, is considered a higher risk group. Younger drivers' propensity to drive unbelted is evident in all the states. The figures on drinking and seatbelts and the previous information on correlations between these risk behaviors suggests that this group is a potential target group for education or policy that may influence the decision to drink and drive and the subsequent decision on seatbelt use.

Rollover

Rollover accidents have been identified as a traffic safety issue for many of these rural states. Understanding the aforementioned rollover incidents is a critical aspect of NRMR traffic safety, considering the most harmful event in fatal crashes. Figure 25 shows the events that are most often the overriding injury event in fatal crashes for the NRMR and the U.S.-48. The five most common events account for approximately 90 and 86% of the most harmful events recorded in fatal light-vehicle crashes between 2001 and 2005 in the NRMR and U.S.-48, respectively. Collision with another moving vehicle is the most commonly reported event in both the NRMR and larger U.S. region. A notable difference does exist in the second event. Vehicle rollovers are the second most common harmful event in the NRMR at 39.6%. Rollovers are the most harmful event in only 17% of the fatal crashes nationwide. In 2005, 53% of fatal accidents in North Dakota and Wyoming involved rollovers. Montana reported a slightly lower rollover frequency at 51%. South Dakota reported 38% of its fatal crash vehicles had rollover events. These levels are all substantially above the national median of 23%.

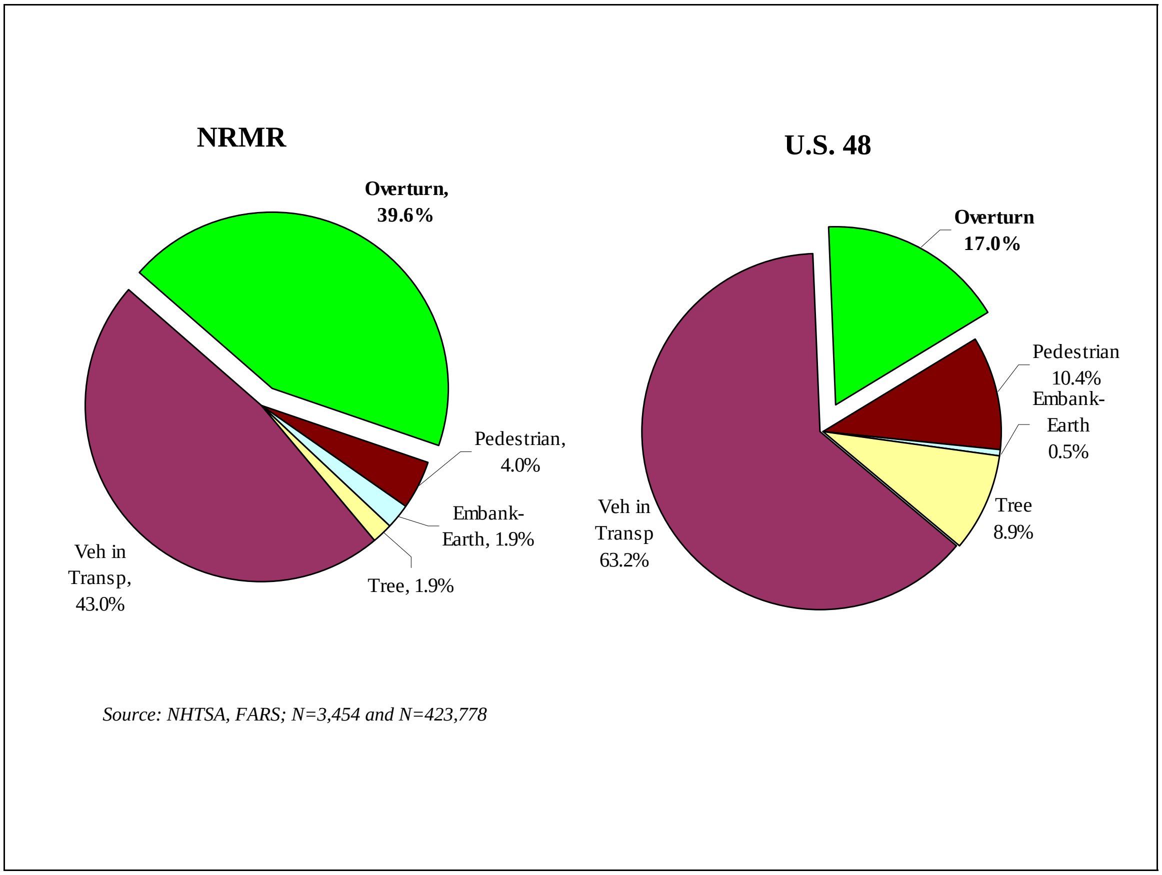


Figure 25 Most Harmful Event in Fatal Crashes, 2001 to 2005

The higher incidence rates in the NRMR may be due to rural road characteristics, but may also be attributed to driver experience and decisions. For instance, the share of rollover accidents that involve drivers who have been drinking is 40% for the U.S. Among the NRMR states, 51% of the 1,600 fatal rollover accidents involve drinking drivers in Montana, North Dakota, and South Dakota. The share is lower in Wyoming where only about 40% of its 400 fatal rollover accidents between 2001 and 2005 involve a driver who had been drinking.

Correlation coefficients in Table 7 suggest that little correlation exists between driver age and gender as markers in identifying target populations for rollover accidents. A very weak correlation is found for driver age and rollovers, supporting the experience theory. Virtually no discernable correlation is found between gender and rollover occurrence in any of the states or regions. Driver decisions that tend toward more risk, such as foregoing occupant restraint, drinking before driving, and driving too fast for conditions appear to be better markers for understanding and targeting the drivers involved in rollover crashes.

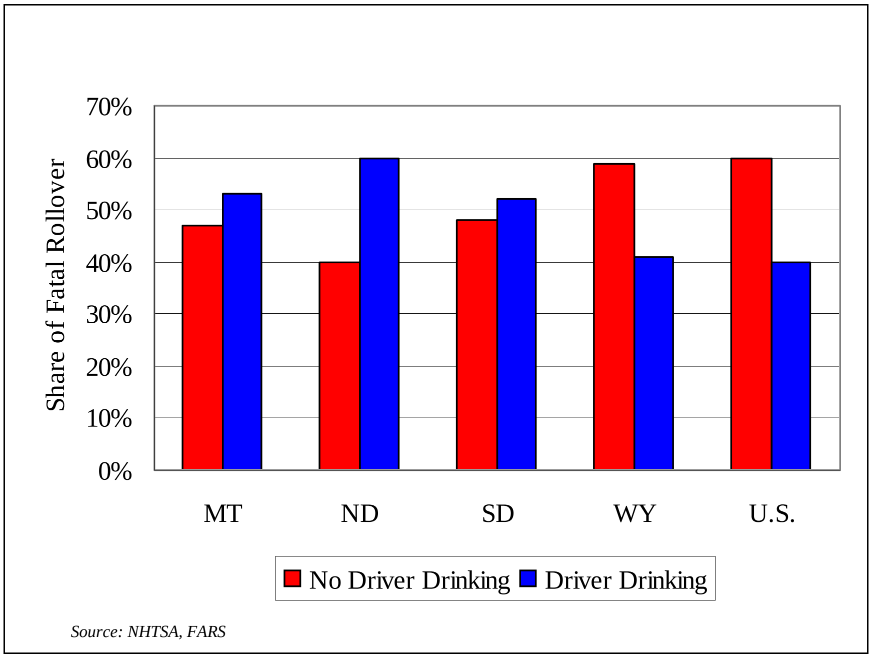


Figure 26 Driver Drinking in Fatal Rollovers

Significant differences are found between drivers in the NRMR and other states with regard to seatbelt usage, driver drinking, and rollover location. Only 27% of NRMR drivers in fatal crashes where the vehicle rolled over were wearing seatbelts, compared to 37% for the larger U.S.-48 (Chi=88.38, $\propto$.000). The NRMR did have a lower share of drinking drivers than the U.S.-48, at 48% compared to 62% (Chi=70.36, $\propto$.000). Both these numbers, however, are far above the U.S.-48 drinking driver rate of 21% for all vehicles involved in fatal crashes. The rollover locals also differed between the NRMR and the U.S.-48 considering rollovers that occurred in small metropolitan and rural areas. Urban areas are not considered because of the previously discussed NRMR urban void. Approximately 73% of rollover accidents occurred in rural counties in the NRMR compared to just 35% for the nation’s non-urban counties (Chi=541.42, $\propto$.000). These statistically significant differences provide support for more local assessment and activities in traffic safety.

Table 7 Rollover and Driver Factor Correlations, by State and Region for 2001 to 2005

Rollover (0=No; 1=Yes)	Montana	North Dakota	South Dakota	Wyoming	NRMR	U.S.-48
Age	-0.0787	-0.1073	-0.1295	-0.0910	-0.0974	-0.1004
	0.0061	0.0128	0.0001	0.0113	<.0001	<.0001
	1214	538	877	774	3403	236757
Gender	-0.0653	-0.0857	0.0076	-0.0391	-0.0394	-0.0546
	0.023	0.047	0.8231	0.2766	0.0215	<.0001
	1214	538	880	775	3407	238790
Seatbelt	**-0.3061**	**-0.3070**	-0.2305	-0.2931	-0.2761	-0.2602
	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
	1131	515	795	752	3193	218532
Driving Too Fast	0.2645	0.2889	0.2327	0.2590	0.2596	0.2362
	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
	1214	538	880	775	3407	238790
Driver Drinking	0.2777	**0.3338**	0.2649	0.2029	0.2645	0.2195
	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
	1214	538	880	775	3407	238790

Significant differences are found between drivers in the NRMR and other states with regard to seatbelt usage, driver drinking, and rollover location. Only 27% of NRMR drivers in fatal crashes where the vehicle rolled over were wearing seatbelts, compared to 37% for the larger U.S.-48 (Chi=88.38, ∝.000). The NRMR did have a lower share of drinking drivers in rollovers than the U.S.-48, at 48% compared to 62% (Chi=70.36, ∝.000). Both these numbers, however, are far above the U.S.-48 drinking driver rate of 21% for all vehicles involved in fatal crashes.

The rollover locales also differed between the NRMR and the U.S.-48 considering rollovers that occurred in small metropolitan and rural areas. Urban areas are not considered due to the previously discussed NRMR urban void. Approximately 73% of rollover accidents occurred in rural counties in the NRMR compared to just 35% for the nation's non-urban counties (Chi=541.42, ∝.000). These statistically significant differences provide support for more local assessment and activities in traffic safety.

This analysis offers insight for individuals concerned with traffic safety in the NRMR. Several distinctions for fatal crash occupants are discussed. Another area for exploration is the Native American population. Because of the limited number of observations, the FARS data offers little viable state-level data for assessing driver behavior. The earlier general observations about the over-representation of this group in traffic fatalities incidence suggests that substantial gains may be achieved from driver behavior programs developed from this population. A challenge remains in identifying potential target age groups or issues for creating and deploying effective traffic safety programs for this segment of the driver population.

CONCLUSION

The exploratory research presented in this study provides insight for topics that may be explored to reduce traffic fatalities and injuries in the NRMR. While national comparisons are included, the analysis generally relied on more localized issue and data discussions. States' self-selected traffic priorities along with public source information such as traffic fatalities, driver statistics, and roadway usage were used in the study. Special attention was given to occupant factors, leaving the more static vehicle and road design elements to engineering-based analysis and literature.

The research findings identify potential targets for education and enforcement initiatives. Significant differences between the nature of this rural region's traffic safety and other more urban areas suggests that local and regional traffic safety initiatives may be more successful if they diverge from some of the national timelines and focus areas. This may prove to be difficult because many behavioral-based traffic safety initiatives are dependent on federal funds and thus tied to nationally established goals. Driver drinking and seatbelt decisions are priorities for the NRMR based on traffic safety initiatives presented in the SHSPs and CHSPs for the states. The FARS analysis does provide additional insight regarding the priorities based on fatal crash characteristics and strongly supports the region's efforts to discourage driver drinking. Efforts to address driver speeding are also supported, as this issues surfaces as a significant factor in NRMR fatal crashes. This more localized view of the occupant safety issue, in the regional and national context, is another resource for assessing goals and progress in traffic safety.

Future research is needed to better understand the role and relative importance of individual occupant factors in traffic safety. Study regarding vehicle driver and occupant decision-making, including risk perception, experience, and influences, also would be valuable assets in formulating policy and allocating scarce resources. Improvements in accessibility and quality of other traffic safety data sources should also be considered as critical elements in traffic safety. While the FARS database does provide national coverage for traffic safety issues, questions remain about its representation of the larger traffic population. Furthermore, the small size of the traffic fatality population in less densely populated areas severely limits its functionality as a tool in understanding and addressing traffic safety in rural areas where it is much needed.

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APPENDIX. HIGHWAY SAFETY FUNDING

SAFETEA-LU Overall Highway Safety Funding, 2006

State	S. 402 Formula	S. 405 Oc. Prot.	S. 406 Primary Law	S. 154 - Open Container Transf.	S. 164 - Repeat Offender Transf.	S. 408 Data Improve.	S. 410 Alcohol	S.1906 Prohibit Racial Prof.	S. 2010 Motor-cycle	S. 2011 - Booster Law	TOTAL FY 2006 (in 1,000)
U.S. 48	29.3%	3.4%	16.8%	10.7%	16.0%	4.7%	16.6%	1.3%	0.8%	0.4%	$691,475
NRMR	21.0%	0.8%	0.0%	17.4%	33.1%	4.7%	18.9%	2.5%	1.6%	0.0%	$ 25,575
Montana	31.5%	4.8%	0.0%	0.0%	0.0%	6.9%	39.7%	14.8%	2.3%	0.0%	$4,352
North Dakota	56.5%	0.0%	0.0%	0.0%	0.0%	11.7%	27.9%	0.0%	3.9%	0.0%	$2,572
South Dakota	19.0%	0.0%	0.0%	0.0%	51.9%	3.9%	23.9%	0.0%	1.3%	0.0%	$7,745
Wyoming	9.8%	0.0%	0.0%	40.8%	40.8%	2.8%	4.9%	0.0%	0.9%	0.0%	$10,906

Source: NHTSA, 2007
http://www.nhtsa.dot.gov/portal/site/nhtsa/menuitem.570e0ebf9d6b03ed304a4c4446108a0c/