SEAT BELT USE ON ND RURAL ROADS, 2009

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September 2009

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ABSTRACT

North Dakota's rural roads are vital social and economic connectors. These roads, however, are associated with relatively high crash injury risk. While a multitude of efforts is underway to reduce crash risk through road improvements and vehicle technology, seat belts offer an immediate and low-cost protection that can reduce occupant crash injury risk by half. To increase knowledge about seat belt use on these roads, a pilot observation study was conducted around the time of the state's annual seat belt campaign. Observations showed a 44.8% rural roads use rate. Because of the higher relative risk and disparate use rates, it may be more informative to consider the use rates by road environment. Statewide rural seat belt use rates of 55.2% and 35.6% were estimated on highways and in towns, respectively, based on 6,919 driver observations. Results showed higher use among female drivers than male, and that the lowest use rate was among male pickup truck drivers. Evidence from post and ex ante surveys showed promise for increasing seat belt use on rural roads by involving local sheriff and police departments in high visibility enforcement. This pilot project creates a building point for increasing knowledge and strengthening programs through empirical analysis of rural seat belt use rates. The value of this pilot will be determined by future work that reduces crash injury and death by knowledge gained in extending and expanding the empirical analysis initiated by this endeavor.

Acknowledgement

This research was conducted in cooperation with the ND Department of Transportation and ND Safe Communities, and supported by the Federal Highway Administration.

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1. INTRODUCTION

North Dakota's rural roads provide vital social and commercial links for a widely dispersed population. The safety of these roadways is paramount in managing traffic assets to enhance the state's livability. Approximately 55% of the state's travel, in vehicle-miles, takes place on rural roads that interconnect small communities and join the rural geography to interstate corridors and urban centers. This level of rural driving is relatively high considering that only about 26% of the nation's travel is attributed to rural roads (U.S. Department of Transportation [DOT] 2007). From a safety perspective, this poses an inherent challenge in that the risk for serious injury and death on these roads is relatively high compared to their urban counterparts (U.S. DOT 2005).

The over-representation of nation's rural roads in serious crashes is evident, as they account for nearly half of all traffic fatalities and only about a quarter of total vehicle miles traveled (VMT). Fatal and injury crash incidence is generally higher on rural roads due to factors such as faster speeds and longer medical response time, along with some propensity for risk taking (Clark and Cushing 1999, Muellemen et al. 2007, Clark 2003). The U.S. DOT reported that nationwide, 49% of the traffic deaths occurred on rural roads between 2003 and 2007 (2009c).

The significance of rural road safety in public health is evident in the death and serious injuries reported for fatal crashes in North Dakota. Fatal crash reports from 2003 to 2007 show that 89% of serious injuries, which includes fatal and disabling injuries, occurred on rural roads (2009c). Among the rural roads, local and principle arterial are the most common location, among the functional classes, for serious crashes (Figure 1.1). The guidelines for the functional classification of roadways are administered by the Federal Highway Administration, U.S. DOT. The process groups similar roads, depending on traffic characteristics and density, for administering programs and monitoring system performance (U.S. DOT 2009e).

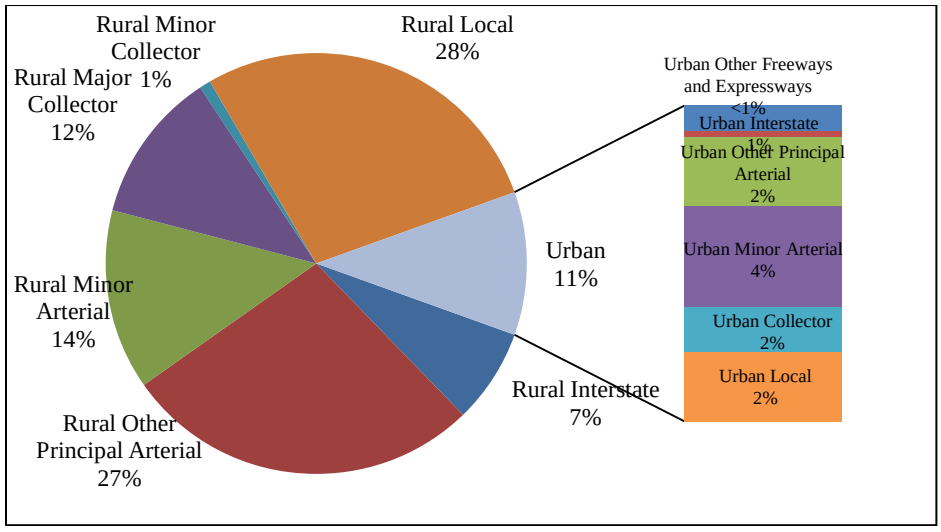


Figure 1.1 Fatal and Disabling Injuries by Road Functional Class in ND Fatal Crashes, 2003 to 2007

A view of these crashes with rates normalized by annual vehicle miles traveled (AVMT) provides an indication of risk exposure across the functional classes. From this perspective, the most dangerous rural roads are those with the highest levels of crash incidence – which include minor arterials and local collectors (Figure 2.1). The risk for fatal crashes on local roads is twice as great as on rural interstates nationwide. In North Dakota, the fatal crash injury risk on local roads is five times greater than on the rural interstates. The risk compared to urban interstates in North Dakota is more than twelve times greater. Thus, it seems prudent that rural roads, and certainly the local roads in this class, be given special attention in efforts to advance the state's economic connectivity and social livability through safe roadways.

The effort to reduce death and injury from traffic crashes is a multifaceted activity involving the public along with all levels of government. While no single technology, countermeasure, or intervention can eliminate exposure to crash injury, ongoing efforts are underway in the engineering, education, enforcement, and emergency medicine fields to reduce it. Increased seat belt use is among the leading measures in this effort and has been shown as a proven measure to successfully reduce crash death and injury.

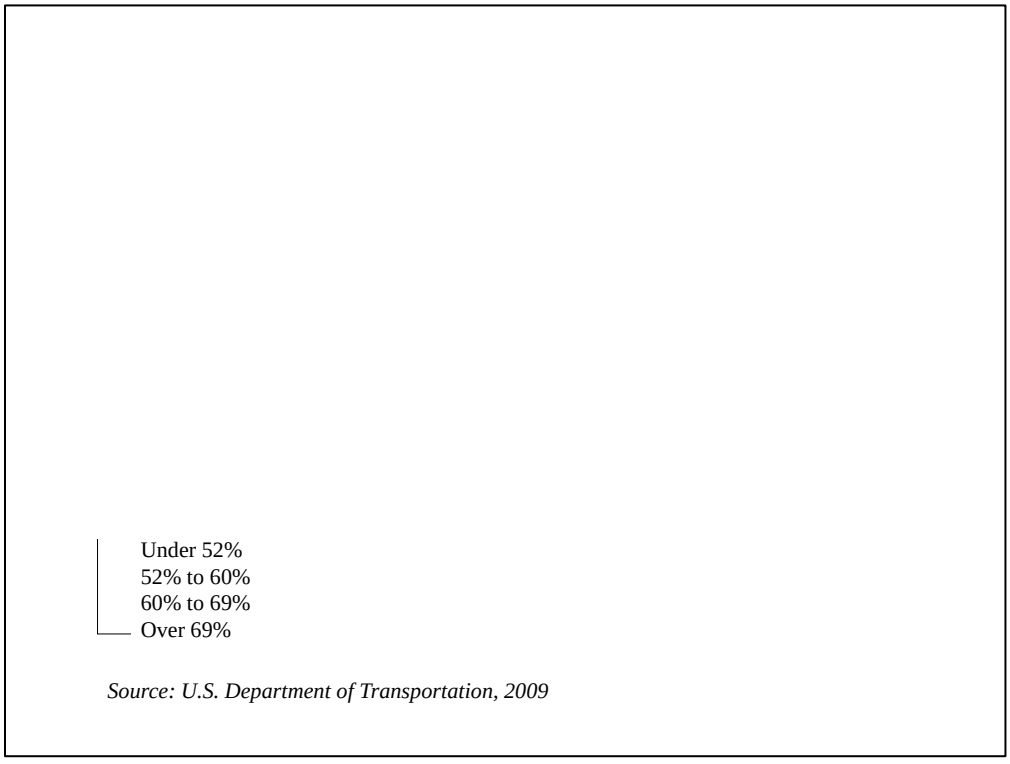


Figure 1.2 Driver Seat Belt Use Rates in Fatal Crashes on Rural Roads, 2002 to 2007

In crashes from 2002 to 2007,North Dakota has the lowest reported seat belt use rate in fatal crashes reported for rural roads (U.S. DOT 2009a). Only 36% of the state's crash victims were belted according to the national database on fatal crashes, compared to an average of 60% among the 48 contiguous states. Figure 1.2 shows that many other states in the region, including Montana, Nebraska, South Dakota, and Wyoming, are also in the lowest quartile for seat belt use in rural road fatal crashes. Seat belt use in these rural road fatalities is highly correlated to the statewide seat belt use rates reported by the U.S. DOT for states in April 2009 (Pearson Corr.=0.743, $\rho<0.001$; $n=48$).

2. BACKGROUND

A primary offense for occupants in vehicle safety systems is the seat belt. They are a relatively low-cost safety device in the realm of vehicle enhancements related to occupant protection. Seat belts are estimated to reduce risk for fatal injury by about half when used properly (Williams 2008, Blincoe 1994, Evans 1986). Since seat belt equipment was mandated for manufacturers in the 1960s, use has increased substantially with continued education and enforcement efforts. Primary offense laws that require seat belt use at all times have been adopted in 30 states. In addition, 19 states have secondary offense laws that allow officers to ticket for non-use when a motorist is stopped for another traffic violation. Research has shown primary use laws are superior to secondary use laws in increasing seat belt use rates. Some secondary states, such as Arizona and Nevada, have had success in achieving high use rates. These seat belt use rates are most often measured through observation surveys.

A major programmatic effort for traffic safety and public health advocates is to save lives by increasing seat belt use. Reliable seat belt use rate data that is shared regularly with the public and with policymakers is an important asset in discussing seat belt use as an intervention for reducing injury and death from traffic crashes – the leading cause of death for residents between 1 and 45 years of age (Centers for Disease Control, 2009). The U.S. Department of Transportation works with states to measure seat belt use through the annual National Occupant Protection Use Survey (NOPUS) contribution to that effort. The method uses random probability sampling and is governed by the protocol in Federal Register, 23 CFR Part 1340 (U.S. DOT 2000). The initial sampling stratum is county population; with intra county intersection observation sites sampled using a traffic density stratum. The 2008 survey for North Dakota showed a seat belt use rate of 81.6%, including use rates of 80.9% for 22,722 drivers and 85.6% for the 3,758 passengers.

Individual county seat belt use rates in the NOPUS publication for North Dakota show that only 4 of the 16 counties included in the survey sample had seat belt use rates above the statewide average. These counties – Stark, Cass, Burleigh, and Nelson – are home to 38% of the state's residents and attribute 29% of state annual vehicle miles traveled, but cover only about 8% of its geography. The vehicle miles traveled in these counties are heavily dominated by urban traffic – as they attribute 60% of the state's urban annual travel and only about 11% the state's rural annual travel (NDDOT 2008a). This most recent NOPUS survey also shows seat belt use rates of 85.8% on the state's interstates, while only 74.2% and 71.8% are reported for state and federal roadways in North Dakota, respectively (NDDOT 2008c). The NOPUS survey does not include observation sites on rural local roads – which have been the location for 1 in every 3 fatal crashes during the past five years (NDDOT 2008b).

As mentioned and shown in Figure 2.1, rural roads are relative high risk travel routes nationwide. For example, in North Dakota rural local roads account for 11.4% of annual travel and 27.9% of fatal and disabling injuries in fatal crashes. This results in a fatal crash injury incidence rate of 2.46, which is above the national rate of 2.36. Rural interstates, which account for largest travel share among the functional classes, attribute 18.4% of annual travel and 7.3% of the reported fatal and disabling injuries in fatal

crashes for an incidence rate of 0.39. This rate is less than half that of the national rate of 0.80. If all roads had equal risk based on travel exposure, one would expect the incidence ratio to be equal to 1 for each of the functional road classes.

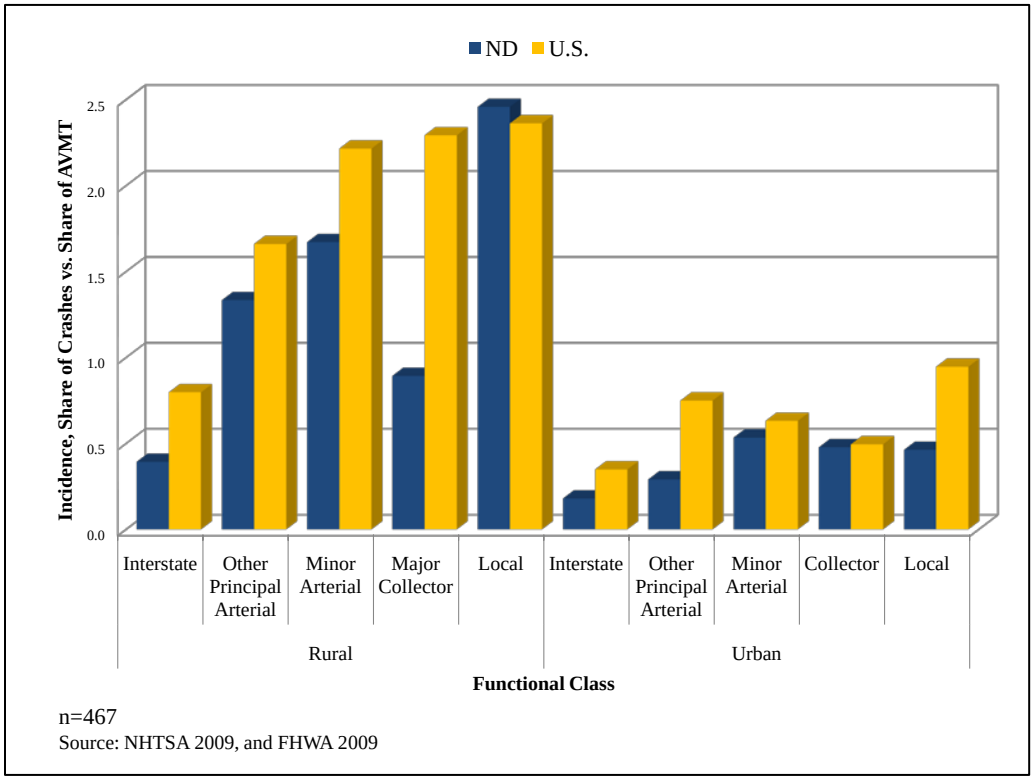


Figure 2.1 ND and U.S. Fatal and Disabling Injury Incidence by Functional Road Class, Fatal Crashes 2003 to 2007

Understanding this safety priority, North Dakota has chosen to initiate work on measuring rural roads seat belt use, in pursuit of its 'Measure It to Manage It' initiative. Rural roadways – defined here as roads beyond interstate and urban corridors – are a priority focus for relative risk for serious injury. Traffic crashes are a leading cause of injury and death in North Dakota, and seat belts are a primary offense in reducing traffic-related injury. While crash records, random projects, and the annual statewide seat belt survey offer some indication for seat belt use trends, a more rigorous and consistent metric is desired for conducting project assessment and discussing program strategy.

3. GOAL

To conduct cooperative pilot project to establish scope and method to estimate a rural seat belt use metric that is needed for project management and program strategy in community health and public safety.

4. OBJECTIVES

1. Establish basic seat belt survey protocol that can be widely adapted to rural geographies, defining parameters for
    a. Collection sites,
    b. Collection times, and
    c. Observation protocol and criteria.
2. Define a preferred rural county sample, based on population and geographic stratification.
3. Solicit and establish partnership with state and local associates to complete seat belt site observations, concentrating on the preferred county sample.
4. Coordinate survey geography and timeline to establish baseline rate for seat belt use in rural counties.
5. Measure effects of new rural high visibility enforcement (HVE) activities, if possible.

5. METHOD

The traditional observation survey method will be used for this study. A first critical step in administering the survey is to define a representative and realistic survey sample. Stratified random sampling of the rural counties, or non-NOPUS counties, was conducted based on rural county population and geographic representation of counties across four quadrants of the state. The quadrants are defined based on 2009 ND Safe Communities (NDSC) regions, which also closely align to North Dakota Health Department administration regions, are shown in Figure 5.1. The Northwest includes NDSC regions 1 and 2; Northeast includes NDSC regions 3 and 4; Southwest includes NDSC regions 7 and 8; and Southeast includes NDSC regions 5, 6 and 9.

County geographies are used as the boundaries for the initial selection stratum in the sample because population and other demographic information are readily available. In addition, many education and law enforcement programs are administered by the county-level political boundary or cities located within the counties. U.S. Census estimates for county population were used to select a minimum preferred group to initiate a process for estimating rural county seat belt use. The rural counties account for 64% of the state's geography and 52% of the estimated rural annual vehicle miles traveled and are home to 24% of the state's residents.

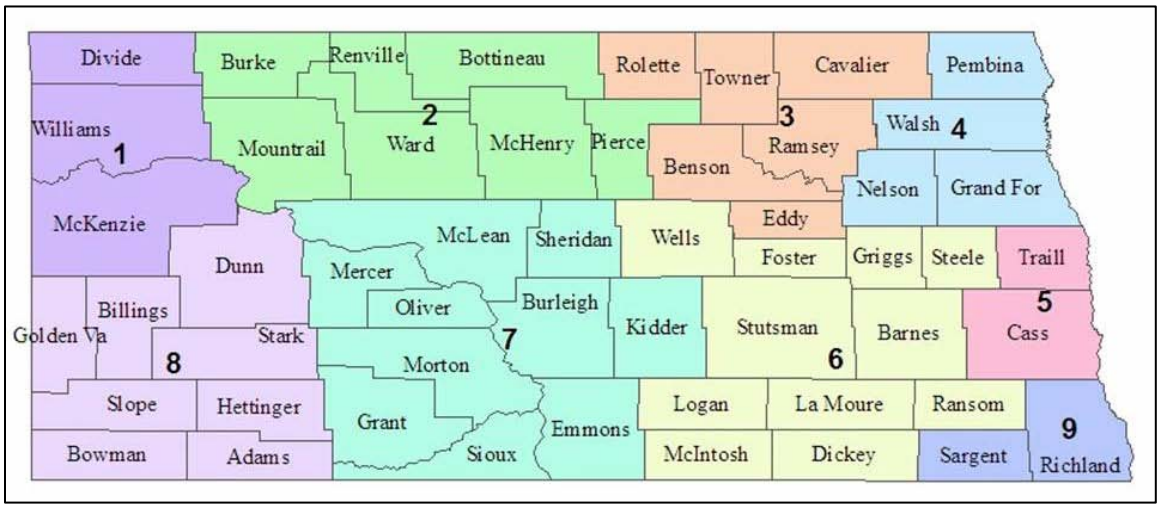


Figure 5.1 Safe Communities Regions, 2009

In addition, participation in the NDDOT high visibility enforcement (HVE) program was considered in designating preferred counties so an assessment could be made for the initial year of a rural county program modification. High visibility enforcement refers to funding of overtime wages for local and state law enforcement agencies to increase visibility and participation in seat belt enforcement. The ND DOT conducts an annual HVE program, commonly called *May Mobilization*, to coincide with the national *Click It or Ticket* (*CIOT*) campaign held each year during May. The NDDOT strategy for the 2009 *May Mobilization* was modified compared to previous years. Each year the NDDOT recruits local law enforcement, including local police departments and county sheriff offices, to apply for enforcement grants. This year the NDDOT extended invitations to police and sheriff departments in rural counties, as an experiment, to enhance efforts to increase seat belt use in the geography beyond the traditional 16 NOPUS counties.

The heightened local enforcement during May is coordinated with statewide coverage by ND highway patrol enforcement and a state-level media campaign around *CIOT*. In the past, HVE grants were offered to NOPUS counties for overtime pay to support additional patrol hours. During 2009 the grant offering was expanded to include several rural counties in the state – specifically those with the highest serious crash incidence with no seat belt use. In this initial year, the NDDOT awarded grants to newly participating local enforcement agencies in eight rural counties, including four police departments and nine county sheriff offices. The location of these counties and agency participation is shown in Figure 5.2. The map also distinguishes the counties based on seat belt use in reported crashes. The counties shaded in red and yellow are in the lowest quartile for seat belt use rates, considering crashes from 2003 to 2007. Thus, they were viewed as the most critical rural counties in efforts to recruit rural agencies. Seven of the nine most critical counties (red) joined the HVE effort in this first year it was offered to rural counties.

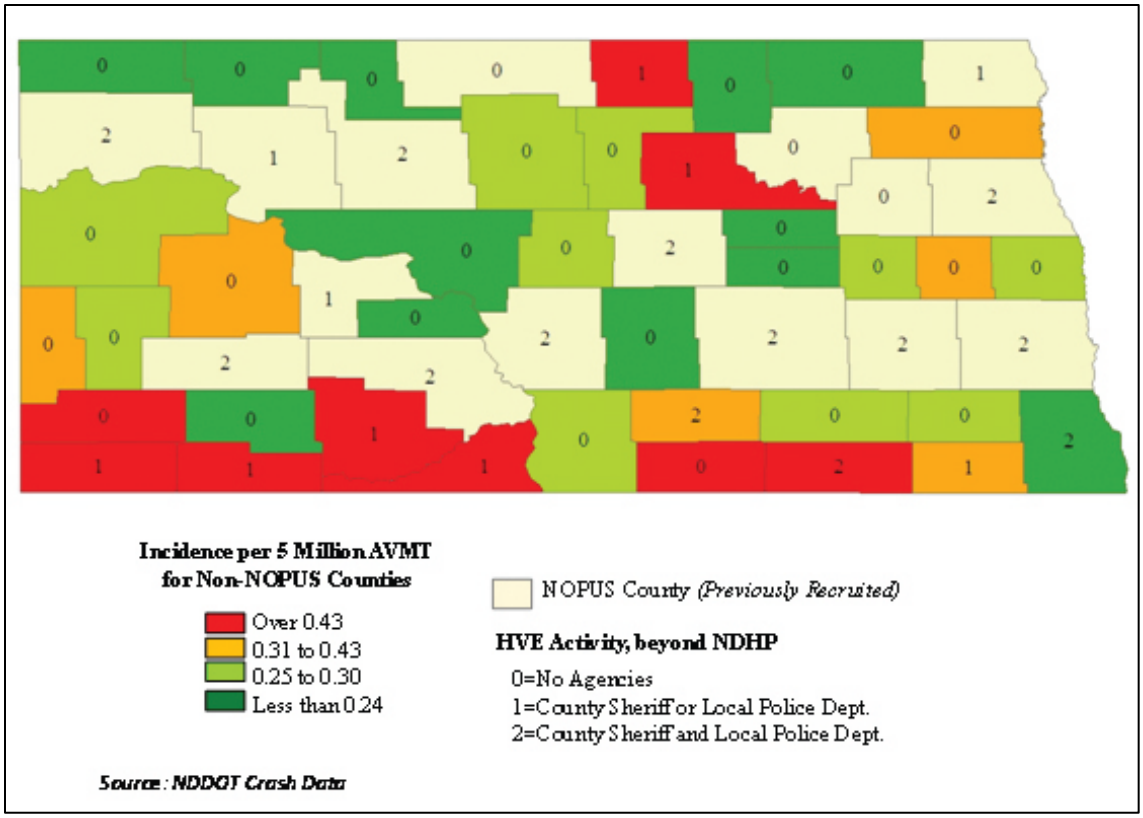


Figure 5.2 Crash Incidence with No Seat Belt 2003-2007, and HVE Agency Participation 2009

As noted earlier, the counties excluded from the annual NOPUS survey are considered in the state's rural-county geography for this project. The three highest population counties in the NOPUS survey have about nine people per square mile compared to only two per square mile for the three highest in the rural county preferred sample created here. Although some counties with lower population densities are included in the NOPUS sample, the counties selected for that survey include the most populated – thus most urban – counties in the state. Of the 37 counties not surveyed in the annual NOPUS project, 15 counties were identified as a preferred minimum sample for rural seat belt use considering population, geographic location, and HVE participation (Figure 5.3). The 15 preferred counties account for 48% of the rural-county land area and 68% of the rural-county population. Considering implications for traffic safety from increased seat belt use, the rural counties accounted for 60% of fatal and disabling injuries between 2003 and 2007 (NDDOT 2008b).

Within the preferred sample counties, sites selected for observation were based on state traffic flow maps and local traffic knowledge. Annual vehicle miles traveled, or traffic density, is not available for local roads so local experts were consulted to identify the best observation points for county traffic. These experts most often included local law enforcement and county roads managers.

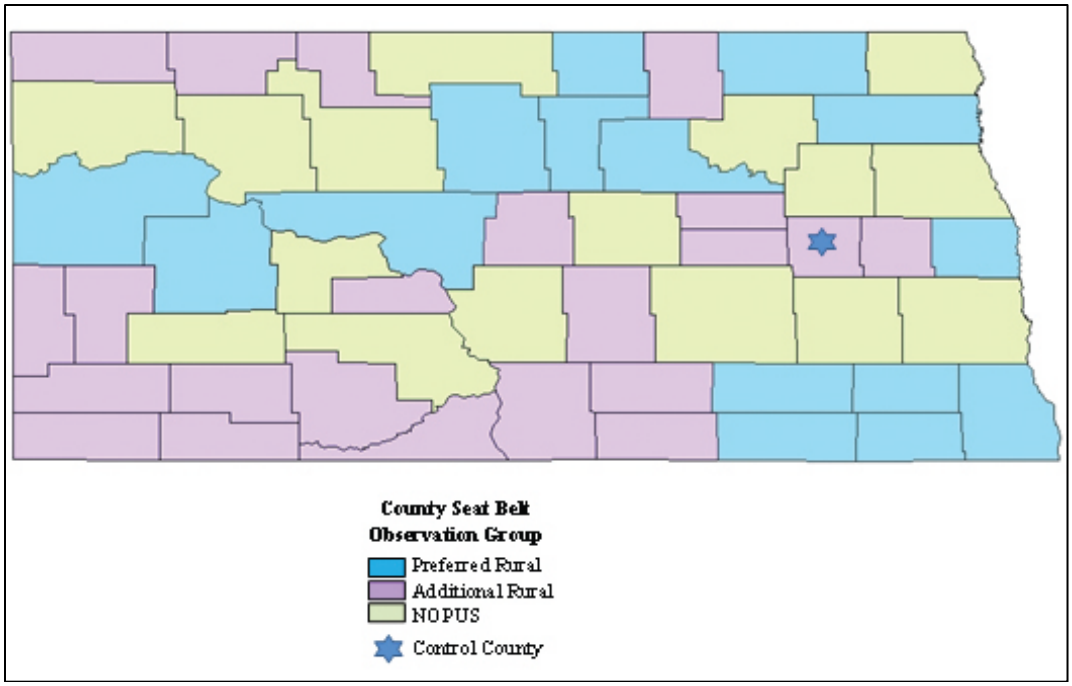


Figure 5.3 County Seat Belt Observation Groups

Timing for the seat belt observations was suggested to include two visits to each site during this pilot. Observers were asked to collect information at the sites in April and then again in June or July. In addition to an overall estimated seat belt use rate for rural roads that could be done with the latter surveys, the observations collected prior to May creates a pre-intervention baseline for rural counties participating in the HVE program. The ex post survey is timed to follow the NDDOT coordinated high visibility enforcement and *CIOT* media campaign that takes place during *May Mobilization*. Figure 5.3 provides a map of the rural survey counties selected for the preferred sample counties, along with Griggs County as a control county, for measuring statewide rural seat belt use in this pilot study.

The seat belt observations were conducted in partnership with the NDDOT Office of Traffic Safety and ND Safe Communities offices. Eight of the nine Safe Communities offices were asked to participate in the project by conducting a survey of seat belt use in one or more counties located in their region. The list of preferred and possible additional counties, as illustrated in Figure 5.3, were sent along with a framework to complete the county observation based on a shared protocol. A map of traffic density was also included as a resource for identifying higher-traveled corridors in the counties along with a suggestion for consultation with local traffic experts in selecting specific sites (Appendix A). The basic protocol included these instructions for site selection, timeline, and conducting the survey.

General site selection and timeline guidance:

1. One site in each town (up to 4 towns per county),
2. Two to four sites beyond the town to cover higher traffic intersections on non-interstate/non-urban roads in the county,
3. Each site minimum time 30 minutes, up to one hour at site if extra time is needed to meet 30 observation minimum for a site,
4. Two multisite surveys per county, including a baseline survey in March or April and follow-up survey in June or July.
5.

Additional detail for 2009 survey:

1. Minimum of four observation sites per county.
2. At least two sites on rural roads outside towns.
3. Minimum time per site is 30 minutes; if needed, extend time up to 1 hour at site to reach a minimum of 30 observations per site.
4. Hours for collection are from 7 am to 7 pm.
5. Two surveys: Baseline surveys conducted between March 17 and April 30, 2009. Follow-up surveys between June 1 and July 31, 2009, at same observation sites.
6. Main focus is on driver seat belt use; also collect passenger use when traffic flow and field of view permit.

6. RESULTS

A total of 6,919 observations of driver seat belt use were collected during surveys conducted at 149 sites across the state. The sites were in rural towns and on rural highways located at least 20 miles from interstate highways to avoid bias associated with urban commuter traffic. Passenger seat belt use was also collected when possible. The limited information on passenger use, which includes 1,051 observations, will be used primarily to assess correlation with driver use. It may be useful to consider this correlation in the benefit/cost determination for including a passenger observation requirement in future surveys.
Of the sites surveyed, 64 percent were located on rural highways with the balance situated in rural communities. Observations were completed in 23 of the 37 rural counties. The counties included in the survey covered 14 of the 15 in the preferred group, with Richland County missing. Seat belt observations were collected between March and August in 2009.

Table 6.1 County Observations

	Pre-HVE	Post-HVE	Total		HVE Participant
Adams	0	30	30	*	Y
Benson	0	449	449	*	N
Billings	53	60	113	*	N
Bowman	37	34	71	*	Y
Cavalier	0	267	267	*	N
Dickey	152	200	352	*	Y
Divide	0	150	150	*	N
Dunn	85	80	165		N
Eddy	0	452	452	*	N
Griggs	164	175	339		N
Hettinger	36	30	66	*	N
LaMoure	159	173	332		N
McHenry	332	306	638		N
McKenzie	117	118	235		N
McLean	261	313	574		N
Pierce	217	271	488		N
Ransom	120	218	338		N
Rolette	0	751	751	*	Y
Sargent	151	131	282		Y
Slope	30	30	60	*	N
Towner	0	340	340	*	N
Traill	0[1]	155	155		N
Walsh	137	135	272	*	N

*Safe Communities Partners Conducted Observations; Other observations completed by UGPTI, NDSU.
[1]All highway observations were within 20 miles of interstate so not included.

Where two observations could be completed for a county, the observations were timed to occur before and after the *Click It or Ticket* high-visibility enforcement and media efforts held during May. All 23 counties were observed in the post-HVE after June 1, with 17 counties also observed in the pre-HVE interval (Table 6.1). Results from these ex-ante and ex-post observations can be used to measure effectiveness of agencies from rural counties participating in the HVE – participation of the rural counties was a 2009 modification to the program in North Dakota, as described previously. The party responsible for conducting the observations is also noted to show the partnership that was needed to complete these activities.

6.1 Rural Seat Belt Use

Unweighted seat belt use by drivers observed in the rural counties was 44.4%. Based on the regions defined in the Methods section, drivers in the Northeast have the highest use at 49.4%, with second highest in the region to its south, at 45.5%. Driver seat belt use in the western regions was observed at 33.9% and 30.8% in the North and South quadrants, respectively.

A statewide rural seat belt use rate of 44.8% is estimated, based on county population weights. This figure may be skewed by the mix of rural highway and rural town seat belt observations – which may not truly reflect crash exposure risk. Because an appropriate weighting factor for the mix of highway and town traffic exposure was not identified, it is recommended to consider the different driving environments. The more relevant numbers may be seat belt use by road type, used here as the driving environment, due to relative injury risk between the rural town and rural highway roads. The greater risk associated with travel beyond town is evident in state crash data. It shows only 3% of fatal crashes on rural roads occur in town (NDDOT 2009). Therefore, the rural highways are given special attention in this study.

The observed seat belt use rate for drivers on rural highways, 56.0%, is significantly different than the use rate in rural towns at 33.4% (χ^2=359.04 ρ<0.0001, n=6,919). The overall state use rates are estimated at 55.2% and 35.6% for rural highways and rural towns, respectively, based on county population weights. Both these figures fall well below the statewide NOPUS rate of over 80% (Figure 6.1).

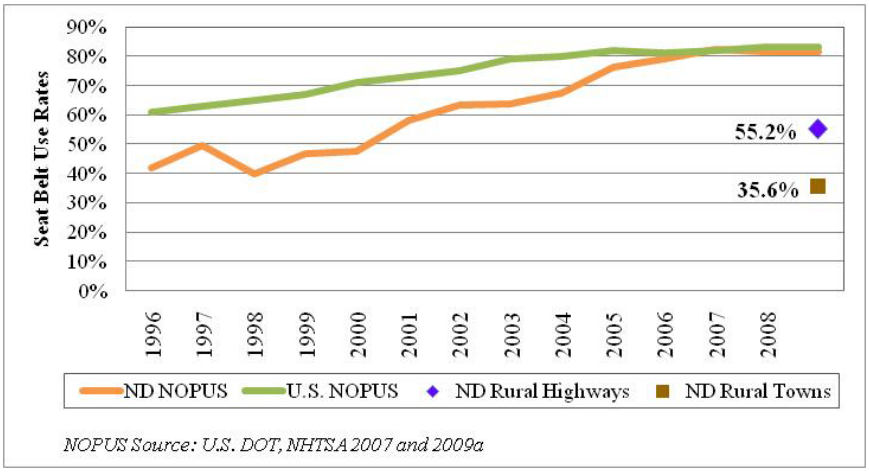


Figure 6.1 Seat Belt Use Rates

Median observed county-level seat belt use for drivers among the rural counties surveyed was 56.0% on highways. The range was large, considering a high of 74.0% in Divide and a low of 29.6% in Bowman (Figure 6.2). Other counties with driver use rates over 60% include Billings, Dickey, McKenzie, and Slope. Those falling below the county average for rural highway belt use include Adams, Benson, Eddy, Hettinger, LaMoure, Rolette, and Towner. The range in seat belt use suggests some potential to investigate the environment and practices in the more successful counties to determine if best practices can be transferred to other areas or if there are unique cultural or travel situations surrounding the higher rates.

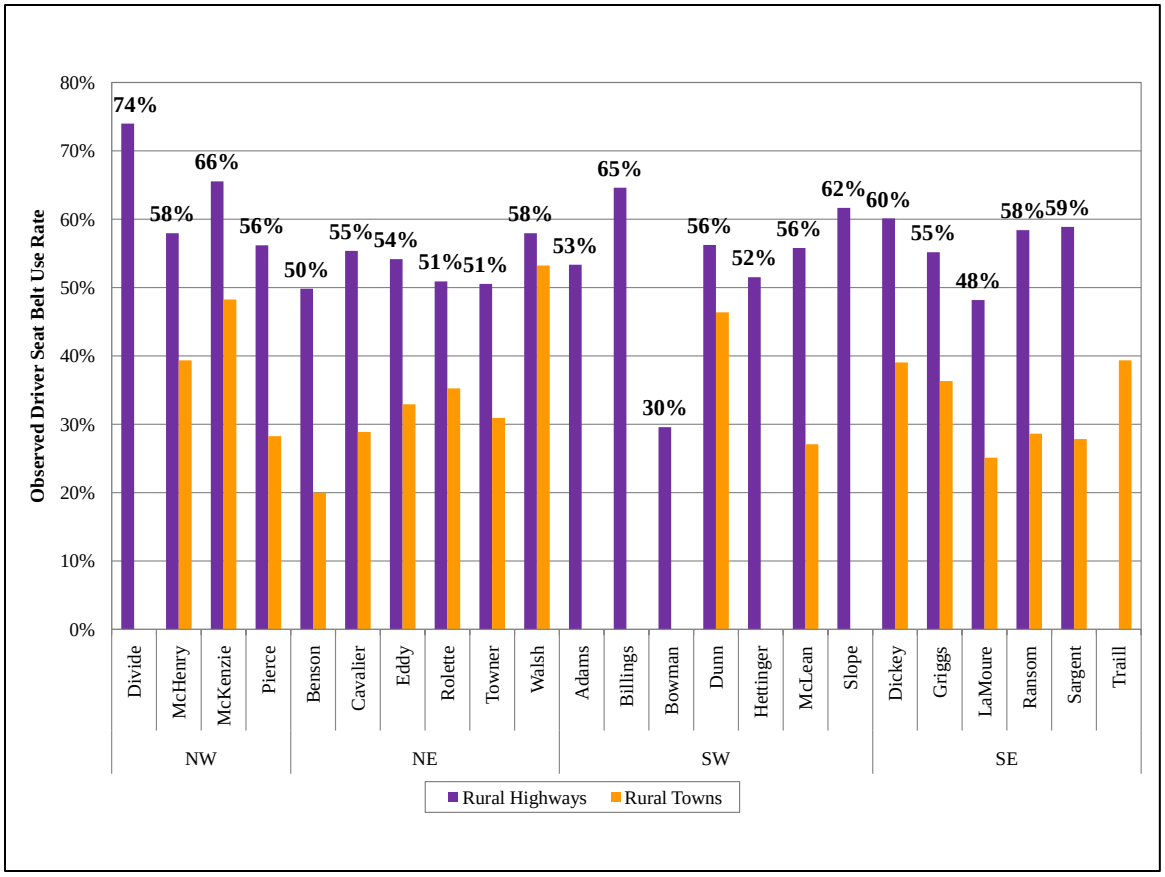


Figure 6.2 Seat Belt Use on Rural Roads, by County

6.2 Driver Gender

Males were represented at a rate of about 2 to 1 in the driver population for the rural roads seat belt observations. Of the 6,919 drivers observed, 4,478 were male. Females were a smaller share of the driver population both on highways and in towns, with the share higher in town at 40.3% compared to 30.0% on the highways. Gender is a common topic in seat belt use research because of the relatively low-cost and ease with which the information can be collected. The lower propensity for males to use seat belts, as found in this study, is consistent with other research (U.S. DOT 2008, Gross et al. 2007, Vivida et al 2007, McCartt and Northrup 2004).

Female seat belt use at 51.5% is, as expected, significantly higher than the rate of 40.6% seen for male drivers (χ^2=75.97 ρ<0.0001, n=6,919). The estimated statewide seat belt use rates on rural roads are 53.7% and 40.2% for males and females, respectively, based on county population weights. Considering the road environments – highway and town – along with the gender factor, showed an expected higher use rates for females on all roads. Statewide, the estimated female use was at 67.4% compared to 50.0% for males on rural highways. These weighted seat belt figures produce estimated rates in rural towns at 42.8% for female drivers and only 30.1% for males.

Table 6.2 shows county-level seat belt use rates on rural highways and in rural towns. The county information shows the highest female use rates are in Dickey, Walsh, Divide, Slope, and Pierce, ranging from 86.7% to 73.4%. The lowest rates seen among female drivers, with rates under 62%, were in Bowman, Benson, Cavalier, Rolette, and Towner counties.

Table 6.2 Seat Belt Use Rates on Rural Highways, by Gender

	Rural Highways				Rural Towns			
	Female		Male		Female		Male	
Adams	71.4%	**	47.8%	*				
Benson	53.1%		48.3%		27.2%		15.8%	
Billings	70.8%	*	62.9%					
Bowman	44.0%	*	21.7%					
Cavalier	55.7%		55.1%		25.6%		31.3%	
Dickey	86.7%		51.4%		64.2%		22.5%	
Divide	81.3%		72.0%					
Dunn	68.4%		48.3%		42.9%	*	47.9%	
Eddy	62.0%		51.1%		37.8%		30.1%	
Griggs	69.2%		78.1%		45.7%		31.0%	
Hettinger	63.2%	*	46.8%					
La Moure	70.2%		36.7%		34.7%		19.2%	
McHenry	68.3%		52.6%		45.9%		35.2%	
McKenzie	72.2%		48.7%		41.5%		54.0%	
McLean	69.0%		50.0%		36.5%		19.8%	
Pierce	73.4%		48.3%		41.5%		17.6%	
Ransom	63.0%		56.8%		33.0%		25.2%	
Rolette	56.8%		47.9%		39.5%		32.5%	
Sargent	63.1%		57.0%		28.8%		27.4%	
Slope	77.8%	*	54.8%					
Towner	60.7%		46.2%		38.1%		25.8%	
Traill	n.a.		n.a.		50.0%		31.0%	
Walsh	86.0%		50.0%		66.7%		43.2%	

*Fewer than 30 observations; **Fewer than 10 observations.

Griggs, Divide, Billings, Sargent, and Ransom counties had the highest use rates among male drivers on rural highways, ranging from 78.1% to 57.0%. Bowman County had the lowest use rate among the counties for observed seat belt use among male and female drivers. Fewer than half the female drivers and only 1 in 5 male drivers used seat belts on the county's rural roads. Other counties in the lowest tier use group for male drivers were LaMoure, Towner, Hettinger, and Adams.

6.3 Vehicle Type

As with gender, vehicle type is also commonly considered in seat belt surveys. Both offer potentially useful information for greater efficacy in directing enforcement and education outlays toward a driver group (U.S. DOT 2009d). For example, a nationwide study of fatal crashes showed that pickup truck occupants had the highest percent of unrestrained fatalities among all passenger vehicle types (U.S. DOT 2008). Similar results were found here, with male pickup truck drivers having the lowest use rates among the gender-fleet mix.

The rural seat belt observations included slightly more pickup trucks than cars at 2,619 and 2,606 units, respectively, along with 1,069 sport utility vehicles (SUVs) and 625 vans (Figure 6.3). The weighted fleet composition for passenger vehicles on rural roads, based on county population, changed the proportions slightly. With these estimated figures, cars comprise the largest share of the estimated total rural roads fleet at 39.4% with pickup trucks next at 35.9%. SUVs and vans complete the fleet at estimated shares of 15.5% and 9.2%.

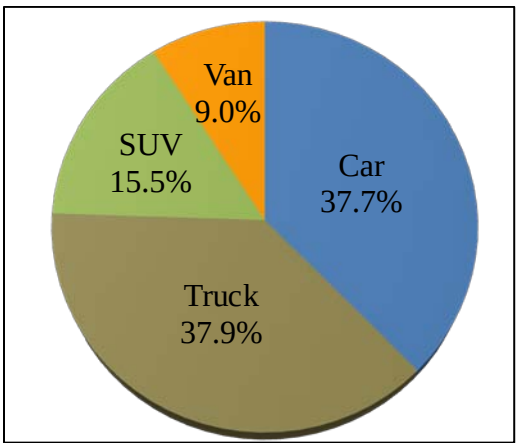


Figure 6.3 Observed Rural Road Passenger Vehicle Fleet, by Vehicle Type

A significant variation in seat belt use is found across passenger vehicle types, controlling for gender and road type ($F=81.50$, $\propto=.0001$, $n=6,919$). Driver seat belt use in cars was 47.4% compared to 34.5% for pickup truck drivers. Sport utility vehicle and van drivers both had higher observed use rates than drivers in cars and pickup at 50.2% and 63.7%. Statewide use rates are similar. Using the county population weights, the use rates are 48.0% for cars, 34.4% for pickup trucks, and 50.6% and 63.7% for SUVs and vans, respectively.

Further stratification for gender shows that female drivers have higher seat belt use rates among all vehicle classes, ranging from 42.5% for pickup trucks to 65.1% for vans (Figure 6.4). Males, in comparison, used seat belts only 33.6% of the time in pickup trucks and 62.2% in vans. A significant difference was not found in seat belt use between female and male drivers for cars or vans. The variance is significant for pickup truck ($\chi^2=8.50$ $\rho<0.004$, $n=2,619$) and SUV drivers ($\chi^2=11.93$ $\rho<0.0006$, $n=1,069$).

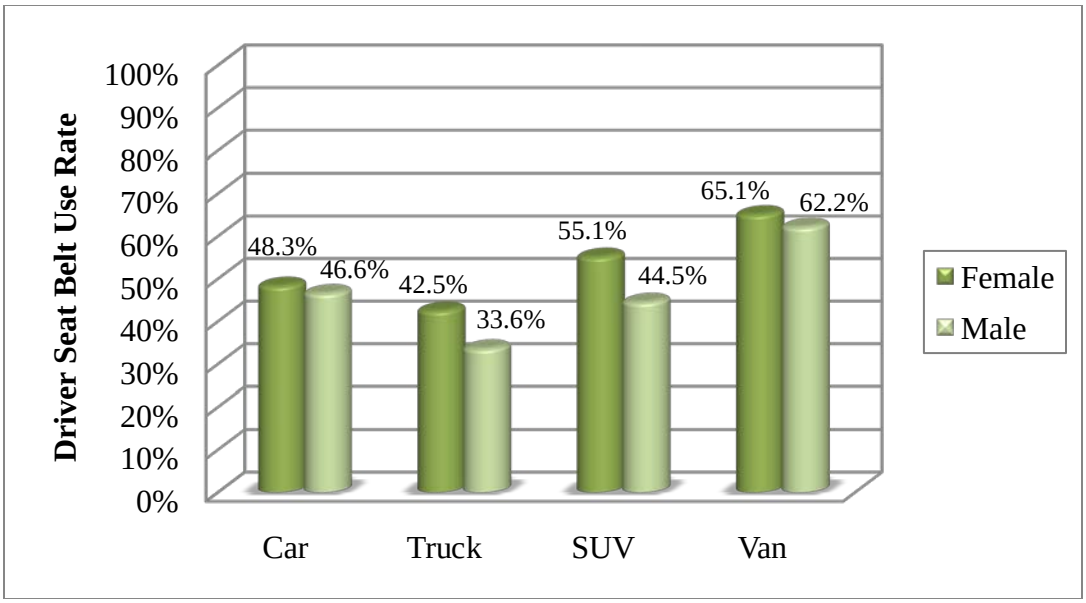


Figure 6.4 Driver Seat Belt Use, by Gender and Vehicle Type

When also considering also the road environment, the highest use rate was among females driving vans on rural highways. Seat belts were in use for 119 of the 148 drivers observed in this group for a use rate of 80.4%. The lowest use rate, 21.2%, was found among males driving pickups in rural towns where only 230 of the 1,091 were observed to be using seat belts. A significant difference was not found when considering road environment along with gender and vehicle ($F=1.36$, $\propto=.2466$, $n=6,919$).

Table 6.3 Seat Belt Use by Gender and Vehicle, for Rural Highways and Towns

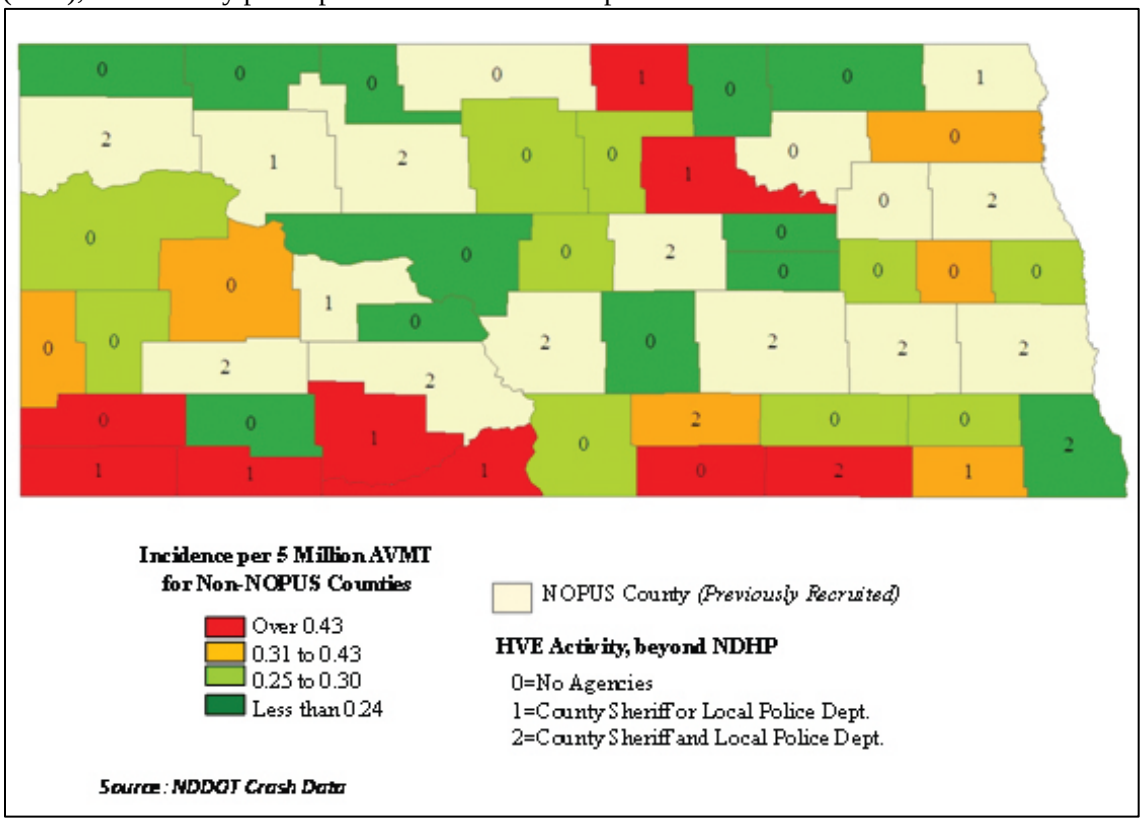
	Highway		Town	
	Female	Male	Female	Male
Car	63.8%	55.9%	37.8%	36.6%
Truck	51.0%	44.4%	36.7%	21.2%
SUV	72.0%	59.2%	42.8%	30.1%
Van	80.4%	73.3%	52.0%	47.7%

6.4 Special Topics

The final pieces of analysis touch on high visibility enforcement activities and passenger seat belt use. While the primary objective for this study was to estimate rural roads seat belt use, it is also possible to investigate driver and passenger seat belt use and to gain insight into how enhanced visibility affects driver decisions. The additional detail may be useful in discussions regarding future surveys and other seat belt resource discussions.

6.4.1 High Visibility Enforcement

A limited investigation into effectiveness of HVE on rural roads is possible with information collected for this study. A new HVE effort was organized for May in conjunction with the nationwide *CIOT* campaign, as described previously. The HVE program was expanded to encompass rural law enforcement agencies in several counties during 2009. This was the first year that agencies outside the NOPUS counties had been invited to participate in the program. With the cooperation of the NDDOT Office of Traffic Safe (OTS), rural-county participants were identified as per



Figur5.2. Overlap between these counties and valid paired ex post and ex ante seat belt observations is used to gain insight into the rural HVE activity.

The gains in driver seat belt use rates from increased enforcement visibility are found to be statistically significant in comparing observations collected in rural counties with HVE activity, compared to observations collected in rural counties that did not participate in the program (Figure 6.5). The initial seat belt use rates, collected prior to May, were significantly different at 43.8% for non-HVE counties compared to 38.5% for the counties who would be participating in the HVE program (χ^2=2.84 ρ<0.09, n=2,051). Seat belt use rates following the May HVE activities were 50.1% in the HVE counties and 46.7% in the non-HVE counties. With the 30% increase in the use rate for the HVE counties, and only 7% increase in the seat belt use rate for the non-HVE counties, a significant difference in seat belt use was not

found between the county groups following the HVE activities (χ^2=1.43 ρ<0.09, n=2,274). Although the rigorousness of the assessment may be weakened by the limited geographic scope, in that only three counties where both the pre and post observations conducted were participating in the HVE program, it does offer some empirical evidence in what would otherwise be a largely qualitative and anecdotal discussion. Additional information on county-level seat belt use rates in the ex post and ex ante periods is provided in Appendix C.

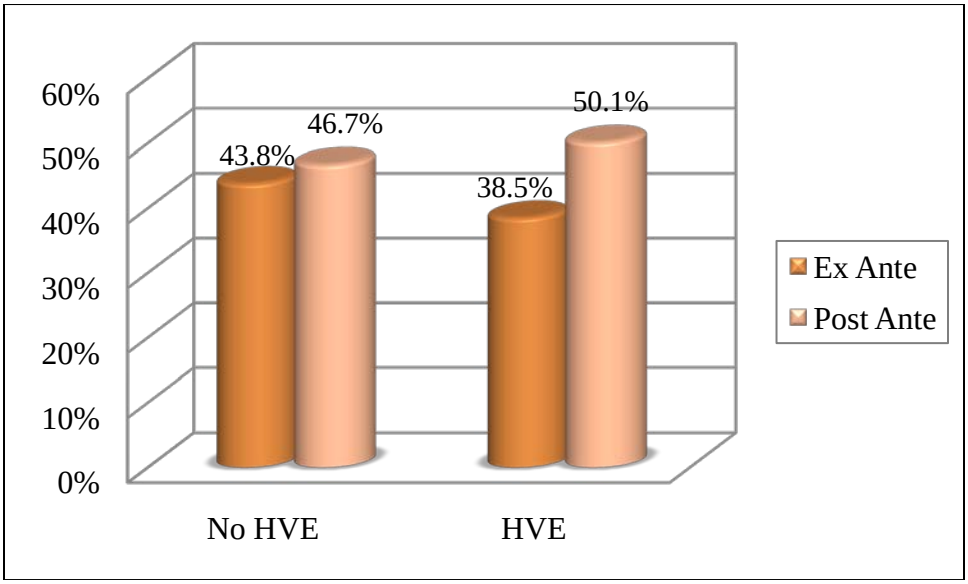


Figure 6.5 Seat Belt Use for Rural HVE Assessment

6.4.2 Passenger Seat Belt Use

As mentioned, the passenger observations were collected by observers when traffic flow and visible field allowed them to collect information beyond the driver seat belt use. In the 1,051 passenger observations, 51.0% were reportedly wearing seat belts. Unlike the driver observations, a majority of passenger observations were female as they comprise 60.0% of the group. As with driver observations, gender was a significant factor in seat belt use (χ^2=79.56 ρ<0.0001, n=1,051). Female passengers were using seat belts in 60.2% of the observations, compared to 26.2% for male passengers.

The driver and passenger seat belt use rates were strongly correlated in cases where passenger use could be recorded (Pearson's Corr.=.744, $\propto$=.0001, n=1,051). These findings are consistent with earlier research (Nambisan and Vasudevan 2007). In 44.2% of cases both driver and passenger were belted (Figure 6.6) Neither driver nor passenger was belted in 43.0% of the cases, nearly the same share of observations. The driver was belted and passenger unbelted in 8.0% of the observations, and the reciprocal for unbelted driver and belted passenger was seen in 4.9% of the cases. Males were driving in a majority of the cases where passenger gender and belt use was recorded, representing 71.3% of the drivers. Passenger seat belt use, though, was not found to be significantly related to driver gender.

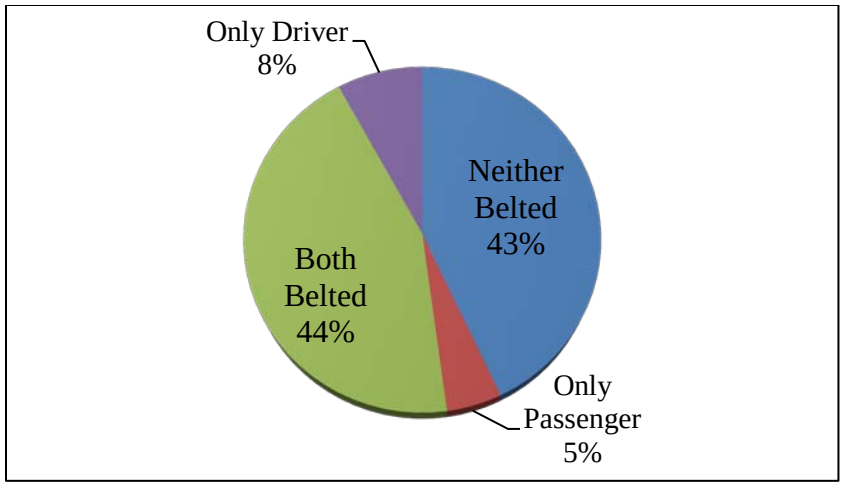


Figure 6.6 Seat Belt Use in Passenger Observation Cases

Stratifying the passenger seat belt cases by road type does show that the belted passenger and belted driver observations was the greatest share of observed cases for the highways, 56.5% (Table 6.4). The unbelted passenger and unbelted driver observations was the most common in town at 56.8%. Less than one-third of the observations on highways found neither occupant to be belted. Cases with only the driver belted were 6.8% and 9.5% of the cases on highways and in town, respectively.

Table 6.4 Passenger Observation Cases, by Road Type

	Highways *n=588*	Town *n=463*
Neither Belted	32.1%	**56.8%**
Only Passenger	4.6%	5.2%
Only Driver	6.8%	9.5%
Both Belted	**56.5%**	28.5%

The high degree of correlation between the driver and passenger observations may dissuade future investment associated with increasing passenger data collection. For instance, an observer team rather than an individual observer may be required to collect both driver and passenger seat belt use – this cost may not be justified in considering the benefit of the knowledge gained, because the passenger seat belt use rate follows the data already collected by observing the driver. Certainly, collection where possible by single observer and special case studies may be justified with regard to the passenger seat belt observations.

7. DISCUSSION

North Dakota's rural roads provide vital economic and social connections for residents and visitors. These roads are a relatively high risk travel environment. Rural roads attribute 11.4% of annual travel and 27.9% of fatal and disabling injury crashes. While there are many important aspects of road safety, interest here is in measuring rural seat belt use for managing it as a safety priority.

Seat belts offer a relatively low-cost safety enhancement for protecting occupants from potential crash injury and death. Research on seat belt use in fatal crash studies and in observation studies has shown use rates to be lower on rural roads. While this piece of 'general knowledge' is useful, it lacks specificity needed to pursue initiatives to educate and engage citizens and decision-makers in this aspect of rural road safety.

The goal here was to estimate seat belt use on North Dakota's rural roads through a cooperative pilot study with local traffic safety partners. A total of 6,919 driver seat belt observations were collected at 149 sites across 23 rural counties. Seat belt use was found to be significantly different on rural highways and in rural towns. The statewide seat belt use rates of 55.2% and 35.6% were estimated on highways and in towns, respectively. Observed use rates for counties ranged from 74% to less than 30%. As expected, female driver seat belt use, at 67.4%, was higher than the 50.0% seat belt use rate found among male drivers. Seat belt use rates were also found to vary significantly by vehicle type with pickup truck drivers having the lowest propensity to use seat belts at 34.4%. This rate is nearly 50% lower than the 63.7% seat belt use rate among van drivers.

Other findings from the study also offer insight into high visibility enforcement (HVE) and passenger seat belt use. Promising results are found in a limited assessment change in the state HVE program which extended efforts into rural counties through their local sheriff and police departments. Gains in driver seat belt use in HVE counties following the *May Mobilization* and *Click It or Ticket* activities were found to be significant compared to counties not participating in the program. Seat belt use rates increased by 30% in the rural HVE counties following May activities compared to a 7% increase in other rural counties. While this assessment is limited to evidence from three counties, it provides some insight for future endeavors.

Results show a strong relationship between driver and passenger seat belt use. Where observations were collected in driver and passenger shared seat belt behavior, in the former cases, both are belted in 44% of cases neither are belted in 43% of cases. These relationships may be useful in assessing the relative benefits for allocating additional resources to collect additional passenger seat belt observations.
This pilot established a scope and method in estimating seat belt use on rural roads in North Dakota. The statewide baseline seat belt use rates estimated in the pilot create a foundation for empirical analysis of testing and strengthening programs related to seat belt use on rural roads. It was conducted in cooperation with the state Department of Transportation and local Safe Communities organizations, with the support of the Federal Highway Administration. As expected, the use on the state's rural roads was found to be significantly less than the commonly reported statewide seat belt use rate collected in the annual NOPUS survey of all state roads. The relative risk and significant difference in use rates between rural highways and towns should be considered in future research around rural seat belt use. In addition, continued assessment of programs to increase local seat belt enforcement or awareness on rural roads is suggested.

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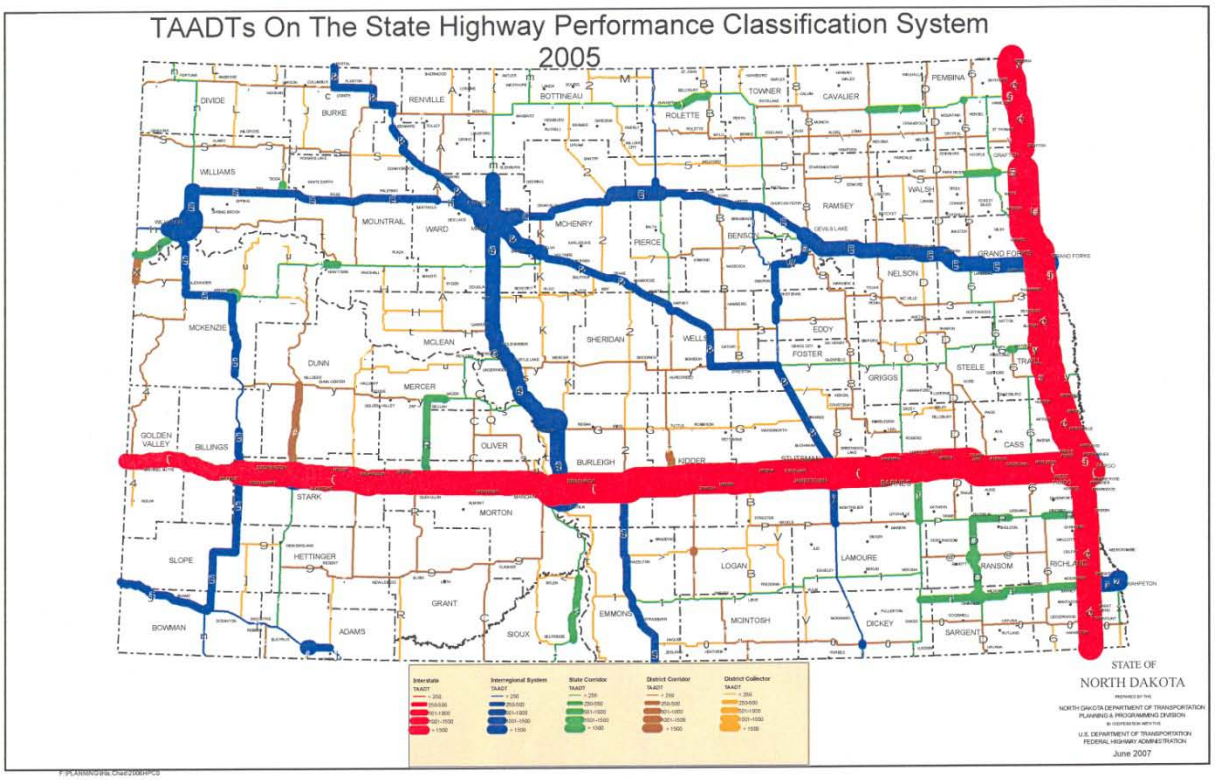
APPENDIX A. TRAFFIC DENSITY MAP



APPENDIX B. SEAT BELT USE BY ROAD TYPE

Observed Seat Belt Use Rate, 2009

County	Rural Highways	Rural Towns	All Observations
Adams	53.3%		53.3%
Benson	49.8%	20.0%	39.9%
Billings	64.6%		64.6%
Bowman	29.6%		29.6%
Cavalier	55.4%	28.9%	46.4%
Dickey	60.1%	39.1%	50.0%
Divide	74.0%		74.0%
Dunn	56.3%	46.4%	52.1%
Eddy	54.2%	32.9%	46.5%
Griggs	55.2%	36.3%	42.8%
Hettinger	51.5%		51.5%
LaMoure	48.2%	25.1%	34.6%
McHenry	58.0%	39.4%	48.0%
McKenzie	65.5%	48.3%	57.0%
McLean	55.8%	27.1%	36.6%
Pierce	56.2%	28.3%	42.6%
Ransom	58.4%	28.6%	39.6%
Rolette	50.9%	35.3%	37.5%
Sargent	58.9%	27.8%	41.5%
Slope	61.7%		61.7%
Towner	50.5%	30.9%	41.8%
Traill		39.4%	39.4%
Walsh	57.9%	53.2%	56.6%

APPENDIX C. COUNTY SEAT BELT USE FOR HVE ANALYSIS

County Ex and Post Ante Seat Belt Use Rates				
	HVE	**Ex Ante**	**Post Ante**	**Sig.**
Billings	N	62.2%	66.7%	
Bowman	Y	21.6%	38.2%	
Dickey	Y	45.4%	53.5%	
Dunn	N	44.7%	60.0%	*
Griggs	N	45.1%	40.6%	
Hettinger	N	50.0%	53.3%	
La Moure	N	32.7%	36.4%	
McHenry	N	44.0%	52.3%	
McKenzie	N	51.3%	62.7%	
McLean	N	35.3%	37.7%	
Pierce	N	40.6%	44.3%	
Ransom	N	41.7%	38.5%	
Sargent	Y	35.8%	48.1%	*
Slope	N	53.3%	70.0%	
Walsh	N	56.2%	57.0%	

*Significant at .05 ** Significant at .01