Using Laws, Enforcement, and Sanctions to Increase Seat Belt Use on Rural Roads

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Disclaimer

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ABSTRACT

Seat belt use on rural roads is especially important due to the relatively high risk for injury compared to urban areas. In the northern plains, where nearly 90% of travel occurs on rural roads, addressing this issue is particularly critical. A cohort group of 32 states was used to study seat belt use on rural roads. Means tests and regression models were designed to identify influential factors in state-level seat belt use rates as well as individual driver seat belt decisions. Results show state-level seat belt use rates are inversely related to the share of annual miles traveled on rural roads. Higher citation rates are positively related to seat belt use in the case of state-level rates. Fatal crash event analysis shows that higher shares of urban population in the state where the crash occurred increases likelihood for seat belt use. Primary enforcement is associated with a 14% greater probability for seat belt use among cohort drivers. Higher fines also have a significant influence. Cohort drivers were 21% less likely to be belted when fines were $20 or less. This effect is more pronounced in primary states than secondary states. Drivers in those states are 36% less likely to be wearing seat belts when fines are at $20 or less. Findings also show that increased driver compliance with seat belt laws in secondary states is influenced by enforcement intensity – drivers were 18% more likely to be belted in states with high enforcement activity. Among drinking drivers and young adults, primary enforcement produces a substantial increase in likelihood a driver was belted. Findings will be useful in promoting more efficient seat belt interventions for rural areas based on alignment with state and local driver characteristics.

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1. INTRODUCTION

Seat belts as an integral component in passenger and commercial vehicle safety systems are proven to reduce crash injury risk. Studies indicate that consistent seat belt usage reduces potential for fatal injury by about half when used properly (Robertson 1976, Evans 1986, Blincoe 1994, Kabane 2000, Williams et. al 2008). Since seat belt equipment was mandated for vehicles in the 1960s, use has increased substantially. Unfortunately, this particular aspect of the vehicle safety system often has an operator engagement requirement which diminishes its potential effectiveness.

Public education was the sole means for increasing seat belt use in the initial years when manufacturers began to install them as standard safety features. States then began enacting seat belt legislation to further encourage seat belt usage. This legislation paved the way for programs that couple education and enforcement which have been shown to increase compliance with seat belt laws. While these efforts have produced a large increase in seat belt use nationwide, gaps in use rates among user groups still remain a problem. Understanding and addressing these gaps offer a prospect for effectively targeting user-based factors such as the driving environment or user characteristics.

One recognized gap is among user groups in rural and urban road environments. While one might expect greater propensity to use seat belts on rural roads due to relatively high injury risk associated with higher speeds, undivided traffic lanes, fewer traffic controls, and longer emergency response times, seat belt use rates on rural roads have generally been shown to fall below that on urban roads (Dinh-Zarr 2001, Nichols et. al 2007, Strine et. al 2010). The reasons for this lower use rate are not well understood. Anecdotal evidence suggests that driver familiarity and cultural differences may be contributing factors. Rural roads generally experience lower traffic densities, so they may seem less threatening than congested urban roadways. While efforts continue to better understand human, roadway, and vehicle safety factors to improve rural road safety, seat belts are an immediate way for occupants to reduce crash injury risk.

The goal here is to gain insight into the role of enforcement, sanctions, and media education in seat belt use for rural areas, especially over recent years when increases have slowed (CDC 2011, NHTSA 2010). While it is expected that gains in seat belt use rate will slow when rates reach the range of 70% to 90%, many states are still finding ways to convert nonusers to users. It is hypothesized that even in recent years, when seat belt use rates are at relatively high levels, optimized interventions can still generate noticeable increases in seat belt use rates.

For instance, changing a secondary law to a primary law has generally produced at least some increase in a state's seat belt use rates. Because many of the secondary laws are in states with predominantly rural road systems, it is important to consider this factor. Raising fines associated with seat belt laws has also been effective in converting seat belt nonusers to users. Encouraging compliance, through traditional and enhanced enforcement levels, is hypothesized to be effective in rural areas even though lower traffic density may reduce citation frequency. It also is posited that targeting high-risk user groups, such as impaired drivers and young drivers, on rural roads may be more heavily influenced by certain types of intervention than other drivers. Identifying effective influences, along with understanding prevalence of high-risk groups on rural roads of interest, may provide safety advocates with another decision tool in encouraging efficient use of limited resources.

2. BACKGROUND

Seat belt use on the rural road system is substantially lower than on urban roadways – 65% on rural roads and 72% on urban roads according to data from the most recent three years of driver use in fatal crashes (National Highway Traffic Safety Administration [NHTSA] 2007-2009). Although reported at a higher rate for a more representative sample of the larger population, seat belt use in rural areas is also found to be significantly lower in self-reported survey figures (Centers for Disease Control [CDC] 2010). Therefore, in discussing seat belt use it is important to recognize the relative importance of rural roads to driver safety among individual states and what factors affect use on urban and rural roads.

Aggregate crash fatality figures show that efforts to improve rural road system safety are relatively more important in the Northern Plains region than in many other areas in the nation. The Northern Plains are defined here to include the predominately rural states of Montana, North Dakota, South Dakota, and Wyoming. In the region, 86% to 91% of fatalities occurred on rural roads compared to 55% nationwide (Figure 2.1).

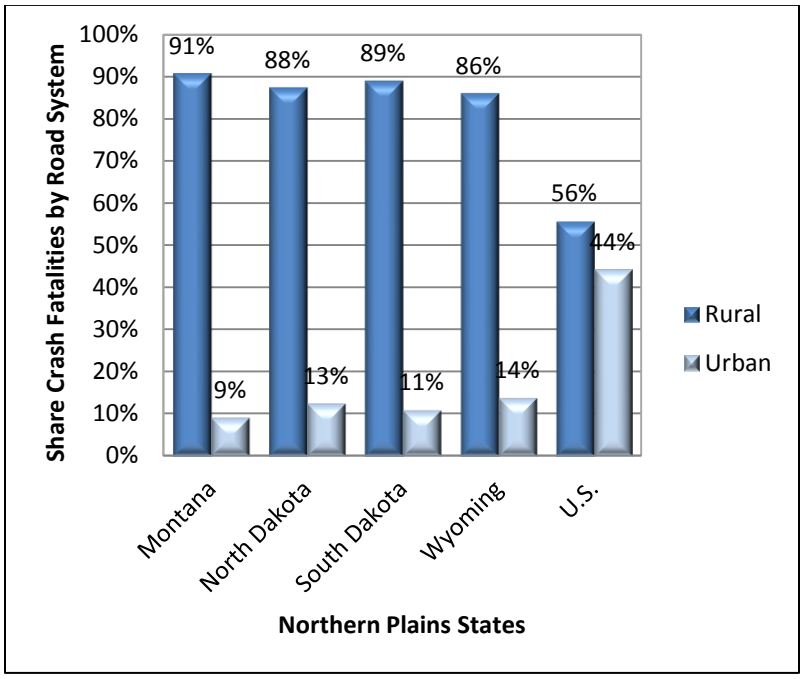


Figure 2.1 Location of Crash Fatalities in 2008, Rural and Urban Roads

Many interventions are available to encourage seat belt compliance through policy, enforcement, and education. The first attempt to legislate seat belt use in the United States was in New York. That state passed a law in 1984 that made it a primary offense, allowing officers to stop and cite individuals for failure to use seat belts. Early studies of the effects of seat belt legislation showed an increase of more than 30 percentage point increase in seat belt use rates, bringing total seat belt use rates to around 50% (Nichols and Ledingham 2008). A share of the increased use nationwide was due to states' passage of initial seat belt legislation – by the end of 1992, nine states had primary seat belt laws and 32 had established secondary laws. Secondary laws allow enforcement only after the vehicle has been stopped

for another violation. Early assessments showed primary laws were superior to secondary in increasing seat belt use. The National Highway Traffic Safety Administration reported to Congress in 1996 that:

> *The average use rate in the eleven states which have laws that permit primary enforcement is 14 percentage points higher than the average of those states which permit only secondary enforcement. The average use rate among primary law enforcement states in 1995 was 75 percent. The average use rate among secondary law enforcement states in 1995 was 61 percent.*

Eight states responded to early studies with upgrades of their secondary laws to primary laws during the 1990s, with more following in the following decade. Subsequent studies have supported findings that primary laws are superior to secondary laws in effects as measured by observed seat belt use and effects on crash fatalities (Cohen and Einav 2003, Shults et. al 2004, Farmer et. al 2005, Houston et. al 2006, Beck et. al 2007, Carpenter and Stehr 2008, Hedlund et. al 2008, Strine 2010, Tison 2010). Nichols and Ledingham (2008) did, however, find that laws had less impact on higher-risk groups such as males and rural drivers. Currently, there are 31 states with primary seat belt laws. Laws, however, do not assure seat belt use by all drivers and passengers.

National and local groups have tried a number of approaches to encourage compliance with seat belt laws. Harris (2005) identified six main interventions in increasing seat belt use, including safety belt laws and the aforementioned primary enforcement. In addition, enhanced enforcement programs, incentives, mass media campaigns, and education programs have been enlisted in the effort. Early seat belt enforcement and messaging programs were typically local. National efforts to encourage seat belt enforcement were initiated in the early 1990s with statewide demonstration projects such as the Selective Traffic Enforcement Program (STEP). A coordinated national effort was introduced with the Operation ABC – Air Bag Campaign. The experiences and partnerships developed in this effort formed the foundation for today's nationwide Click it or Tick it (CIOT) program.

Six Main Interventions

- seat belt laws
- primary enforcement
- enhanced enforcement
- incentives
- mass media campaigns
- education programs

Systematic review has shown seat belt laws, especially primary, and enhanced enforcement efforts to be effective interventions. Based on 18 studies of seat belt use, Dinh-Zarr et. al (2001) estimate a 14 percentage point increase in use and an 8 percentage point median decrease in fatalities. A recent study substantiated a positive relationship between higher enforcement levels, measured in CIOT citation activity, and increased levels of seat belt use (Tison 2010). Coupled with another study that showed enforcement efforts are significantly higher in states that have primary laws (Campbell 1988), it seems likely the gap in use rates between primary and secondary law states will increase unless overcome though deliberate actions.

Other strategies are primarily associated with public education and perceptions. Shults et. al (2004), Houston and Richardson (2006), Hedlund et. al (2008), and Nichols et. al (2008) found that enhanced public awareness and perceived ticket risk are strong determinants in effectiveness of seat belt laws. Based on their case study of 10 successful states, Hedlund et. al (2008) recommend a coordinated, long-range strategy to reach complete compliance with seat belt laws through strong emphasis on enforcement activities and interagency relationships. Shults et. al. also recommend emphasis on enforcement, but with prevailing effort on upgrading a seat belt legislation to primary.

Nichols and Ledingham (2008) identify several characteristics common among states with successful seat belt programs. These include a primary seat belt law, year-round seat belt enforcement with one or more enhanced enforcement efforts, strong multijurisdictional relations in law enforcement, effective/creative seat belt publicity, high priority for increasing seat belt use, and strong management and implementation plans for long-term seat belt use. A few secondary law states have been successful in increasing seat belt use by relying on the latter portion of this list but cultural and resource commitment to seat belt use are essential in these cases.

Key Success Characteristics

- primary seat belt law
- year-round enforcement
- one or more annual enhanced enforcement effort
- strong multijurisdictional relations in law enforcement
- effective/creative seat belt publicity, high priority for increasing seat belt use
- strong management and implementation plans for long-term seat belt use

(Nichols and Ledingham 2008)

The research here takes a two-step approach in looking at the recent information on state-level seat belt use and individual drivers' seat belt use to investigate relative effectiveness of interventions, with specific attention to rural roads and user groups. The following section provides an overview of the data and methods. Analysis of state-level seat belt use rates and individual driver seat belt use decisions are presented in section four. The final section offers highlights and points for moving forward to improve seat belt use rates on rural roads.

3. DATA AND DESIGN

Three systematic measures of seat belt use were identified at the state and individual user levels. Two datasets are offered by NHTSA – the Fatality Analysis Reporting System (FARS) and the National Occupant Protection Use Survey (NOPUS). The Centers for Disease Control (CDC) monitors seat belt use in its Behavioral Risk Factor Surveillance System (BFRSS). These sources all show slow, but continued improvement in seat belt use rates.

Nationally, the FARS data provides a glimpse into crash events that is useful in identifying trends for seat belt use. It captures reports for fatal crashes on all roads. Individual FARS event records include parameters that identify on which FHWA functional road system and class the crash occurred. Using these parameters, crashes on the rural road system can be distinguished from those on the urban system.

FARS reports show that about 39,000 drivers were involved in fatal crashes on lower travel density rural roads, including the minor arterial, major collectors, minor collectors, and local roads. Nationwide, these road classifications accounted for 77% of the fatal crash driver cases between 2007 and 2009. Seat belt use rate among these drivers was only 54%. Considering road location detail of functional class for these crashes, in the more than 9,500 fatal crash driver cases recorded on these local rural roads between 2007 and 2009, only 45.1% were wearing seat belts (Figure 3.1).

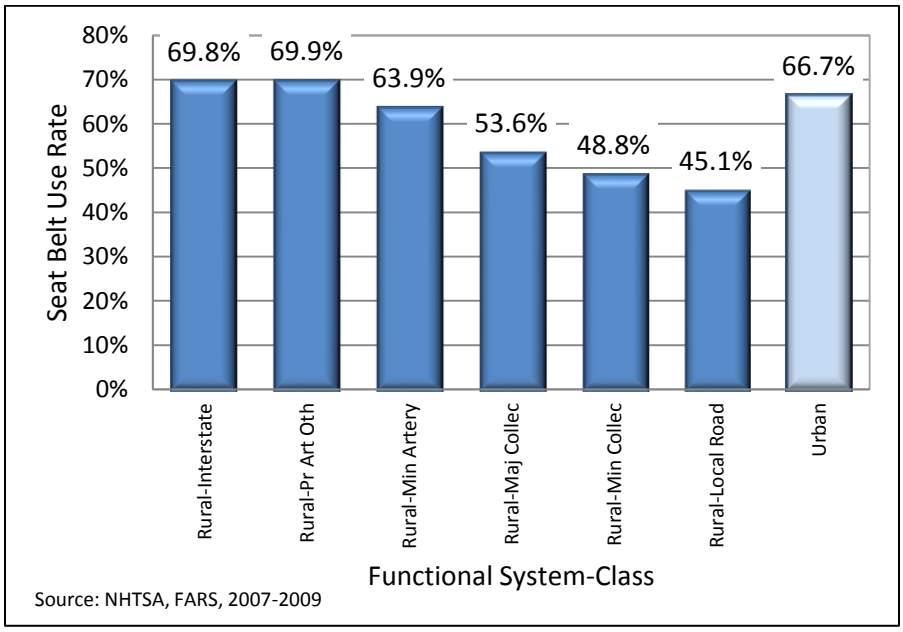


Figure 3.1 Driver Seat Belt Use in Fatal Crashes by Road System and Among Rural Classes

The NOPUS survey uses probabilistic sampling to estimate seat belt use among travelers on federal-aid roads. This observation survey has been conducted in most states for more than a decade. However, the estimate does not include sites on the local rural road class which causes a problem in collecting data for the rural focus here.

The other source, the BRFSS, is an ongoing phone survey of U.S. residents that has been conducted in most states since 1994. Information is gathered annually to monitor trends in health-related behaviors, care, and access. A question about seat belt use is included as one of the core questions in monitoring preventative injury and risk topics (CDC 2010).

Empirical work conducted here relies heavily on self-reported seat belt use and law enforcement reported seat belt use for passenger-vehicle drivers in fatal crashes. The CDC self-reported survey data is attractive in that it is a statewide sample of residents 18 years and older. Seat belt use rates from 2002 and 2008 will be used here to study state-level seat belt use rate factors. FARS data on drivers involved in fatal crashes from 2007 to 2009 are also used in the study. The FARS data includes environment and driver detail for disaggregate analysis of seat belt decisions made by drivers. Information on law enforcement activity and media campaigns will be drawn from existing sources.

The initial analysis considered state-level seat belt use levels and factors that may influence that rate. Data sources required that all roads be considered in this effort. Quasi experimental design was used to study seat belt use factors among states that still have secondary enforcement and states that have more recently adopted primary enforcement for seat belt violations. Cohort groups were defined based on enforcement status for the seat belt law. In addition to enforcement status, the year a primary law was enacted was also used to define study groups.

Not all states are included in the study. Legacy states, defined as states that had primary seat belt laws in place before 1997, were omitted. In the contiguous 48 states, these include New York, Texas, Connecticut, Iowa, New Mexico, Oregon, California, and Louisiana. Preliminary work showed that these states have characteristics that distinguish them from states with more recent adoption of primary seat belt laws so they were excluded in the modeling. In addition, Washington was not included in the modeling due to special seat belt initiatives conducted during the study period that seemed to generate unique influences in the self-reported seat belt rate.

The final cohort group included 32 states. These states all had secondary seat belt laws in 1997. During the intervention period, from 2007 to 2009, 15 of the states upgraded to a primary seat belt law. Information on enforcement, population, and drivers was collected from previous research reports and multiple public data sources to create the state-level seat belt use dataset.

A second set of analyses involving the cohort states looks at seat belt use factors based on individual records for fatal crashes. The individual crash event records allow for more robust study of predictor factors in identifying priorities for increasing seat belt use on the rural road system. To complete this investigation, driver records in fatal crashes were used in conjunction with some of the information collected for the state-level work.

4. SEAT BELT USE RATES, OVERALL AND BY ENFORCEMENT STATUS

The NOPUS national observation study in 1994 showed that 54% of vehicle occupants were using their seat belts (NHTSA 2000). Fatalities data reported for that year showed only 49% of drivers in fatal crashes were using seat belts. The NOPUS national estimate of seat belt use rate rose to 84% in 2009 (NHTSA 2010). Seat belt use among drivers in fatal traffic crashes that same year had only increased to only 63%. Although NOPUS limited rural road geography may explain some of this difference, the apparent lagging increase in use rates among drivers in fatal crashes is concerning as the gap continues to widen (Figure 4.1).

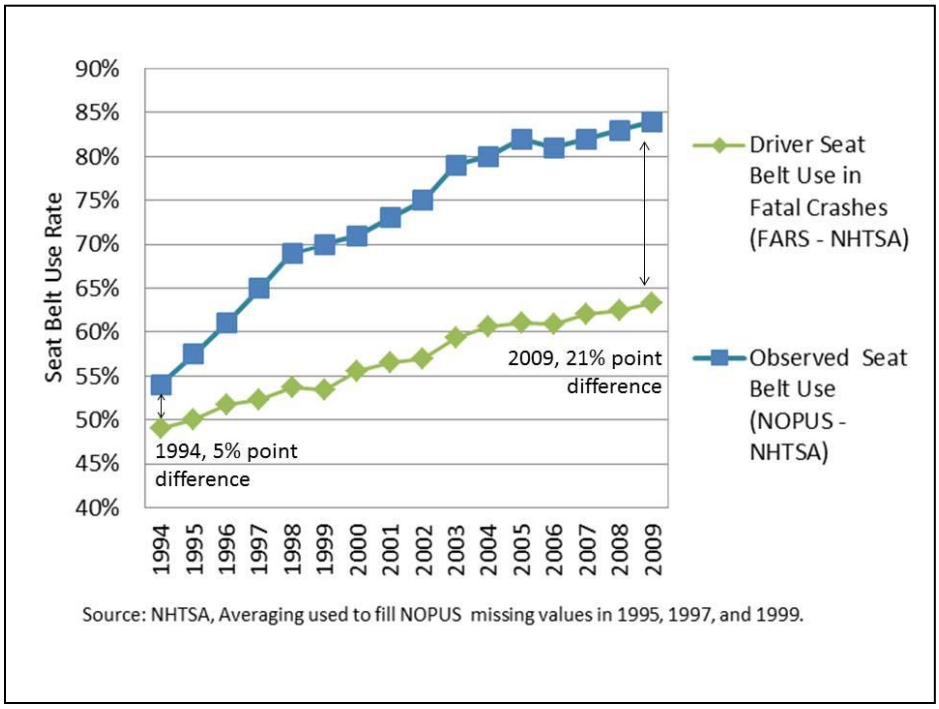


Figure 4.1 Seat Belt Use, 1994 to 2009

For the national population measure, a self-reported seat belt use rate of 85.0% was reported by the CDC for 2008. This was slightly above the NOPUS observed use rate in 2008 of 83.0%. The CDC 2008 use rate was an increase of 4.5 percentage points compared to 2002. These figures are based on the share of adults reporting that they always use their seat belt. The CDC also released statistics showing that self-reported seat belt use remains higher in states with primary laws at 88.2% in 2008, compared to 79.2% in states with secondary seat belt laws (2011). Table 4.1 shows the distribution of states by these self-reported seat belt use rates from highest to lowest. The median rate among the 48 states is 82.2%. Among the more rural states – defined here as those with greater than median share, 69.9%, of their population in rural areas – 40% are in the lowest quartile of states ranked by CDC reported seat belt use. This compares to only 8% of states with a larger population share in urban areas.

Table 4.1 BRFSS Self-Reported Seat Belt Use Rate and Enforcement, States Sorted from Highest to Lowest

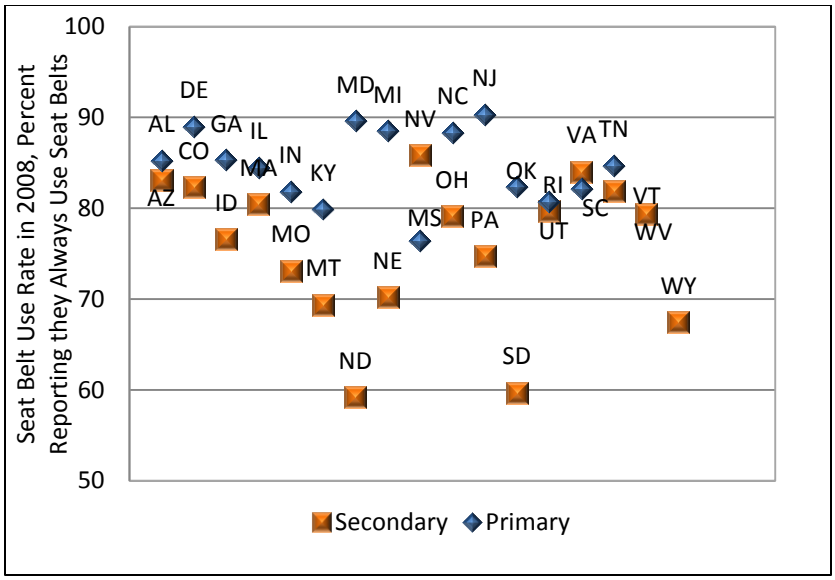
	Enforcement[1]						Enforcement[1]				
	'02	'08	2008 Use	Point Change	Percent Change		'02	'08	2008 Use	Point Change	Percent Change
Oregon*	P	P	93.7	5.8	6.6%	South Carolina	S	P	82.1	7.3	9.8%
California*	P	P	93.2	1.0	1.1%	Vermont	S	S	81.9	5.5	7.2%
Washington	P	P	92.0	6.3	7.4%	Indiana	P	P	81.8	5.0	6.5%
Texas*	P	P	91.1	5.0	5.8%	Minnesota	S	S	81.7	6.2	8.2%
New Jersey	P	P	90.3	7.8	9.5%	Maine	S	P	81.6	9.0	12.4%
New Mexico*	P	P	89.9	3.2	3.7%	Rhode Island	S	S	80.7	5.2	6.9%
Maryland	P	P	89.6	2.1	2.4%	Massachusetts	S	S	80.4	8.4	11.7%
Louisiana*	P	P	89.2	9.9	12.5%	Kentucky	S	P	79.9	5.5	7.4%
Delaware	S	P	89.0	8.7	10.8%	Utah	S	S	79.7	7.7	10.7%
Michigan	P	P	88.5	4.7	5.6%	West Virginia	S	S	79.4	5.0	6.7%
North Carolina	P	P	88.3	1.0	1.1%	Ohio	S	S	79.1	2.6	3.4%
Florida	S	S	86.3	2.9	3.5%	Idaho	S	S	76.6	11.4	17.5%
New York*	P	P	86.2	5.6	6.9%	Mississippi	S	P	76.4	3.7	5.1%
Connecticut*	P	P	86.0	3.8	4.6%	Pennsylvania	S	S	74.7	6.2	9.1%
Nevada	S	S	85.8	7.0	8.9%	Kansas	S	S	74.2	7.5	11.2%
Georgia	P	P	85.3	2.2	2.6%	Missouri	S	S	73.1	6.3	9.4%
Alabama	P	P	85.2	1.8	2.2%	Wisconsin	S	S	72.9	6.7	10.1%
Tennessee	S	P	84.7	3.5	4.3%	Arkansas	S	S	70.7	6.1	9.4%
Illinois	S	P	84.5	9.9	13.3%	Nebraska	S	S	70.2	1.5	2.2%
Iowa*	P	P	84.4	8.5	11.2%	Montana	S	S	69.4	0.9	1.3%
Virginia	S	S	84.0	6.2	8.0%	Wyoming	S	S	67.4	9.2	15.8%
Arizona	S	S	83.1	2.7	3.4%	New Hampshire[2]			66.4	2.6	4.1%
Colorado	S	S	82.3	3.4	4.3%	South Dakota	S	S	59.7	4.9	8.9%
Oklahoma	P	P	82.3	4.8	6.2%	**North Dakota**	**S**	**S**	**59.2**	**6.8**	**13.0%**

[1]Enforcement: Primary (P), Secondary (S); [2]No Seat Belt Law for Occupants 18 and Older.
*Legacy State

Source: Adapted from CDC 2004 and CDC 2011

States falling in the lowest quartile for seat belt use in 2008 are those with self-reported seat belt use rates under 76.6%. North Dakota has the lowest reported use rate in both 2002 and 2008. Other states included in this lowest quartile were unchanged for 2002 and 2008 with the exception of Idaho – which improved its position by moving slightly above the group rate. Mississippi – which passed a primary seat belt law in 2006 – is the only primary law state in the group. With the exception of Florida, all states in the highest seat belt use quartile have primary seat belt laws. Florida did pass primary seat belt legislation in 2009.

Figure 4.2 illustrates the distribution of seat belt use among the contiguous states, distinguishing their primary and secondary enforcement status. While there is some mix of enforcement strategies in the states in the mid-range, the upper and lower echelons are heavily comprised of primary and secondary enforcement states, respectively. Previous research has shown that the primary law is neither necessary nor sufficient in establishing the upper-tier use levels, but that it is an important intervention strategy in establishing significant gains and sustained highs in seat belt use rates.



Source: CDC 2011

Figure 4.2 Enforcement Type and Seat Belt Use Rates, 2008

The variance in self-reported seat belt use rates is significant between enforcement types in 2008 ($t=-4.01$, $p<0.001$, $n=32$). Significant increases in seat belt use occurred in the primary and secondary enforcement states when comparing 2008 to 2002. While the number of states with primary seat belt laws increased from 17 to 24 over the six years, the primary use states showed little change in distribution with a much narrower range around the higher median use (sd=4.4) compared to secondary states (sd=7.5) as illustrated in Figure 4.3.

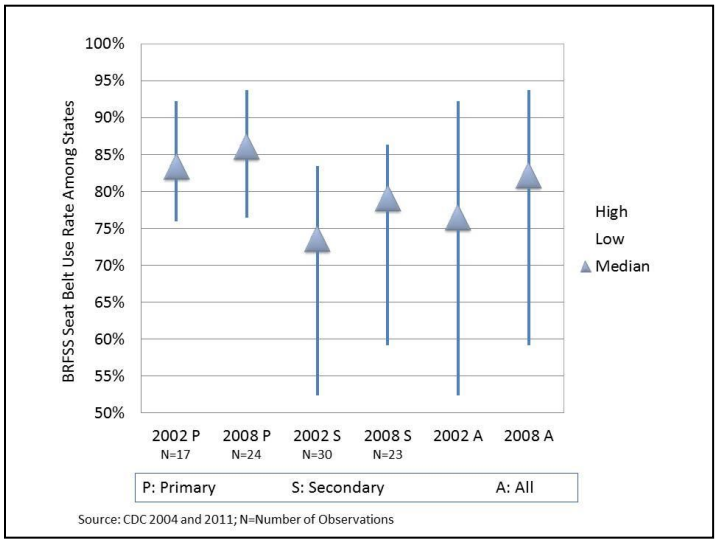


Figure 43 Self-Reported Seat Belt Use among States in 2002 and 2008, by Enforcement

5. EMPIRICAL ANALYSIS

State-level seat belt use rates, considering the BRFSS, provide a general measure of the likelihood that residents will use their seat belts given macro environmental factors. The aforementioned seat belt use trends and studies indicate that interventions do affect decisions to use seat belts. In addition, underlying demographic and cultural characteristics may be used to explain some of the variation in seat belt use. Results from means tests and regression modeling done to estimate the influence of these factors follow.

5.1 State-Level Seat Belt Use – Cohort States, All Roads

The cohort study looked at seat belt use rates in 32 states. For the state-level analysis, 2002 was selected as the base year for comparison with an intervention year of 2008. Self-reported seat belt use rates in primary states averaged 80% in 2002, compared to 70% among secondary enforcement states. Use rates increased for both groups between 2002 and 2008. Seat belt use between the groups varied significantly during the baseline and intervention periods ($t(df=31)=-3.88$, $p<0.001$, two-sample $t(df=31)=-3.86$, $p<.001$).

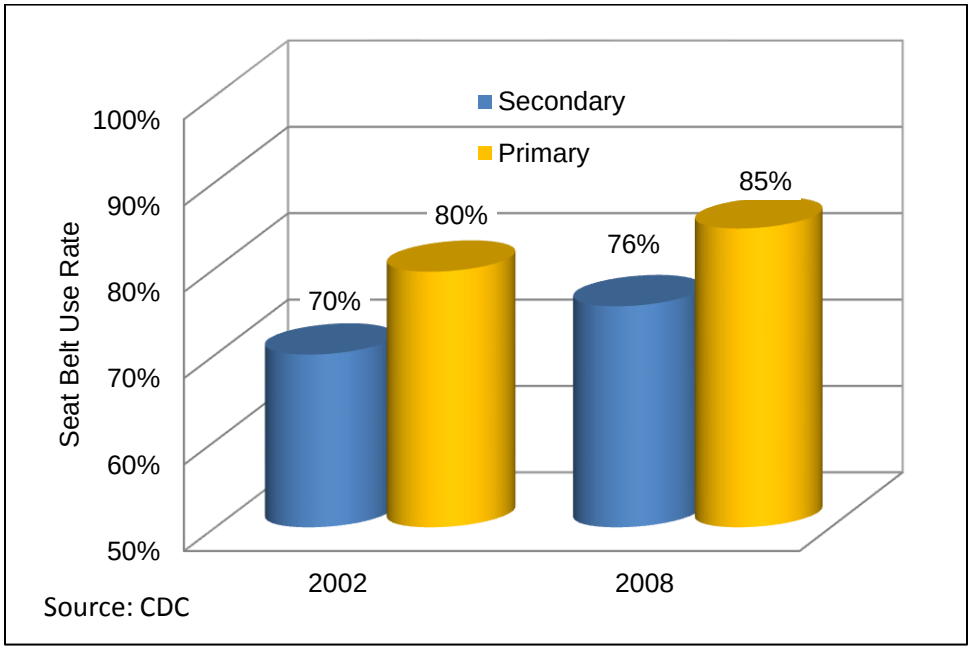


Figure 5.1 Seat Belt Use for Study Cohorts

5.1.1 Variable Selection

Initially, t-test statistics were used to filter potential variables for use in a state-level seat belt use rate model. A review of previous work was used to select variables related to demographics, enforcement, and education in developing the preliminary ordinary least squares (OLS) regression model. Eight variables were collected and considered as predictors in the model to estimate statewide seat belt use rates (Table 5.1).

The gender ratio, reported by the U.S. Census, measures the number of males per 100 females. A ratio greater than 100 shows a higher share of the state's population is male. The share of males was significantly higher in the control group than among the intervention states. Since males have been found less likely to use seat belts, it is expected that the larger share of males will decrease overall seat belt use rates in the secondary states compared to the primary states (Boyle and Schulman 2008, Strine 2010). U.S. DOT figures on driver licensing showed the states did not vary significantly with regard to the share of drivers between ages 18 and 34. Research has shown this age group to be at a relatively high risk for crashes, so a larger share of drivers in this group seemed a likely inverse predictor in the overall seat belt use rate (NHTSA 2005).

The driving environment, with regard to traffic density, has also been discussed as a factor in targeting seat belt users. Urban settings, which have higher traffic densities, are generally associated with higher seat belt use rates. This may be a result of perceptions of greater risk due to more vehicles on the road or cultural factors in which urban users are more conscious of healthy behaviors such as wearing their seat belts (Ward 2007, Nichols et. al 2009, NHTSA 2009). Data were collected to define two variables related to this factor – rural share of annual vehicle mile traveled (VMT) and urban share of population in a state. The rural share in VMT was found significantly different between the primary and secondary cohort groups, with the secondary states attributing 48.8% of travel to rural roads compared to 33.1% in the primary states ($t=-2.10$, $p<0.045$).

The final three data items gathered for the model were related to enforcement and education (

Table 5.2 Mean Values and T-tests for Statewide Seat Belt Use Rate Predictor Variables

Table 5.1). Enforcement is shown to be important in increasing seat belt use rates through perceived risk for being ticketed for non-compliance and through penalties associated with fine levels (Nichols et. al 2008, Tison 2010). Data on seat belt citations issued annually during the nationwide Click it or Ticket (CIOT) campaign, which is designed to promote seat belt use, was provided by NHTSA. An annual count of seat belt citations by all agencies in a state was not available, so the CIOT data provides a proxy for each state's relative level of enforcement.

Higher levels of enforcement were expected to be associated with higher seat belt use rates. For states reporting CIOT participation between 2007 and 2009, enforcement ranged from 23 to 1,704 citations per 100,000 population. The median enforcement rate was 539. This rate is an increase from 186 CIOT citations per 100,000 between 2004 and 2006. Citations rates were found to be significantly higher for primary enforcement states during 2007 to 2009 period ($t=-4.67$, $p<0.001$, $n=32$). The average CIOT citation rate was 370 per 100,000 population among secondary enforcement states compared to 952 in the primary enforcement group. Note that in a test of CIOT enforcement for the cohorts between 2004 and 2006 the difference was not significant. Citations were below 300 per 100,000 population for both cohort groups. Data on spending by states during the CIOT enforcement period showed spending did not vary significantly between the cohorts (Nichols 2008, NHTSA 2011). On average, secondary states spent $22,697 per 10,000 per population. This value is slightly higher than the average spent by primary states at $22,601. The plot for models of state-level seat belt use and gender, rural VMT, and CIOT citations are shown in Figure 5.2, Figure 5.3, and Figure 5.4. The graphics provide visualization of the relationship between the independent and dependent variables and tendency for clustering based on cohort type.

Table 5.2 Mean Values and T-tests for Statewide Seat Belt Use Rate Predictor Variables

Predictor Variable	Mean Control	Mean Intervention	t-statistic[1]
Gender Ratio	98.9%	95.5%	4.03**
Driver Share under Age 35	31.7%	30.5%	
Share of Fatal Crashes Involving Drinking Drivers	23.4%	19.0%	
Rural Share in VMT	48.8%	33.1%	2.45*
Urban Share in Population	62.5%	72.8%	
CIOT Enforcement	370	952	4.67**
Seat Belt Citation Fines	$25	$29	
CIOT Media Expenditures 2007-2009	22,697	22,600	

[1]Significance: *** p is <.001, ** p is <0.01, * p is <0.05.

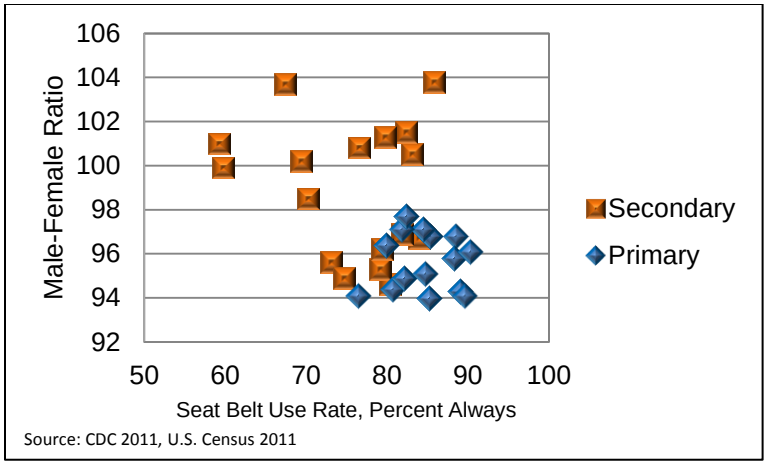


Figure 5.2 Gender and Seat Belt Use for Cohort States

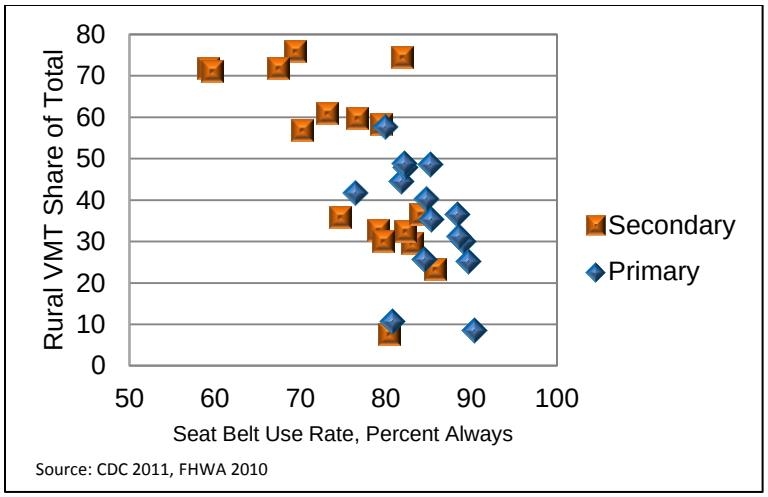


Figure 5.3 Rural VMT and Seat Belt Use for Cohort States

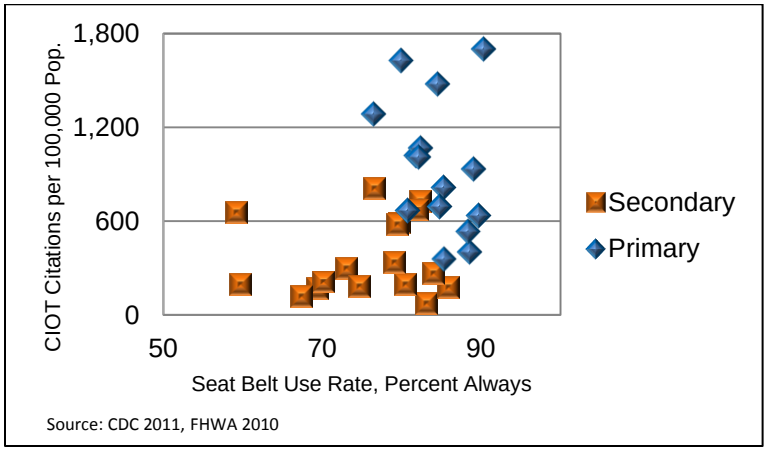


Figure 5.4 CIOT Seat Belt Citations and Seat Belt Use for Cohort States

5.1.2 State Model Results

An OLS model was used to estimate simultaneous effects of variables on the self-reported state-level seat belt use rates. The resulting model has good predictive value as 93% of the variance in the use rate is explained by the model parameters. The baseline use rate, measured by the self-reported rate in 2002, provides the largest share of the explanation as expected. The baseline rate has a weight of 81% in explaining the seat belt rate variance. States with the highest seat belt use rate in 2002 are likely to have relatively strong seat belt use rates at the end of the study period. Holding the other parameters constant at their mean values, having a seat belt use rate one standard deviation below the mean in 2002 – 45% below the average – results in a 2008 seat belt use rate that is 18% lower than the average. As noted, seat belt use rates tend to show relatively small changes year-to-year with an increasing trend over time. Considering these findings, state-level seat belt use was modeled as a function of rural travel and enforcement intensity.

Table 5.2 State-level Seat Belt Use Model Results, Cohort States

Parameter	Estimate	Standard Error	t-statistic	Sig.[1]
Dependent: Share that Self-Reported Always Use Seat Belt, CDC 2008				
Rural VMT Share	-0.06963	0.02556	-2.72*	**
CDC Use 2002	0.75426	0.05874	12.84**	***
CIOT Citation Density	0.00218	0.00090	2.44*	**
R^2=0.93				
N=32				

[1] Significance: *** p is <.001, ** p is <0.01, * p is <0.05.

Travel environment and citation density – number of citations issued per 100,000 population – are also shown to be significant in predicting the state-level seat belt use rate. As the share of vehicle miles traveled (VMT) attributed to rural travel increases, the state-level seat belt use rate decreases. It is estimated that decreasing the average rural VMT share from the mean of 42% to 21% increases the seat belt use rate by 2%. Increasing citation density from the mean value of 643 per 100,000 population to the maximum of 1,704 citations per 100,000 would increase seat belt use by an estimated 2.9% if rural VMT and CDC use in 2002 are held constant.

Variance inflation factors reveal no multicollinearity with inflation factors all less than 2.0. The Durbin-Watson statistic of 1.7 indicates no autocorrelation effects in the model.

5.2 Driver-Level Seat Belt Use – Cohort States, Rural Roads

A second step in the analysis relied on the national database of law enforcement reported fatal crashes for the cohort states. These crash reports include descriptors for driver, roadway, and environmental factors that can be used to gain insight into the propensity for seat belt use. The roadway descriptors include a location element classifying the crash site under the FHWA functional class system (2000). This element, along with driver, vehicle, and other location parameters, was used to create a subset of the data. It includes passenger vehicle drivers over age 17 that were involved in crashes on rural roads in the 32 cohort states from the larger dataset. State-level information on enforcement, citations, fines, and rural/urban population were added to individual crash records. The query resulted in 32,847 fatal crash driver observations between 2007 and 2009.

5.2.1 Crash Variables

Several crash-level items of information were collected with regard to driver and environment. In addition, state-level intervention effects were pulled in from data compiled in the first set of analyses. In developing the model, the review of literature supported driver variables related to gender, age, and drinking related to high-risk target groups such as males and younger drivers. Strine et. al also identified body mass index (BMI) as a potential predictor in their injury prevention study (2010).

Table 5.3 shows the share of fatal rural road crash observations associated with exploratory and potential predictor variables for modeling driver seat belt use decision. Means analysis between primary and secondary enforcement cohort groups shows significant differences for several variables. Males, younger drivers, and young adults are found in a significantly higher share of crashes for secondary states. Drivers with previous violations or accidents are also more prevalent among drivers in the secondary state fatal crashes. With regard to the driving environment, the higher share of urban population is expected given what is known about the location of primary seat belt laws among the states with more urbanized geography. Surprisingly, however, the primary cohort attributes a significantly larger share of fatal crashes to the rural road system. The primary cohort also has a larger share on roads with fewer travel lanes. These may be more rural roads with construction and operation parameters that include lesser requirements for engineering safety elements.

A large difference is found with regard to the intervention factors associated with fatal crashes for the primary and secondary cohorts. Low fines are far more common with the crash environment in secondary states. Low fines, defined as under $20, were associated with 46% of the secondary state cases compared to only 19% of the primary state cases. High CIOT citation incidence, which is included as a proxy for overall enforcement activity, is typical with the primary cohort and rare for the secondary cohort. High enforcement is defined as a state-level citation rate for May CIOT activity that is above the mean – 539 per 100,000 population. As expected, a high CIOT media expenditure level is also more prevalent for primary cohort fatal crashes than for the secondary cohort. High media spending is defined as greater than the median spending among all states of $2,007 per 100,000 population.

Table 5.3 Bivariate Analysis of Independent Variables, Rural Road Crashes in Cohort States 2007-2009

	Cohort Group			
	Secondary *n=11,986*	Primary *n=20,861*	t-statistic	Sig.[1]
Driver				
Male	70.60%	68.60%	3.82	***
Drinking Driver	27.90%	22.90%	10.01	***
Age 18-24	22.91%	21.38%	3.23	***
High BMI	2.59%	2.57%	2.40	**
Previous DWI	4.04%	3.57%	2.11	**
Previous Suspension	14.19%	13.34%	2.15	**
Previous Accident	13.58%	12.78%	2.06	**
Environment				
Urban Population	63.97%	68.75%	30.31	***
Rural Roads	89.19%	90.98%	5.17	***
High Speed Road	89.85%	90.23%	1.12	
Pickup Truck	26.44%	27.00%	1.11	
Dark Conditions	38.36%	39.66%	2.33	**
Few Travel Lanes	87.74%	89.53%	4.86	***
Late Night	14.92%	14.96%	0.11	
Intervention				
Fine Low	46.12%	18.72%	51.76	***
CIOT Citations High	18.54%	81.13%	139.92	***
CIOT Media High	22.96%	45.43%	43.53	***

[1] Significance: *** p is <.001, ** p is <0.01, * p is <0.05.

Preliminary logistic regression models were tested using all variables with bivariate associations at the 90th percentile. The final model includes all variables with significance of at least 0.10 in predicting seat belt use among drivers in fatal crashes on rural roads. Although the dark condition and previous DUI variables had significance in the bivariate association, they were eliminated in the final model due to weakness and confounding relationships in the associations with the dependent variable.

The final model of seat belt use in fatal crashes includes 15 parameters related to driver, environment, and intervention. The variables are defined in Table 5.4. A baseline model includes all variables to confirm that rural roads present a unique driving environment with controls introduced for other potential influences in likelihood a driver involved in a fatal crash is wearing a seat belt. The road group variable was tested with a three-level definition including urban, interstate, and rural roads. The difference between the interstate and urban road groups was not significant. Because the focus here is on rural roads, the urban interstate roads and other urban roads are not included in the final model. The rural road variable was included to differentiate the other rural roads from the rural interstate environment. Two additional models look at the driver seat belt use in the cohort group by enforcement type. Additional models are used to differentiate high-risk groups – drinking drivers and young adults – who consistently perform as low user groups across the models. The models are used to see which factor influences carry the greatest weight among driver groups.

Table 5.4 Driver Seat Belt Use Model Variable Definitions

Driver		
	Gender	Male=1, Female=0
	Drinking	Drinking Driver=1, Non Drinking Driver=0
	Young Adult	Age 18-24=1; Over 24=0
	High BMI	BMI (weight/height) equal to 2.8 or greater=1; Under 2.8=0
	P Suspension	Driver's Previous License Suspension(s)=1; None=0
	P Accident	Driver's Previous Reported Accident(s)=1; None=0
Environment		
	Pickup	Vehicle is Pickup Truck=1; Other Type=0
	Higher Speed	Posted Speed 35 mph or over=1; Under=0
	Few Lanes	Travel Lanes are 1 or 2 =1; More=0
	Rural Road	Functional Class 2 to 9=1; Class 1, 11-16, 19=0
	Late Night	Time between 11:00 pm to 4:59 am=1; Other=0
	Urban	State's Urban Population 69% or over=1; Under 69%=0
Intervention		
	CIOT High	State's CIOT Citation Incidence 539 or over=1; Under 539=0
	Fine Low	State's Seat Belt Fine $20 or under =1; over $20=0;
	Enforcement	State's Seat Belt Law is Primary=1; Secondary=0

5.2.2 Driver Model Results

Most models have good explanatory power with ROC values slightly over 0.70. Concordance is found in over 70% of the cases looking at the relationship between actual and expected dependent variable results. The cohort model, which includes rural roads and drivers in the cohort states between 2007 and 2009, shows the fatal crash drivers on rural non-interstate roads were 24% less likely to be belted than drivers on rural interstate roads (Table 5.5). The variable controlling for differences in urbanization effects showed a positive relationship between urban population share and seat belt use. In states with urban population above the median, drivers were 40.4% more likely to use seat belts than in more rural states.

The variable with the largest weight among predictive factors is whether or not a driver has been drinking, accounting for about a third of the explained variation in the model. A drinking driver was 75.3% less likely to be wearing a seat belt than a non-drinking driver in fatal crashes. Although greater in the primary enforcement states, drinking drivers are 77.3% and 74.5% less likely to be wearing seat belts than other drivers, in the secondary and primary states, respectively. Fatal crash records show 29.4% of drinking drivers in primary enforcement states were wearing seat belts (Figure 5.5). While this use rate is low, they are significantly more likely to be using seat belts, compared to drinking drivers in secondary states at 22.9% (χ^2=43.466, ρ=<.001, n=32,844).

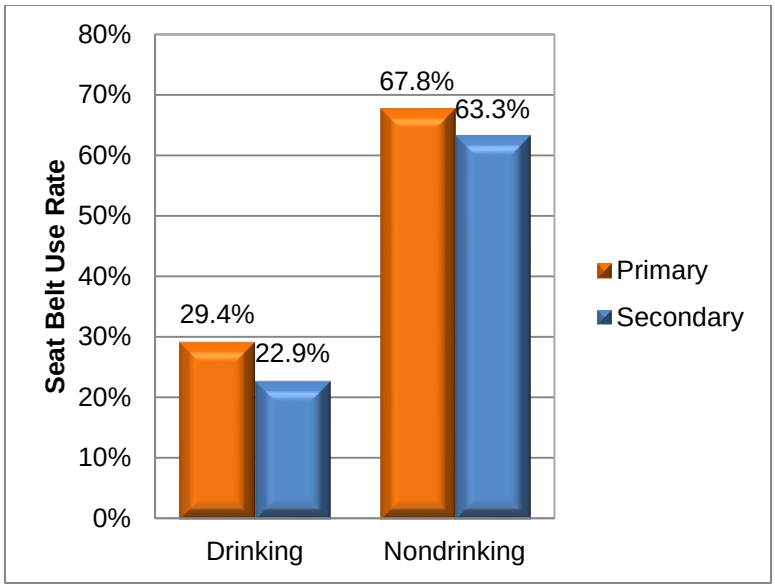


Figure 5.5 Fatal Crash Seat Belt Use in Cohort States, Drinking and Non-Drinking Drivers 2007 to 2009

Young adults are also seen as a higher-risk driver group. Effects of independence, fewer responsibilities, excitement seeking, and risk discounting may contribute to seat belt decisions in this driver group. Fatal crash reports show that fewer than half of the young adults, 48.9%, involved in these events on rural roads were wearing seat belts. This share is 16% lower than among drivers 25 years and older. The gap is significantly larger is secondary enforcement states where a 22% smaller share of young drivers, ages 18-24 years, were belted in fatal crash events than drivers 25 years or older (χ=64.211, ρ=<.001, n=7,206). The share of young adult drivers belted in fatal crash events in secondary states is 18% less than in the primary enforcement states (Figure 5.6).

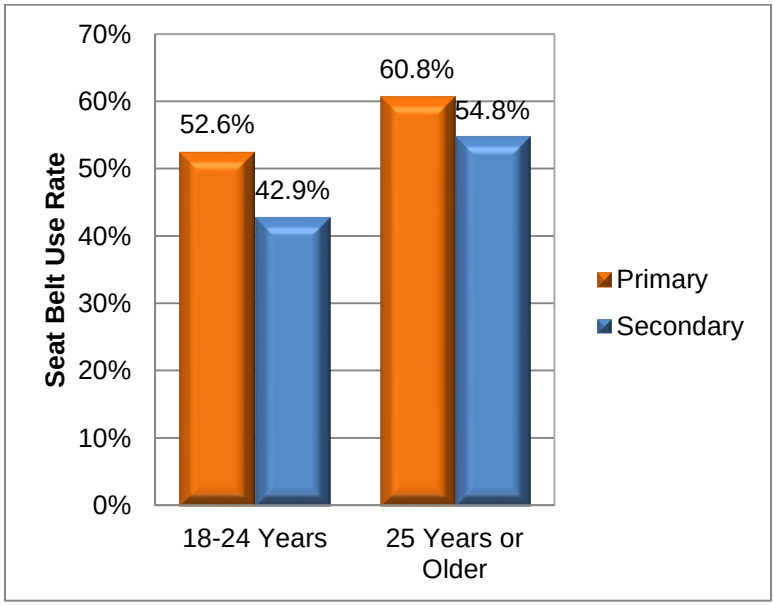


Figure 5.6 Fatal Crash Seat Belt Use in Cohort States, Young Adults and Other Drivers 2007 to 2009

Interventions are significant factors in the likelihood that drivers will be using seat belts in fatal crashes in the model of cohort crashes. Drivers in states with fines higher than $20 were 26.4% more likely to use seat belts than those in lower-fine states, controlling for the enforcement type and intensity, and other predictor variables. Positive effects of primary enforcement are indicated in that drivers in fatal crashes that occurred in primary enforcement states were 13.8% more likely to be using seat belts than drivers involved in fatal crashes in secondary enforcement states (CI 1.059, 1.223). Enforcement intensity, represented by the CIOT citation incidence, is not significant in predicting seat belt use when all cohort cases are considered.

A previous suspension reported on a driver's license has a large magnitude in predicting driver seat belt use in cohort states. Drivers with a previous suspension on their driving record are 36.1% less likely to wear seat belts than drivers with no reported license suspensions. Consistent with previous findings, gender also is a factor. Males are 25.1% less likely to be wearing seat belts in fatal crashes than their female counterparts. Young adults, ages 18 to 24, were 23.1% less likely to use seat belts than drivers 25 years or older. Preliminary models were tested with the age factor defined in multiple strata of 18-24, 25-34, 35-44, 45-54, 55-64, and 65 and older – only the 18-24 group was found to vary significantly compared to the 45-54 control group. Thus, the age category was collapsed into a dichotomous definition – 18-24 and other drivers.

Table 5.5 Driver Seat Belt Use on Rural Roads in Cohort States, 2007-2009

	All Cohort States		Secondary States		Primary States	
	OR	95% Wald CI	OR	95% Wald CI	OR	95% Wald CI
Gender	0.749***	0.704-0.798	0.805***	0.725-0.895	0.718***	0.663-0.777
Drinking	0.247***	0.229-0.265	0.227***	0.201-0.257	0.255***	0.232-0.280
Higher Speed	1.250***	1.139-1.372	1.350***	1.131-1.610	1.212***	1.086-1.353
Young Adults	0.769***	0.717-0.824	0.734***	0.654-0.823	0.790***	0.725-0.862
High BMI	0.992**	0.987-0.998	0.988*	0.979-0.997	0.994	0.987-1.001
P Suspension	0.639***	0.587-0.695	0.558***	0.485-0.642	0.712***	0.640-0.792
P Accident	0.830***	0.764-0.902	0.770***	0.674-0.878	0.853**	0.765-0.951
Pickup	0.702***	0.659-0.748	0.712***	0.640-0.791	0.705***	0.652-0.763
Dark	0.835***	0.780-0.893	0.843**	0.752-0.946	0.828***	0.761-0.900
Few Lanes	0.788***	0.718-0.866	0.830*	0.719-0.959	0.725***	0.640-0.821
Rural Road	0.761***	0.689-0.841	0.782**	0.668-0.917	0.743***	0.660-0.836
Late Night	0.766***	0.695-0.843	0.807*	0.682-0.954	0.755***	0.663-0.859
CIOT High	1.079	0.988-1.179	1.176**	1.042-1.327	1.05	0.916-1.204
Fine Low	0.791***	0.738-0.849	0.939*	0.829-1.064	0.636***	0.577-0.701
Enforcement	1.138***	1.059-1.223				
Urban	1.404***	1.305-1.511	1.355***	1.194-1.538	1.625**	1.455-1.815
Concordant %	71.1		72.3		70.7	
ROC	0.71		0.71		0.71	

Significance: *** p is <.001, ** p is <0.01, * p is <0.05.

Among other factors, pickup drivers on rural roads in the cohort states are less likely to be using seat belts when involved in fatal crashes than other drivers of other types of passenger vehicles such as cars, sport utility vehicles, and vans. Among drivers in the cohort states, pickup drivers were 29.8% less likely to

wear seat belts. Driver seat belt use was also less likely on roads with fewer driving lanes – 21.2% less likely – and during the dark – 16.5% less likely, especially during late-night hours – 23.4% less likely.

Model results for the secondary and primary enforcement state crashes, respectively, are fairly consistent with the overall cohort model. Predictor variables have the expected relationship with the dependent variable. Drinking remains the leading predictor for driver seat belt use across each of the first three models.

Surprisingly, previous license suspension is next in strength as a predictor in the secondary model. A previous license suspension made it 44.2% less likely a driver would be belted compared to secondary state drivers with no previous suspension. Although still an inverse predictor for seat belt use, pickup vehicle-type has less weight in the secondary state model than in the primary state model.

Note that the positive relationship between driver seat belt use and CIOT enforcement incidence is significant only for secondary enforcement states – drivers in secondary states with high levels of enforcement are 17.6% more likely to be using seat belts than those in other secondary states. Fine level is also significant, but relatively small in magnitude among the influences. The likelihood that a driver will be belted is 6.1% higher in secondary enforcement states with fines over $20. The analysis was based solely on the fine levied for the seat belt citation which may underestimate the cost since some states have other fees attached to the citation.

In the model of driver seat belt use for fatal crashes in primary states, fines are third in weight among the predictor factors. Drivers in states with fines $20 or less are 36.4% less likely to be belted than drivers in states with higher seat belt citation fines. As with the cohort model, high CIOT enforcement intensity is not a significant factor. This may be explained by the practices discussed earlier in that successful states often have sustained or targeted enforcement activities rather than the single HVE initiative used here as the measure.

As with the secondary states, gender and vehicle-type are also among the higher magnitude influences in primary states. Males are 28.2% less likely than females to be wearing seat belts in the primary state cases – a larger gender gap than in the secondary states. The gap between drivers of pickup drivers and those of other vehicles in primary state fatal crashes is similar to that for secondary states. It is 29.5% less likely that pickup drivers will be belted when compared to seat belt decisions made by drivers of other vehicle-types.

Because of the large influence drinking drivers have in the first three models, the next two models were included to better distinguish factors that influence decisions of the drinking and nondrinking driver groups. These models have lesser explanatory power, but are still acceptable based on a ROC over 0.5. Several driver factors that are significant across other models no longer have predictive weight in the drinking driver model. These factors include young adult, high posted speed, previous accident, and late night. Given the effects of alcohol on reasoning and decision-making, it is not unexpected that more randomness would be associated with defining influences associated with this high-risk group.

The pickup variable contributes the largest share of explanatory power among the variables in the drinking driver model. Drivers of pickups are 39.7% less likely to be belted than drivers of other vehicle types in fatal crashes. The influence is still inverse for nondrinking drivers, but the difference is smaller – a 27.2% lesser likelihood for wearing seat belts for nondrinking pickup drivers compared to nondrinking drivers in other vehicles types. As with other models in crashes where driver drinking was reported, gender remained a leading influence with males 33.2% less likely to wear seat belts compared to females. Among nondrinking drivers, males are 23.8% less likely to be wearing seat belts than nondrinking females.

Table 5.6 Driver Seat Belt Use on Rural Roads in Cohort States, 2007-2009, Drinking and Non-Drinking Drivers

	Drinking Drivers		Nondrinking Drivers	
	OR	95% Wald CI	OR	95% Wald CI
Gender	0.668***	0.573-0.779	0.762***	0.712-0.816
Drinking				
Higher Speed	0.988*	0.821-1.189	1.322***	1.189-1.468
Young Adults	0.934	0.806-1.082	0.725***	0.671-0.784
High BMI	0.992	0.979-1.006	0.988***	0.983-0.994
P Suspension	0.767***	0.664-0.886	0.584***	0.527-0.646
P Accident	0.91	0.760-1.091	0.820***	0.747-0.899
Pickup	0.603***	0.522-0.697	0.728***	0.679-0.781
Dark	0.745***	0.640-0.868	0.866***	0.803-0.934
Few Lanes	0.646***	0.509-0.821	0.819***	0.741-0.905
Rural Road	0.884**	0.756-1.035	0.702***	0.619-0.796
Late Night	0.664	0.520-0.850	0.783***	0.703-0.872
CIOT High	1.003	0.830-1.210	1.093	0.989-1.208
Fine Low	0.816*	0.696-0.957	0.793***	0.733-0.857
Enforcement	1.341***	1.142-1.573	1.106**	1.021-1.198
Urban	1.420***	1.216-1.658	1.403***	1.291-1.524
Concordant %	63.3		61.9	
ROC	0.64		0.62	

Significance: *** p is <.001, ** p is <0.01, * p is <0.05.

Also note that the rural road environment is the strongest factor, in terms of predictor magnitude, in the nondrinking driver model. Nondrinking drivers involved in crashes on non-interstate rural roads are 29.8% less likely to be wearing seat belts than nondrinking drivers on rural interstates. Driver safety awareness on rural interstates may be heightened by higher travel speeds, greater levels of traffic, more law enforcement visibility, and longer trips.

Interesting results are seen in the intervention factors in these two models (Table 5.6). Drinking drivers in primary enforcement states are 34.1% more likely to be belted when involved in fatal crashes than drinking drivers in secondary states. Among nondrinking drivers, the influence is significant but substantially smaller as these drivers in primary states are only 10.6% more likely to buckle up than nondrinking drivers in secondary states. Fine levels have more influence than enforcement status among nondrinking drivers – in cases with fines are $20 or less, nondrinking drivers were 20.7% less likely to be wearing seat belts than when fines were over $20. Likelihood for seat belt use was 18.4% less among drinking drivers when the fine was $20 or less.

In addition to drinking drivers, young adults are also a high-risk group and are often a focus in seat belt interventions. The likelihood these drivers will be wearing seat belts when involved in fatal crashes was estimated to be 23.1% lower compared to other drivers, compared to the model of all cohort states (**Table**Table 5.5). As with the initial models, drinking far outweighs other factors as a predictor in the models of driver seat belt use by age group (Table 5.7). The effects are smaller in the young driver group as they are 70.9% less likely to be belted than non-drinking young drivers compared to 76.5% less for other drivers. Among other predictors, the urban effects are the strongest. Young drivers in urban areas are 62.8% more likely to be wearing seat belts than those in rural areas. This geographic influence is not

as strong among drivers over 24 years – although still positive, drivers in urban areas are 23.7% more likely to be belted than counterparts in rural areas.

With regard to intervention strategies, the effects of primary enforcement are stronger among the younger drivers. Young drivers are 26.5% more likely to be belted during a fatal crash in a primary state than in a secondary state. The increased likelihood is only 11.0% among other drivers. Fine levels do have some influence with younger drivers but the relationship is weak and smaller in magnitude than that for other drivers. Enforcement intensity is not found to be a significant predictor.

Table 5.7 Young and Non-Young Driver Seat Belt Use on Rural Roads in Cohort States, 2007-2009

	Young Drivers		Non-Young Drivers	
	OR	95% Wald CI	OR	95% Wald CI
Gender	0.733***	0.641-0.839	0.753***	0.702-0.809
Drinking	0.291***	0.249-0.339	0.235***	0.216-0.255
Higher Speed	1.314**	1.08-1.598	1.229**	1.105-1.366
Young Adults				
High BMI	0.998	0.986-1.01	0.990**	0.984-0.997
P Suspension	0.710***	0.607-0.829	0.614**	0.555-0.679
P Accident	0.919	0.784-1.078	0.802***	0.728-0.884
Pickup	0.724***	0.627-0.837	0.697***	0.650-0.748
Dark	0.869	0.75-1.006	0.830***	0.769-0.895
Few Lanes	0.819	0.669-1.003	0.780***	0.702-0.867
Rural Road	0.727**	0.585-0.904	0.764***	0.682-0.854
Late Night	0.850	0.709-1.017	0.713***	0.636-0.800
CIOT High	1.063	0.881-1.284	1.076	0.974-1.190
Fine Low	0.822*	0.706-0.957	0.781***	0.721-0.845
Enforcement	1.265**	1.084-1.476	1.110**	1.024-1.204
Urban	1.628***	1.396-1.899	1.237***	1.237-1.461
Concordant %	70.6		70.8	
ROC	0.71		0.71	

Significance: *** p is <.001, ** p is <0.01, * p is <0.05.

6. CONCLUSION

Seat belts are an effective and low-cost injury prevention asset. Increased seat belt use has been proven to substantially reduce serious injury and death. This is especially important on rural roads where crash injury risk is high and seat belt use remains low. About 39,000 drivers were involved in fatal crashes on lower travel density rural roads between 2007 and 2009. These accounted for 77% of the fatal crash driver cases during the time period. Seat belt use rate among these drivers was only 54%. Findings here offer insight for states and locales with focused interest on rural road safety through increased seat belt use.

In the Northern Plains, where nearly 90% of travel occurs on rural roads, addressing this issue is especially important. A cohort group of 32 states, including a blend of primary and secondary enforcement status, was used to study seat belt use with an emphasis on rural travel. Models were designed to consider state-level seat belt use rates as well as decisions of individual drivers. Understanding behaviors and intervention on rural roads – including the effects of enforcement, education, and sanctions – is important in devising and implementing efficient strategies to increase seat belt use.

Results show state-level seat belt use rates are inversely related to the share of annual miles traveled attributed to rural roads. Driver-level observations indicate drivers in states with higher shares of urban population are 40% more likely to be wearing seat belts than those in more rural states, controlling for demographic, environment, and intervention factors. Primary enforcement, a mainstay in the seat belt intervention strategy, is associated with a 14% greater probability for seat belt use. Findings also show that increased compliance in secondary states is influenced by enforcement intensity – drivers were 18% more likely to be belted in states with high enforcement activity. Higher fines also have a positive, but lesser, influence in secondary states with drivers 6% less likely to be belted when fines are $20 or less. Higher fines do provide a large positive effect in the primary enforcement states; when fines are $20 or less, drivers are 36% less likely to be wearing a seat belt when involved in a rural-road fatal crash compared to when the fine is over $20.

In addition to a model of all cohort states and those based on enforcement status, models for high-risk drinking and young driver groups were estimated to better understand factors more influential with these drivers. Among high-risk drinking drivers, primary enforcement produces a substantial effect in likelihood a driver was belted. Drinking drivers are 34% more likely to be belted when involved in a fatal crash in states with primary seat belt laws than in states where the enforcement status is secondary. Fine levels, however, are a more influential intervention among non-drinking drivers. Primary enforcement is also a significant positive influence with another common target group – young adults. In a model of young adult fatal crash involvement, drivers are 27% more likely to be wearing seat belts in primary enforcement states than in secondary enforcement states.

Understanding influences of laws, enforcement, and education in influencing drivers on rural roads is a high priority in the Northern Plains. Results from the models of statewide and driver seat belt use over recent years offer insight for improving rural road safety. Successfully selecting and implementing interventions based on available resources and prevalence of high-risk groups in crashes requires ongoing investment and analysis. While encouraging the general population to use seat belts through traditional interventions is certainly a recommended strategy, noticeable gains may be achieved by targeting interventions that are effective with high-risk drivers.

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