Safety Insights and Indicators for North Dakota's Teen Drivers

Kimberly Vachal
Donald Malchose
Laurel Benson

Rural Transportation Safety and Security Center
a program of the
Upper Great Plains Transportation Institute
North Dakota State University, Fargo

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ABSTRACT

North Dakota teens have relatively high risk for crash injury and death. Analysis of a survey completed by 2,284 teens in the state shows age, driving exposure, driving experience, and demographics are interrelated factors in safety outcomes. The oldest teens are least likely to be consistent seat belt users. School grades are a strong demographic in teen driving safety – 80% of teens that reported A's in school report high seat belt use compared to 25% of teens that reported F's. Seat belt use is significantly higher among female teens, and for teens located in rural and western areas. Seat belt use has a negative correlation with crash involvement and ticket incidence. Models of safety indicators for licensed teen crashes, tickets, and seat belts are developed to better understand interrelated factors. Low driving exposure, high school grades, and high seat belt use are strong factors in positive safety outcomes. Control variables show safety outcomes vary by geography and region. Teens that completed private driver education did report a significantly higher rate of ticketing, compared to those with public education, but this relationship is not significant when other factors, such as age, geography, and experience, are controlled in the safety outcome model for tickets.

Disclaimer

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1. BACKGROUND

North Dakota was recently recognized by *U.S. News and World Report* as 49th among the 50 states in a ranking of "Best States for Teen Drivers" (Andrews and Terrell 2010). While arguments can be made about the score composition, the position near the bottom with other Midwest states such as South Dakota and Wyoming, did generate local public discussion and debate regarding the future for teen licensing. One parameter in this ranking relevant to this topic is the share of teens with a license; North Dakota ranked no. 1, along with Kansas, in having a teen licensure rate of 60%. Teens are a prominent driver group in the state. Furthermore, teen drivers are overrepresented in crash statistics due to inexperience, over-confidence, and more risk-prone nature (Compton and Ellison-Potter 2008, Shope and Bingham 2008, Braitman et. al 2008). The licensure rates coupled with crash rates puts a relatively high value on investments in teen driver safety.

Many factors influence teen driver performance and safety outcomes. Some recognized factors include education, experience, peer influence, parental guidance, and laws. While it is difficult to distinguish these influences, gaining a better understanding of teen behaviors, perceptions, and performance on North Dakota roads may be beneficial in discussing resource investment and policy decisions. The North Dakota Department of Transportation Traffic Safety Office (TSO) selected the novice young driver group for assessment as it considers how to optimize efforts in its work with this group. Special attention is given to seat belt compliance and the driver education factor in this investigation of teen driving. Because of limited resources, the assessment will draw on existing data sources and expertise.

Seat belts are a proven safety measure. National studies indicate that consistent seat belt usage reduced potential for fatal injury by about half when used properly (Evans 1986, Blincoe 1994, Williams et. al 2008). Since seat belt equipment was mandated for manufacturers in the 1960s, use has increased substantially with continued education and enforcement efforts. Kansas became the 31st state to enact a primary seat belt law with passage of a law in June 2010.

Although information on seat belt use in all crashes is not available, NHTSA does provide information for drivers in fatal crashes in its FARS database. Nationally, a positive correlation is found between a state primary seatbelt law and teen driver seatbelt usage, in analyzing the FARS crash data between 2001 and 2006 (Pearson Corr.=0.498, $\rho<0.001$, n=48). Durbin et. al find 13 to 15 year-olds are twice as likely to be unrestrained in a secondary enforcement state as compared to a primary enforcement state based on a study of insurance claims across 16 states (2007). McCartt and Northrup (2004) find significantly lower use among teen drivers in secondary states, at 30%, compared to teenage drivers in primary law states, at 47%, in their analysis of national data on fatal crashes between 2000 and 2005. In addition to this critique of the research methods, several studies offer compilations of findings with regard to driver education as a factor in teen driver safety.

Several studies have looked at the tie between driver education and safety outcomes in factors such as crash involvement. Clinton and Loreno (2006) focus on the fundamental aspects of research that have been published to date in their development of guidelines for evaluating driver education programs. They find problems with self-selection bias, self-report bias, and extraneous or confounding variables that call into question rigor in findings offered from much of the analysis on driver education efficacy, especially in the older studies.

Several literature syntheses have been conducted to draw upon existing topic knowledge about driver education (Christie 2001, Mayhew 2007, Zhaoa 2006, Deighton and Luther 2007, Clinton 2008, Williams et. al 2009). Although results from these studies are somewhat mixed, the vast majority find no support for driver education as a crash reduction factor for novice drivers. In fact, several noted the accelerated

licensing that is often associated with driver education actually produces an increased crash risk that outweighs any potential benefits of the driver education, and that any true benefits may be short-lived (Hirsch 2003, Engström 2003, Mayhew 2007). In another international review, Christie (2001) concluded that driver training is not an effective crash countermeasure and that approaches such as increased supervision, graduated licensing, and enforcement make greater and more lasting contributions to road safety.

A meta analysis conducted by Vernick (1999) found no evidence to support driver education as a crash countermeasure for young drivers. The meta-analysis was severely limited in scope as only 7 of 29 studies considered met the inclusion criteria, and three of these studies were based on data from the DeKalb experiment (Stock 1983). Loreno (2008) references another meta analysis by Elvik and Vaa (2004) in which quantitative analysis of pooled data again fails to find support for driver education in reducing young driver crash risk. This study also recognizes the inconsistencies in previous evaluations. A few studies do suggest that some short-term benefits may be produced through an updated driver education curriculum. A quasi-experimental study of Ontario teens is one case (Zhaoa 2006). Ontario requires all new drivers to successfully pass through two licensing phases - each scheduled for 12 months – G1 and G2, respectively. GLS guidelines allow teens to reduce the G1 holding time from 12 to 8 months by completing a driver education course. High school student surveys show students who did not complete a driver education course in the first stage were three times more likely to report collision involvement than cohort teens who had completed drivers education in the G1 phase. No significant differences were found between the groups in reported collision rates at the end of G2.

Engström (2003) reported on a ten-year experiment in Tasmania (Australia) that was designed to measure effects of driver training and driver education on young driver safety performance. Students were assigned among three cohort groups: full School Certificate – including driving training and education, driver education only, and no driver education or training. The full School Certificate is a two-part series with 12 one-hour lessons on defensive driving (education) in addition to 12 one-hour lessons on responsible road user behavior (training). Results show students with the School Certificate were significantly less likely than other groups to have been in crashes at the end of the second year (Langford 1997). No difference was found between the School Certificate and driver education groups at the end of year three.

The standard for driver education of “30 hours in-class and 6 hours behind-the wheel” was borne out of a national conference in 1949 (Bishop et. al 2005). Federal funding strongly supported these program basics until the early 1980s when assessment suggested the program was ineffective based on driver performance outcomes in metrics such as traffic collisions and citations (Levy 1990). Since that time, many states reduced or eliminated driver education requirements and schools have divested, thus shifting the role of driver education to private businesses.

Loreno (2008) states that the purpose of traditional driver education curriculum is to prepare beginners for license testing, but notes a promising trend as new programs move away from the traditional ‘blood and guts’ approach to safety to offer a more holistic approach tying driver education to safety outcomes through skills development, feedback, and motivation. Engström (2003) posits that driver training is about teaching people enough skills for controlling and operating a vehicle so they can obtain a license. Driver education is a broader term, including driver training, but also including knowledge about road laws, general road safety concepts, attitudinal and behavior characteristics and awareness. This broader vision of driver education underlies programs such as the Goals of Driver Education (GDE) model which was a component of the Swedish “Vision Zero.” In GDE, a four-level hierarchy model is used to describe a concept where knowledge and skills, risk-increasing factors, and self-evaluation (self-assessment) skills are included in a model of driver behavior. Quantified success for this type of approach would offer an alternative for programs deemed ineffective.

The goal here is not to assess content in North Dakota's driver education program but rather to gain insight into teen driver safety though behaviors and perceptions, as well as by examining teen driver preparation which may include driver education. Driver education does play a role in this system as an existing learning point, especially for teens licensed prior to age 16. The safety of teen drivers, however, is a function of a much larger set of factors.

2. METHOD

A convenience sample of North Dakota high school students' driving habits and experiences was accessed in surveys conducted by the TSO Safe Communities regional administrators. These organizations work with the TSO on local traffic safety initiatives. The survey was administered during the spring 2010. Safe Community coordinators contacted local high schools regarding interest in having students participate. Copies of the survey were provided to the school administrator. Surveys were completed by 19 high schools resulting in 2,284 responses.

The schools were located in 15 of the state's 53 counties. Respondent reported zip codes of residence are illustrated in Figure 2.1. Descriptive statistics, association measures, and means analysis of responses to a high school traffic survey were conducted. In addition multivariate regression analysis of licensed teen driver observations in the respondent pool was used to model safety indicators. The survey data provides a unique opportunity to investigate teen driving safety through self-reported behaviors, experience, and activities. Although self-reported behaviors collected through survey data may introduce bias, research shows self-reporting on youthful behaviors found to be valid under conditions here of anonymity and no consequences (Shrier et. al 2009, Zhao 2006).

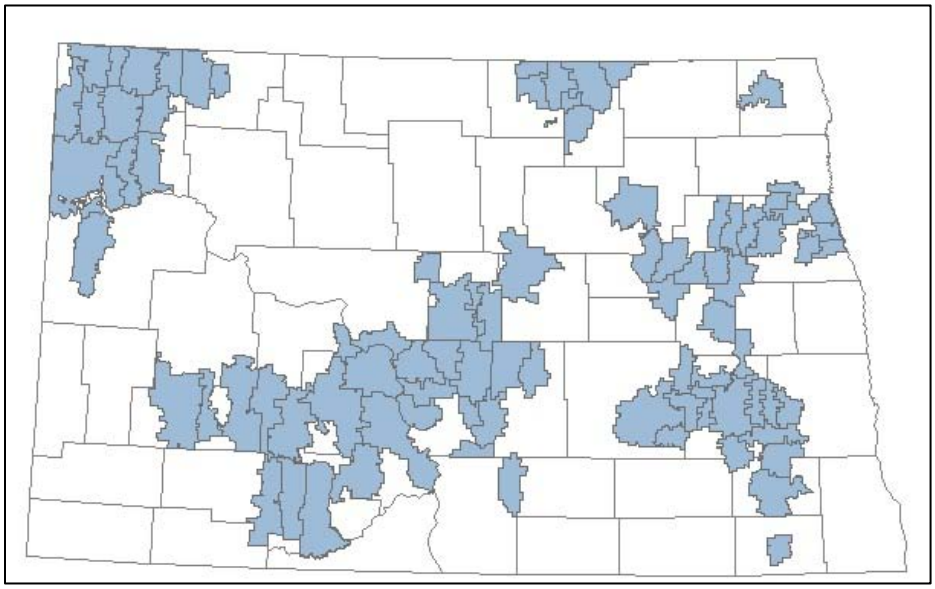

Figure 2.1 Zip Code Areas with High School Survey Responses

Measures of association were calculated for teen responses in Pearson coefficient measures. The Pearson coefficient indicates the strength of association between two variables – in this case the student responses. Correlation coefficients range from -1 to +1, with values closer to these extremes indicating stronger relationships. Relationships between -0.5 and +0.5 are generally considered weak. Chi-square tests were employed to substantiate differences in responses among students, considering factors such as age, gender, and experience. Multivariate analysis was conducted to better understand often interconnected factors in teen driver safety.

In addition to the survey data, a second set of analyses was attempted in quasi-experimental analysis of teen drivers who were licensed prior to age 16. Cohort groups were defined with one group who had completed Department of Public Instruction (DPI) approved courses at schools and another group who had completed the North Dakota Highway Patrol (NDHP) approved courses offered at private driving schools. North Dakota statute allows teens who complete one of these courses to receive a license before

age 16. DPI and NDHP information on approved schools was used to identify potential educators (Appendixes A and B). All 14 private schools and 12 public schools were invited to participate in the project. Four of the public schools agreed to provide information. Unfortunately, the cohort-design study could not be completed because all private schools declined to participate or were non-responsive. Therefore, no data was collected.

3. RESULTS

The North Dakota Safe Communities Teen Driving Questionnaire included 2,284 records for spring 2010. The survey focused on seat belt use, education, experience, and safety during initial years of driving. Surveys were collected from 1,309 licensed drivers and 395 drivers in the permit phase. The remaining teens indicated no licensure activity. Description statistics are reported for all respondents. Additional analysis is conducted for licensed teen driver activity due to interest in driver education and safety performance outcomes.

Demographic information about the teens that is collected in the survey may provide a means to develop or execute more focused traffic safety programs. Age is standard for such demographics, and is often considered as an experience or maturity proxy for seat belt use and teen driver studies (McCartt 2008). Age may also act as a cumulative exposure measure for teen drivers who have moved beyond the early licensing phase.

The largest shares of responses, by age, were from 16- and 17-year-olds, at 27% for each group, respectively. Fifteen-year-olds attributed 23% of the responses with the remainder divided between 14- and 18-year-olds at 10% and 12%, respectively. Slightly more than half the responses, 52%, were from males.

School performance, in coursework grades, is another potential demographic factor that may be useful in focusing traffic safety and teen driver efforts. The average classroom grade among the respondents is a B. Among all teens, 34% report they usually receive As in school and 38% indicated Bs as their typical grade. About 1 in 5 respond with Cs as typical for their coursework, while 5% and 1% reported they most often receive Ds and Fs in school.

A majority of responses came from schools in the eastern region at 89%. The rural and urban responses by geography, as defined by county designations in Figure 3.1, were 28% from teens who live in rural areas and 72% who live in urban areas. Teens were also asked about the specific locale in which they live. Among the locales – including “city” (city/town with population of 25,000 or more), “town” (population under 25,000), and “country” (outside city/town limits0 – the largest share lives in town at 61%, with 35% and 5% of teens reporting they lived in the country and in cities, respectively.

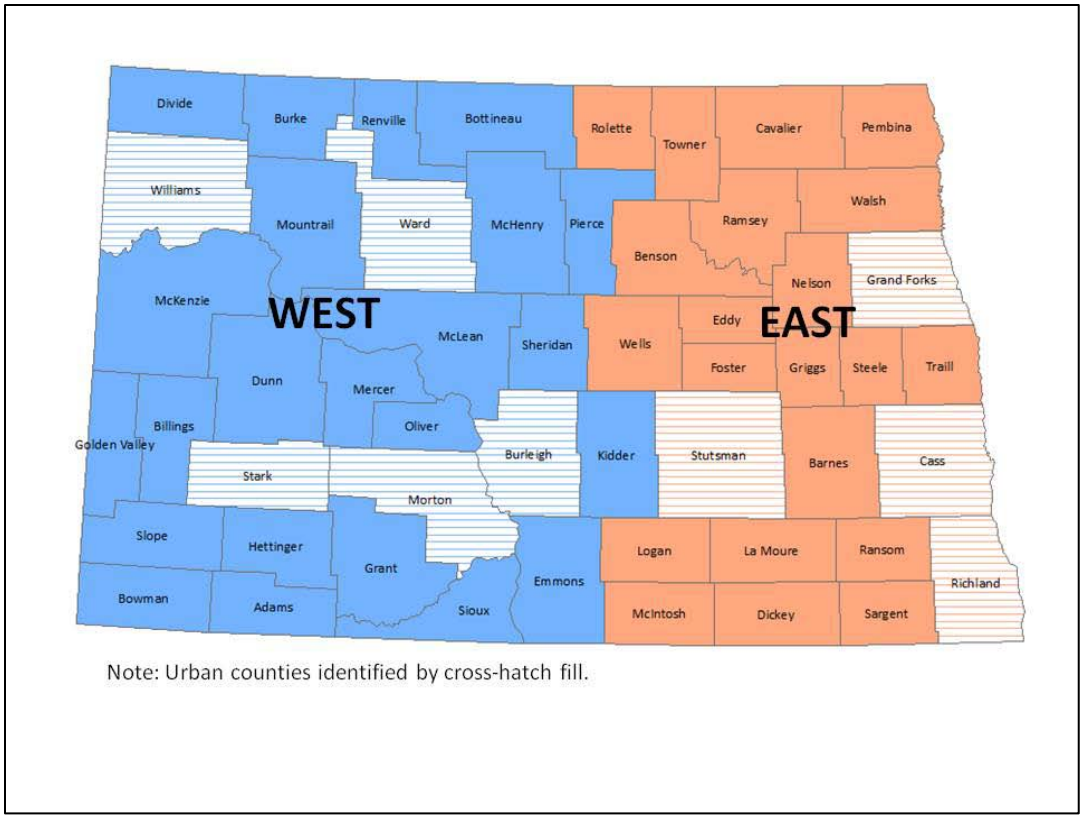

Figure 3.1 Map of Regions and Geography

3.1 All Teens Seat Belt Use

Seat belts are a prominent and critical vehicle safety feature. Teens were asked about their own seat belt use along with use by their parents or guardians. Parents have a strong ability to influence teen safe driving behaviors (Simons-Morton and Ouimet 2006, Lofgren et. al 2009). Thus, their seat belt use is an important factor in teen decisions to buckle up while in the vehicle.

Only 31.4% of teens indicate that they “always” use their seat belts (Figure .2). This share is smaller than the share of moms that ‘always” wear seat belts in 46.2% of cases, but larger than the share of dads’ “always” level of use at 25.1%. Low seat belt use was most commonly reported for dads – as nearly half of the teens said their fathers’ seat belt use was low, including responses of “never,” “rarely,” or “sometimes.” About one-third of the teens also described self-use as low, while moms’ use was least likely to be low.

As expected, a positive correlation is found between teen and parent seat belt use – mother’s use with a Pearson Correlation of 0.4429 ($\rho<0.001$, n=2,167) and father’s use with a Pearson Correlation of 0.4446 ($\rho<0.001$, n=2,119). Responses show that 83% of teens who reported that both parents had high use followed their example by reporting their own use as high. Among the teens with low seat belt use – 43% reported their parents also had low seat belt use.

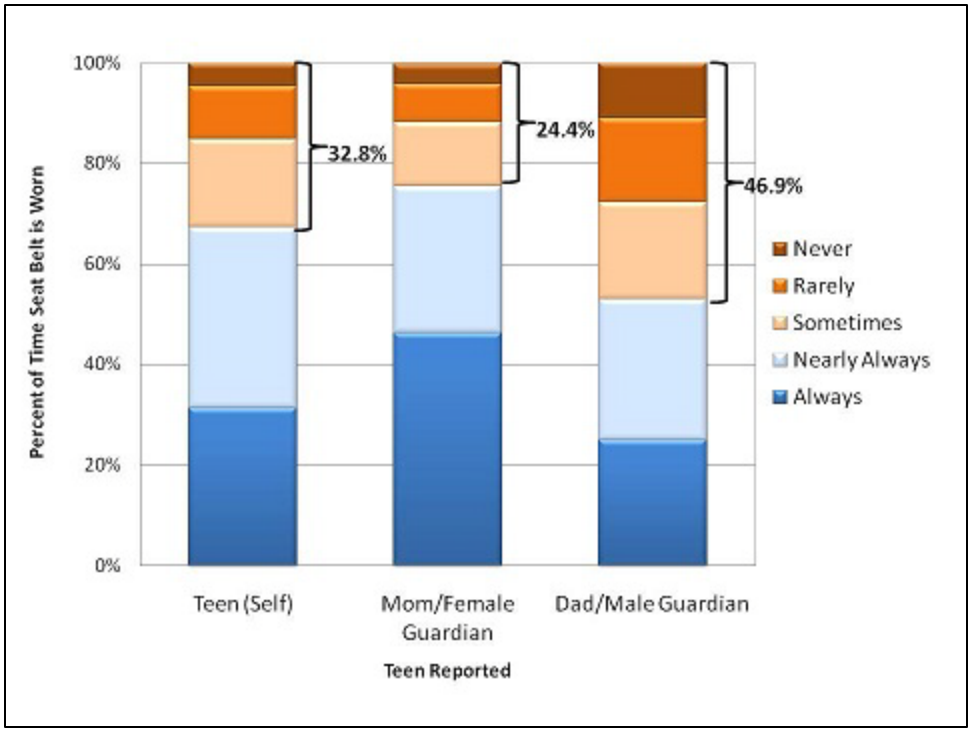

Figure 3.2 Seat Belt Use by Teens and Parents

Responses were queried by age, school performance, gender, geography, region, and residence type to test for significant differences that may be informative in designing programs and understanding trends in seat belt use among teens. Younger teens were most likely to report high seat belt use, with about 70% indicating they wear a seat belt "always" or "most of the time" (Figure 3.3**Figure**). Among the 17- and 18-year-olds, significantly fewer report regular seat belt use. The share using seat belts "Always" or "Most of the Time" drops to 63% and 61%, respectively, among the 17- and 18-year-olds ($\chi^2 = 18.119$ $\rho=0.001$, n=2,073).

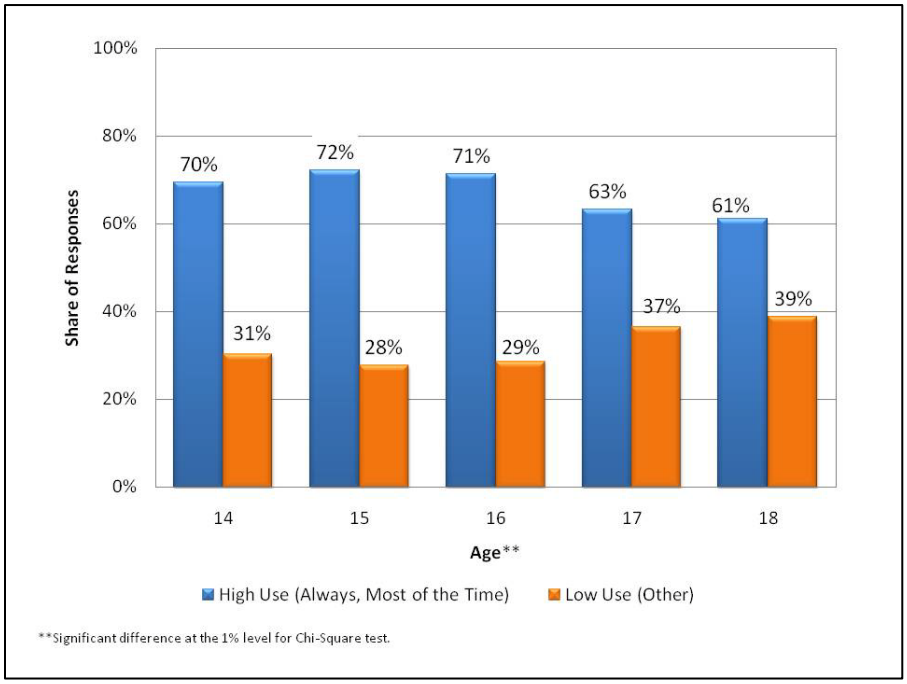

Figure 3.3 Seat Belt Use by Age

A significant inverse relationship between seat belt use and school performance is evident among the responses to the high school survey ($\chi^2 = 134.41$, $\rho<0.001$, n=2,087). While all groups are well below the 100% goal for high levels of seat belt use, the share is very pronounced for students who indicate they typically work at D and F grade levels. For these students, fewer than half report that they use their seat belt all or most of the time. For students who reported their typical grades to be As, 80% report high seat belt use. This is the highest seat belt use rate among the students when they are grouped by their classroom grades. This figure drops to just 25% for students who report that they most often receive Fs in coursework.

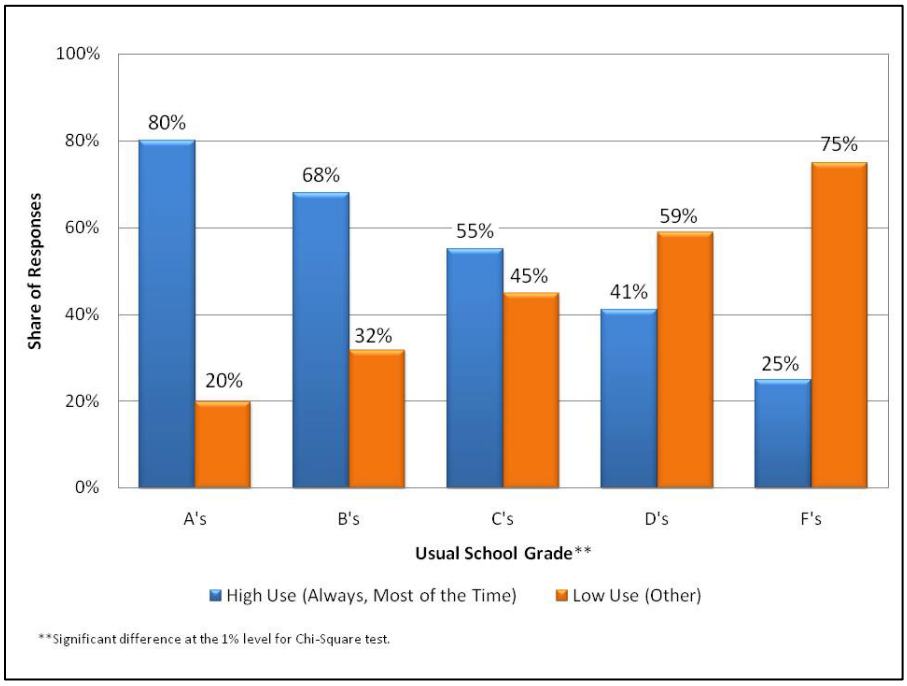

Figure 3.4 Seat Belt Use and School Performance

Responses were also tested for differences with regard to where the student lived. The geography, region, and residence type were considered. A significant difference in responses was found only for the geographic distinction – rural students were more likely to report high levels of seat belt use than their urban counterparts ($\chi^2 = 18.559$, $\rho<0.001$, n=1,951). No differences were found between students from the East and West, or among students in cities with population of 25,000 or more, towns with population under 25,000, and the country – areas outside city/town limits.

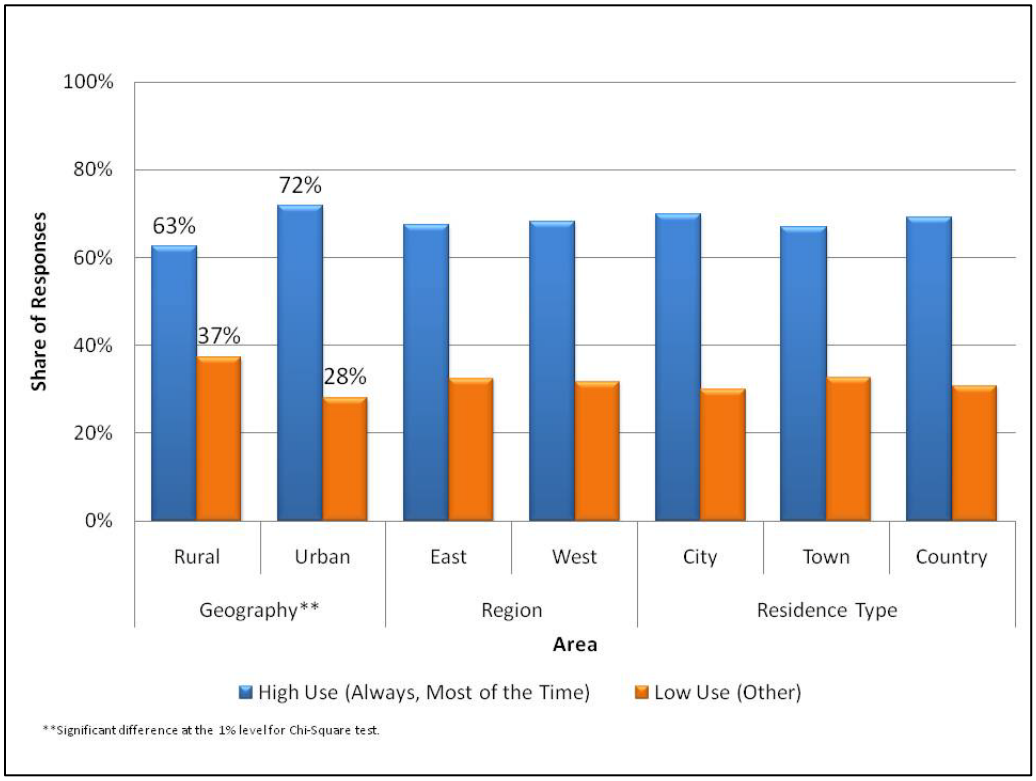

Figure 3.5 Seat Belt Use by Residence Area

A wide range of seat belt use is found among the schools that participated in the survey. This may be related to the classes in the schools that participated and as well as local norms. The average is substantially below the desired 100% rate for seat belt use among teens. About one-third of the students indicated they "always" wear a seat belt. The average share of students who completed the survey for the 18 participating schools was 32.5%, considering the response among classes who took part in the Safe Communities survey. Among schools, the lowest reports for regular seat belt use are in Harvey, Divide County/Ray, and Lisbon – with fewer than 1 in 5 teens reporting that they "always" use a seat belt. The highest reported consistent usage is for teens attending Grand Forks Central and Dickinson High School with 59.6% and 54.7% reporting they "always" wear seat belts, respectively.

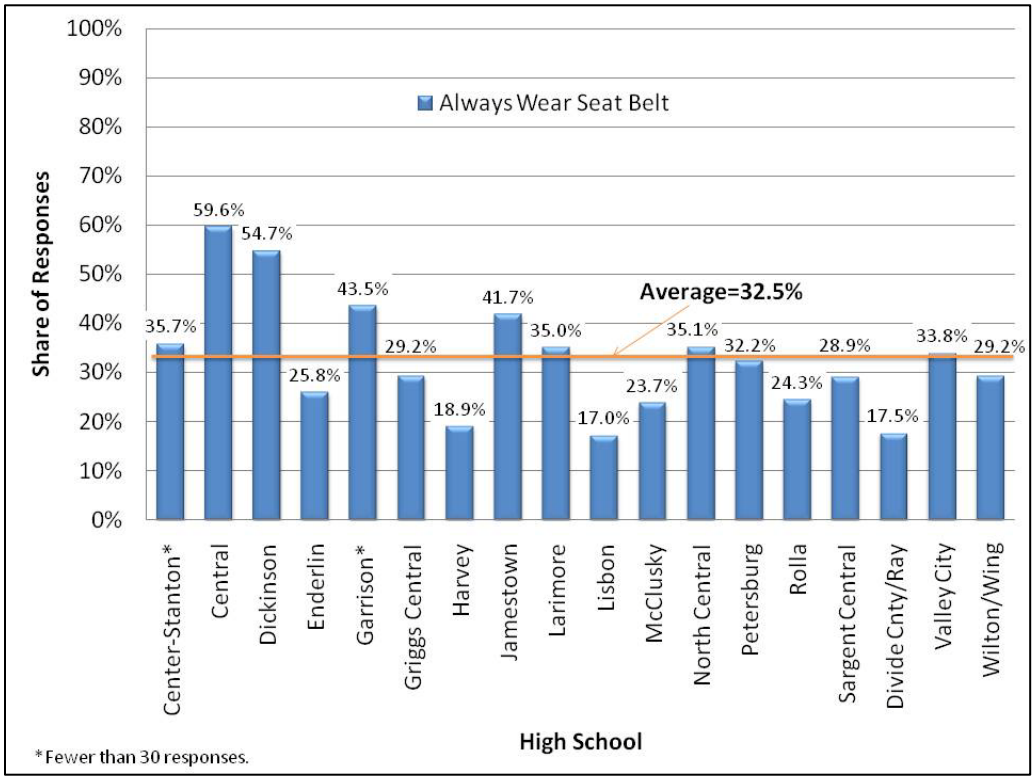

Figure 3.6 Seat Belt Use among Participating High Schools

Teens are aware of the current seat belt laws, with 86.7% indicating that they know teens are required to wear seat belts. Responses showed that 11.0% believe teens are not required to wear seat belts. A small share – 2.3%, didn't know if it was a requirement.

Students who reported less than 100% seat belt use were asked to provide their reasons for not wearing it. The most common response was "short trip" – 28% selected this among their reasons (Figure 3.7). A close second among the responses was simply "I forget." Answers show that 15% of teens just choose not to wear their seat belts. More than 1 in 10 teens do not wear seat belts because of comfort factors. Less common responses include that there are not enough seat belts in the vehicle, worried about what friends will think, and riding in the back seat. Additional information regarding teens' reasons for not wearing seat belts is provided in Appendix C.

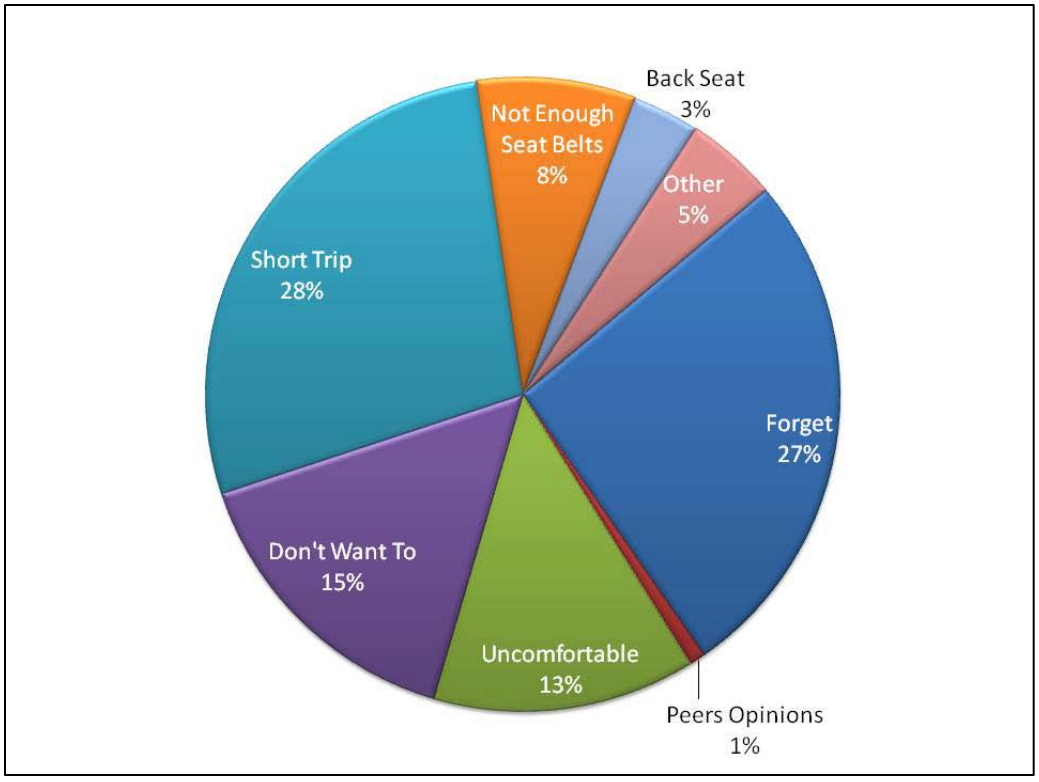

Figure 3.7 Reasons Teens Do Not Wear Their Seat Belt

3.2 Teen Drivers

Teen drivers are a high-risk driver segment. Maturity, education/training, and experience may reduce teen crash risk. Along with positive safety outcomes, specific interest here is in the driver education factor. As discussed, little conclusive evidence has been offered regarding the efficacy of driver education. The descriptive statistics and multivariate analysis in this section offer some localized analysis for this topic. Safety indicators are modeled based on desired outcomes. These indicators include crashes, tickets, and seat belt use. Models provide some insight that may be useful in more efficient use of resources related to teen driver issues.

The NDDOT Safe Communities driving survey of high school students included questions related to licensing. Topics covered by the questions included license status, time licensed, training/education, behavior, and performance. The information in this section includes 14- to 18-year-olds to capture a range of training and experience in the teen driver group.

3.2.1 Characteristics and Training

The largest share of the teen driver respondents, by age group, is 17-year-olds, accounting for 29% of the responses (Figure 3.8). Fourteen-year-olds are the smallest share, at 8%. As expected, the 14- and 15-year-old teen groups have the largest share of respondents in the permit phases at 31% and 62%, respectively. Most 14-year-olds have been licensed for 6 months or less (Figure 3.9**Figure**). In the 15-year-old driver group, about 20% have had their license for at least 6 months of licensed driving. Among drivers age 16 and 17, 15% and 7%, respectively, reported they are still in their first year. A majority, 61% and 81%, of the 16- and 17-year-old drivers have at least a year of driving experience, respectively. More than 90% of the 18-year-old drivers have held their license for at least a year.

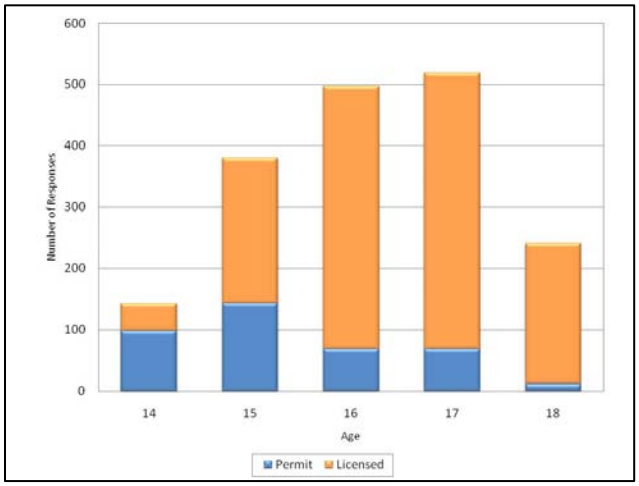

Figure 3.8 Licensure Status, by Age

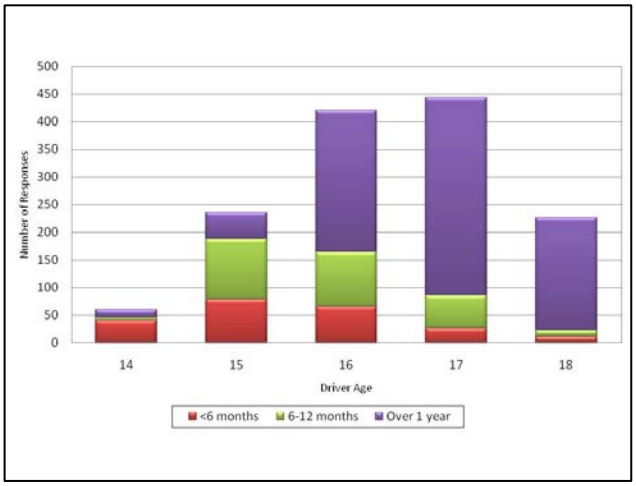

Figure 3.9 Time Licensed, by Age

The male responses slightly outweighed female at 53% compared 47%. The male share is slightly higher than the actual population share of 51% (NDDOT 2009). This includes 422 female responses and 475 male responses. The gender question had a relatively high non-response rate in the initial surveys. In reviewing the responses, it was determined that the question placement may have affected the response rate. After moving the gender question to a new position, the response rate improved from 27% to 84% for that question. In general, the number of responses and distribution between genders provides an adequate representation for the larger survey group.

Teens were asked to report their hours of driving experience prior to licensing along with the current weekly driving exposure in miles driven (Figure 3.10). Teens reported a median of 15 hours behind-the-wheel prior to receiving their license. One in five teens reported that they had 6 or fewer hours behind-the-wheel when they received their license. No correlation was found between the behind-the-wheel driving hours and propensity for crash involvement or driving citation.

Teens reported median weekly driving of 100 miles. A majority drove an average 5 to 15 miles per day. One in four reported that they drove fewer than 20 miles per week. As expected, given the larger exposure in miles driven, a positive correlation was found between current weekly driving and crash involvement background ($\chi^2 = 25.9179$, $\rho<0.001$, n=1,205). For teens driving more than 15 miles per day, 31% had been involved in a crash. Only 16% of teens driving fewer than 20 miles per week reported crash involvement. Driving more miles per week is also positively correlated with ticket incidence ($\chi^2 = 69.4924$, $\rho<0.001$, n=1,205). Only 15% of teens driving less than 35 miles per week had received a ticket, compared to 41% of teens who reported weekly driving of more than 104 miles. About one in five of the teens in the middle-mile driving range report being ticketed.

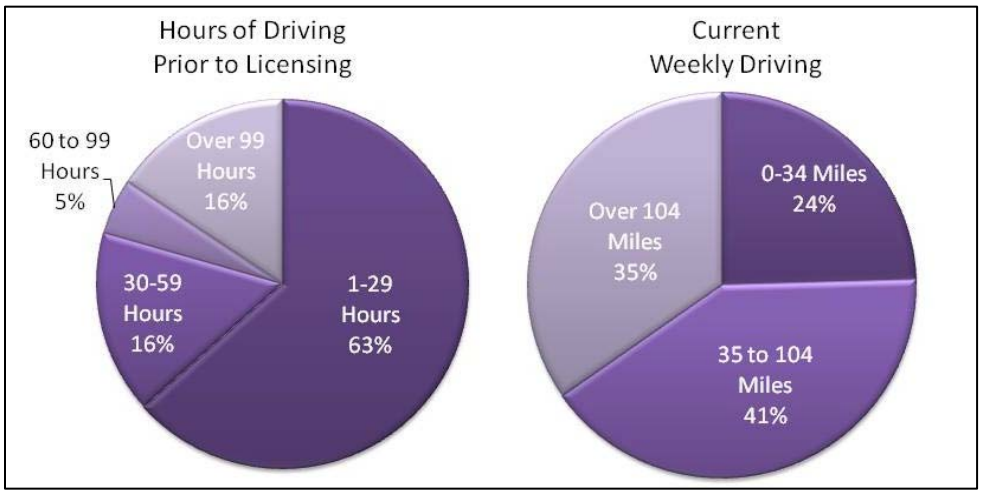

Figure 3.10 Driving Experience and Current Exposure

Among the teens, 77% had completed a driver education course through their public school and 18% had completed driver education through a private driving school (Table 3.1). Among the age groups, 15-year-olds had the highest share that completed a private education course at 29%. Completing an approved education course does allow the 14- and 15-year-old drivers to expedite licensure and may explain the higher participation in private school courses. This rate may be related to course access where the surveys were conducted, so differences are evident in the geographic and regional characteristics of the age groups.

A significant difference in course type is found for age, controlling for geography, and region (F=16.02, $\rho<0.001$, n=1,173). Participation in the private education course type is highest among the 15-year-olds. Responses showed that 29% of the 15-year-olds had completed a private education course –nearly double the rate for other age groups. Private course participation was significantly higher in the East and in urban areas. Responses showed that 5% of the licensed teens did not complete driver education through a public or private school. A few of these teens did report that they had completed a defensive driving course but this was not categorized because it is not an approved driver education course under state statute and administrative rule.

Table 3.1 Education Type, by Driver Age

Age	Total Number =	Education Type None	Public	Private
14	40	0%	83%	18%
15	222	3%	68%	29%
16	383	4%	80%	16%
17	410	6%	79%	15%
18	198	7%	79%	15%

Among teen drivers, 27% reported they had received at least one ticket. A significant difference in likelihood for a teen reporting that they had received at least one ticket for a moving violation was found in comparing teens by the driver education background ($\chi^2 = 10.1372$, $\rho=0.006$, n=1,309). For teens who reported that they had not completed any approved driver education course, 28% had been ticketed. This compares to 25% among teens who had completed driver education in a public school and 36% of teens who had completed an approved private driver education course. No significant difference was found for safety outcome differences among education backgrounds as measured by crash involvement in testing by (1) none, private, and public driver education; (2) no approved driver education compared to approved education, grouping public or private courses for the "approved education," and (3) between teens that had completed public versus private driver education. Overall, 23% of licensed teens who reported their education background have been involved in at least one crash. Teen drivers indicated that only 2% of these crashes resulted in injury.

Safety behaviors and outcomes provide the dependent or "effect" variable in the cause and effect relationship between driver education and driver performance. Since the driver education occurs prior to licensing, the causation chain is easily defined. Quantitative information on safety outcomes is available in questions related to crash involvement, moving violation traffic citations, and seat belt use.
Crash involvement was highest among 18-year-old drivers – 32% report being the driver in a crash. The lowest crash involvement among the age groups was 16% among 14-year-olds (Figure 3.11). It seems reasonable that the older drivers would have a higher crash rate because they are likely to have greater exposure in having a license longer. To quantify this premise, driving exposure is expressed in two factors.

The first is defined by segmenting drivers in their first six months of driving from others as "early licensure" in each age group. A second exposure metric is defined by separating teen drivers by driving experience, segmenting those who drive at least 20 miles per week from others as limited driving experience. Driver education is defined as participation in a state-approved driver education course. Correlations among crash involvement, age, driver education, driving experience, and early licensure show no relationship between driver education or early licensure and crash involvement. Driving experience does have a weak correlation with crash involvement. In controlling for age, driving experience is found to be a significant factor in crash involvement among the teen respondents ($F=8.06$, $\rho<0.001$, $n=1,154$).

The driving exposure is also tested for correlation to whether the teen had received one or more citations for a driving violation. Similar to the crash involvement safety outcome, the ticket involvement was found to have no correlation with driver education or driving experience. The relationship is found to be stronger than for the crash involvement when controlling for age effects ($F=17.23$, $\rho<0.001$, $n=1,154$).

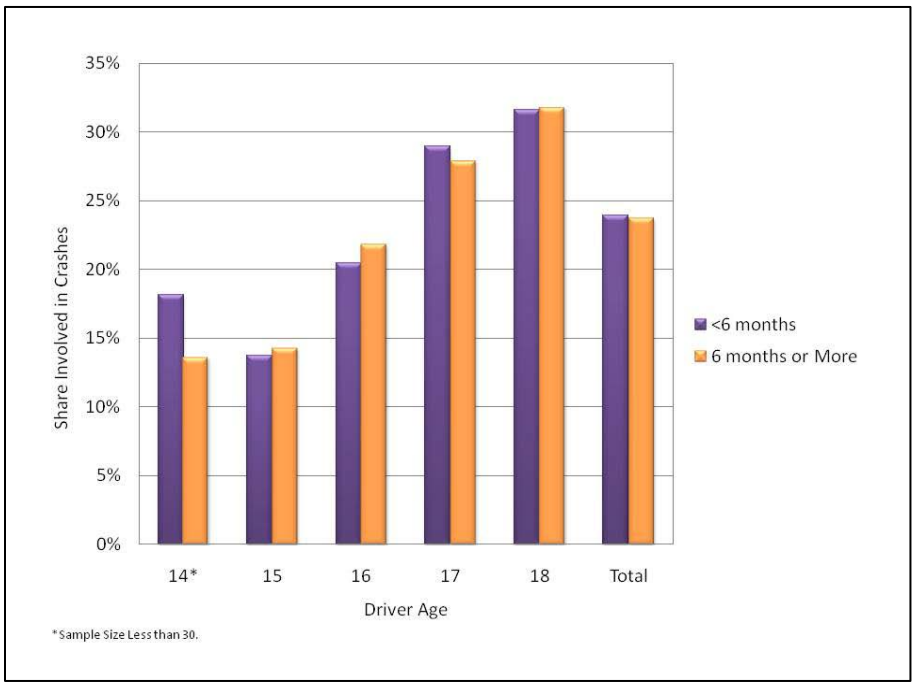

Figure 3.11 Crash Involvement by Age and Licensure Time

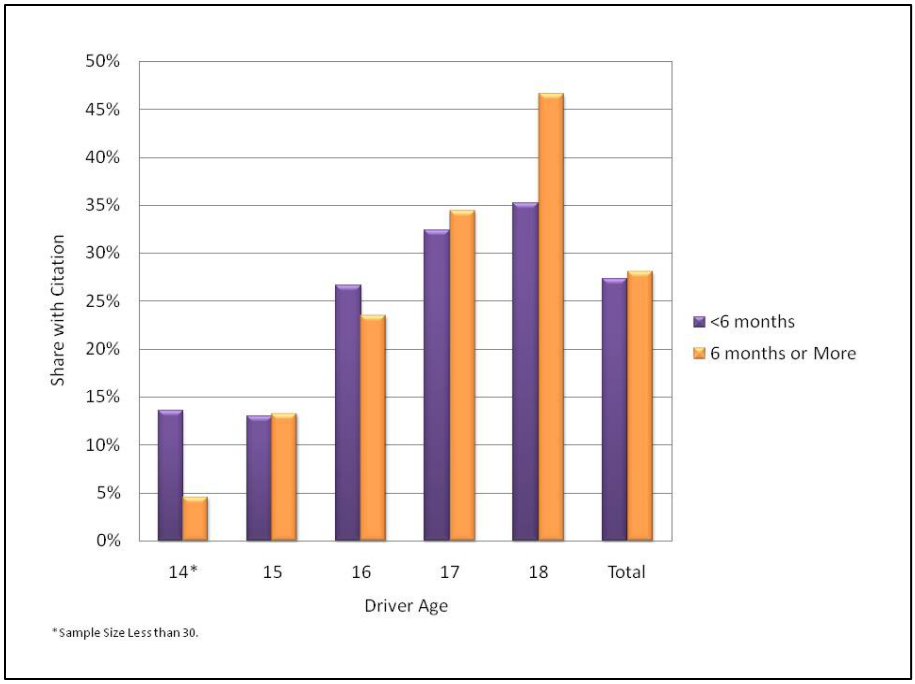

Figure 3.12 Driving Violation Citation by Age and Licensure Time

Seat belt use among the licensed teens was slightly above that for other teens, as measured by those who reported their own use high in "always" or "most of the time." The self-reported use showed that 27% of licensed teens have low seat belt use rates compared to 34% for other teens who participated in the survey. Seat belt use within the teen driver group was not correlated to their driver education background. Seat belt use may be an indicator for a broader view on driver safety since it is found to have a significant positive correlation with likelihood for crash involvement and driving tickets (Figure 3.13). Low belt use is reported by 29% of teen drivers who have been involved in at least one crash compared to 21% among teens with no crash history ($\chi^2 = 11.9079$ $\rho<0.001$, n=1,433). Among teens who have received tickets for moving violations, 42% report low belt use compared to 20% of teens with no record of moving violations ($\chi^2 = 81.4362$, $\rho<0.001$, n=1,433).

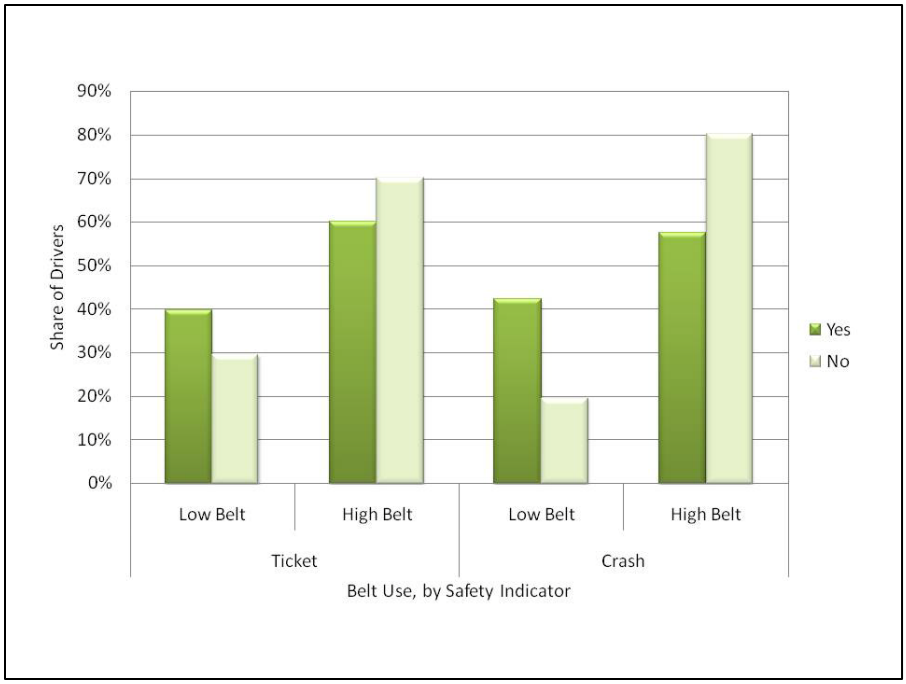

Figure 3.13 Seat Belt Use with other Driver Safety Indicators

3.2.2 Multivariate Analysis

Logistic regression is used to measure the strength of factors as determinants in models of teen driver safety outcomes. The safety outcomes are crashes, tickets, and seat belt use. The model measures the relationship between dependent and independent variables while recognizing simultaneous effects among the independent variables for the licensed teens. The log-odd ratios provide measures of association that are indicative of the relative likelihood a teen driver will exhibit safe behavior. Due to a limited number of responses for 14-year-old drivers, the models of young teen driver safety outcomes are limited to 15-, 16-, and 17-year-olds.

Safety outcomes are modeled as a function of driving exposure, driver education, and demographic factors. The dependent outcomes are presented in the models of crash involvement, driving citations, and seat belt use. Primary interest is in understanding the role of driver education in teen driver safety, performance and behavior. Therefore, several definitions were tested for driver education in relation to safety outcomes. The original model parameters were defined based on a review of literature and information available in the TSO Safe Communities Teen Driver Survey. Those included in the initial model are defined in Table 3.2.

The theoretical teen driver safety model includes the first eight variables listed in Table 3.2, along with the “no education” driver education variable. The “public education” definition was also tested and not found to be significant in any scenarios. As discussed in the previous section, teen driver experience and exposure are predictors of teen driver safety outcomes. A broad indicator of experience is age. Age represents the cumulative driving exposure, with the early licensure variable controlling for the initial driving phase in all age groups. The age variable is expected to have a positive relationship with the crash and ticket safety indicators. In addition to age, the experience element is reflected in the early licensure and low experience variables.

Teens who indicated that they are within their first six months of licensure are categorized by the early licensure variable. Distribution of teen answers for low experience was used to establish behind-the-wheel time of less than 30-hours. Both experience variables are expected to have a positive relationship with the crash and ticket outcomes (Shope and Bingham 2008, Ballesteros and Dischinger 2002). No association between age or experience is expected for seat belt use. The exposure variable is based on the teen-reported weekly driving activity. Based on the response distribution, driving more than 34 miles per week is defined as high exposure. The correlation with safety indicators is uncertain given the confounding effects of after-licensure experience and exposure for teens who report higher weekly driving miles. Male drivers are expected to have a positive risk correlation with each of the safety indicators based on previous research regarding teen driver crash risk. Previous studies have shown male drivers to be less likely to use seat belts and more likely to engage in risky driving behaviors (Biggs et. al 2008, Bingham et. al).

Table 3.2 Teen Driver Safety Model Variables

Variable Name	Definition
Independent Variables	
Driver Age	16, 17 (15 is omitted as the control variable)
Gender	Female (0) or male (1)
Region	West (0) or East (1) as defined in Figure 3.1
Geography	Rural (0) or Urban (1) as defined in Figure 3.1
Low Grades	School grades D or F (1) or school grades A, B, or C (0)
Early Licensure	Licensed less than 6 months (1) or 6 months or more (0) at time of survey
Low Experience	Fewer than 30 hours of behind-the-wheel prior to licensing
High Exposure	Driving more than 34 miles per week (1) or driving 34 miles or less per week (0)
Driver Education*	
No Education	State-approved public or private driver education, none (1) or completed (0)
No Public Education	State-approved public driver education, none (1) or completed (0)
Dependent Variables	
Crash	One or more crashes (1) or no crashes (0)
Ticket	One or more moving violation tickets (1) or no tickets (0)
Low Seat Belt Use**	Wear seat belt never, rarely, or sometimes (1) or most of the time or always (0)

*A parameter was also tested comparing only teen drivers who had completed the public (1) and private education (0) courses but no significant relationship was found in modeling for any of the dependent variables.

**Variable also used in an independent variable.

The low grades variable is tested for association in the safety indicator models. This lifestyle variable is included as a demographic element that may be useful in targeting teen driver risk messages and identifying higher return for specific teen driver target groups. Region and geography are included as control variables to capture variance related to population densities and travel patterns. These may also be useful in targeting and message design.

Original models for the teen driver safety indicators, including crash, ticket, and seat belt use, included all variables with the exception of crash and ticket. The final models discussed in this section were derived from these baseline models. The final crash and seat belt models include only significant variables, along with the driver education parameter and parameters that may introduce bias if omitted. Elimination of the insignificant variables provided a more robust model by increasing the number of cases included in the model, due to fewer missing values. It should be noted that concordance remained within one percent of the model.

The crash model used 837 of the 1,111 available teen driver cases. Five variables were found to be statistically significant in the likelihood that a teen had been involved in one or more crashes (Table 3.3). These include age, geography, early licensure, exposure, and seat belt use. Most parameters had the expected sign in a positive or negative relation to crash likelihood discussed previously. The explanatory variables produced a concordance value of 65.3%. This means that in 65.3% of cases the predictor variables were consistent in generating the expected dependent variable result.

Table 3.3 Teen Driver Safety Indicator: Crash Model Results

Parameter	Estimate	S.E.	Significance	Log Odds	95% CI
16 Years	0.4368	0.2648	n.s.	1.548	0.921-2.601
17 Years	0.6512	0.2618	*	1.918	1.148-3.204
Geography	0.5729	0.1714	**	1.773	1.267-2.482
Early Licensure	-0.7471	0.3617	*	0.474	0.233-0.963
High Exposure	0.4151	0.1184	**	1.514	1.201-1.910
Low Seat Belt Use	0.5379	0.1789	**	1.712	1.206-2.432
No Driver Education	-0.2354	0.4499	n.s.	0.790	0.327-1.909

N=837
*p=0.05
**p=0.01

Parameter estimates show the oldest teen drivers are nearly twice as likely to report crash involvement compared to 15-year-old drivers (OR=1.918, 95% CI 1.148,3.204). This is reasonable as the cumulative driving exposure would make it more likely for older teens to have crashes. The risk for 16-year-old drivers does not differ significantly from the 15-year-olds. Surprisingly, when controlling for other variables, the most recently licensed teens are less likely to report crash involvement. Teens in their first 6 months of driving were 53% less likely to report crash involvement than teens driving for more than 6 months. Teens residing in urban counties are 77% more likely to report crash involvement than teens from rural counties. Teens who drive more miles are 51% more likely to have a crash history. The magnitude for seat belt use, included as risk proxy for risk propensity, shows it to be a third strongest in effect among the parameters. Teens who reported their use as low were 71% more likely to report crash involvement than teen drivers who reported high seat belt use.

Of the 1,111 surveys from licensed teen drivers, 671 are used in the ticket model. Only two variables, hours of driving prior to licensing and driver education, are not significant factors in the likelihood a teen has received a ticket for a driving violation (Table 3.4). Concordance is found in 77.8% of the cases.

Table 3.4 Teen Driver Safety Indicator: Ticket Model Results

Parameter	Estimate	S.E.	Significance	Log Odds	95% CI
16 Years	0.9455	0.3185	**	2.574	1.379-4.805
17 Years	1.3070	0.3154	**	3.695	1.991-6.856
Gender	0.6924	0.2083	**	1.998	1.328-3.006
Region	0.7534	0.2226	**	2.124	1.373-3.286
Geography	0.6899	0.2014	**	1.993	1.343-2.958
Low Grades	1.7063	0.4767	**	5.509	2.164-14.023
Early Licensure	-1.3984	0.4848	**	0.247	0.096-0.639
Low Experience	-0.0643	0.1982	n.s.	0.938	0.636-1.383
High Exposure	0.5444	0.1382	**	1.723	1.314-2.260
Low Seat Belt Use	0.9863	0.2064	**	2.681	1.789-4.018
No Driver Education	-0.2383	0.5057	n.s.	0.788	0.292-2.123

N=671
*p=0.05
**p=0.01

Largest in magnitude in predicting ticketing, among the variables, is average school grade. Teens who receive primarily Ds and Fs are 5.5 time more likely to have been ticketed for a driving violation than teens with higher grades (OR=5.509, 95% CI 2.164, 14.023). Age is also an important factor in the ticket likelihood as older teens are more likely than their 15-year-old counterparts to have been ticketed. The 16-year-olds are 2.5 times more likely to have received a ticket. Drivers two years older are 3.7 times more likely to have a ticket history than 15-year-olds. Teens in their first 6 months of driving are 75% less likely to have a ticket. It is twice as likely that a male will have one or more tickets when compared to females. As with the crash model, low seat belt use has a strong association with the safety indicator. Teens who report low seat belt use are 2.7 times more likely to report they've been ticketed than teens with high seat belt use. Teens who do more driving each week are also more likely to have a ticket history, while teens in urban and eastern locations are more likely to report being ticketed for driving violations compared to their rural and western counterparts.

The final safety indicator model, seat belt use, includes five significant variables. The model is found to be concordant in 65.4% of the cases. As with the ticket model, low grades have the largest effect among the variables in predicting seat belt use. Teen drivers with low school grades are 3.5 times more likely to have low seat belt use than teen drivers with high grades (OR=3.551, 95% CI 1.601,7.876). Gender is also a factor in this safety indicator as males are two times more likely to report low seat belt use than females (OR=2.010, 95% CI 1.404, 2.934). Unlike the other two models, the hours teens drove prior to licensing is significantly related to the safety indicator. Teens who had 6 hours or fewer behind the wheel when they received their license are 45% more likely to have low seat belt use. The oldest teens are more likely to have low seat belt use, while the likelihood 16-year-olds will use seat belts does not vary significantly compared to 15-year-olds.

Table 3.5 Teen Driver Safety Indicator: Seat Belt Model Results

Parameter	Estimate	S.E.	Significance	Log Odds	95% CI
16 Years	0.3135	0.2578	n.s.	1.368	0.825-2.268
17 Years	0.6212	0.2510	*	1.861	1.138-3.044
Gender	0.7080	0.1879	**	2.030	1.404-2.934
Low Grades	1.2672	0.4064	**	3.551	1.601-7.876
Low Experience	0.3695	0.1791	*	1.447	1.019-2.056
High Exposure	0.3973	0.1205	**	1.488	1.175-1.884
No Driver Education	-0.4248	0.4808	n.s.	0.654	0.255-1.678

N=677
*p=0.05
**p=0.01

4. SUMMARY

Potential for return on investment in teen driver safety in North Dakota is relatively large compared to other states, given high rates of licensure and crashes for this driver group. This study of 2,284 driving safety surveys completed by teens in the state offers insight regarding safety factors, particularly seat belt use and drivers education. Age is a significant factor in seat belt use, with highest use among the youngest teens. With regard to demographics, a strong inverse relationship is found between seat belt use and average school grades. Among teens who report their typical school grade to be an A, 80% reported high seat belt use. This compares to only 25% of the teens whose typical school grade is an F. No significant difference was found in teen driver crash rates when comparing groups by driver education backgrounds – including public, private, and none. However, teens that completed the public education course were least likely to have been ticketed for a moving violation.

Models of driving safety indicators distinguish factors in teen driver safety among the complex of interrelated influences. The crashes, tickets, and seat belt use models, for teens ages 15 to 17, show that demographic, experience, and exposure factors are significant influences on safety outcomes. Crashes are more likely for teens that have higher exposure levels through length of licensure and miles driven weekly. In addition, teens who reported low seat belt use were 71% more likely to have a crash history than teen drivers who reported high use. Exposure and low seat belt use are also positively related to the likelihood a teen has been ticketed for a moving violation. The largest factor for ticket likelihood, in magnitude, is low school grades. Teens with low grades are 5.5 times more likely to have received a ticket than teens who reported high grades. Teens in urban areas and in the East are also more likely to have been ticketed. As with the ticket model, high grades have the most weight among factors in a positive safety outcome. Females, novice drivers, and teens that who drive more than 34 miles per week are also more likely to be high seat belt users. Driver education was not found to be a significant factor in the crash involvement, ticket likelihood, or seat belt use levels safety outcome models.

While the findings cannot be generalized to the student population, teen responses provide potential gains from learning points that may be available with older teens and young males. Teens may need messages, through education or enforcement, to reinforce the legal requirement that they wear seat belts regardless of the trip duration or comfort. It may be especially beneficial to engage older teens in these messages. Traffic safety programs designed to reach teens with low school grades may also provide positive results.

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APPENDIX A. DPI HIGH SCHOOL DRIVER EDUCATION COURSE ENROLLMENT FOR 2007, 2008, AND 2010

Region	County Name	Enrollment Estimate County	Enrollment Estimate Region	Region	County Name	Enrollment Estimate County	Enrollment Estimate Region
East	Barnes	66	3,235	West	Adams	18	3,419
	Benson	106			Bottineau	261	
	Cass	838			Bowman	110	
	Cavalier	145			Burke	20	
	Dickey	222			Burleigh	173	
	Foster	47			Divide	20	
	Grand Forks	332			Dunn	18	
	Griggs	30			Emmons	61	
	LaMoure	143			Golden Valley	23	
	Logan	27			Grant	9	
	McIntosh	36			Hettinger	29	
	Nelson	30			Kidder	34	
	Pembina	127			McHenry	83	
	Ramsey	177			McKenzie	94	
	Ransom	50			McLean	121	
	Richland	124			Mercer	88	
	Rolette	293			Morton	277	
	Sargent	47			Mountrail	71	
	Steele	32			Pierce	41	
	Stutsman	90			Renville	37	
	Towner	23			Sheridan	15	
	Traill	89			Sioux	49	
	Walsh	135			Stark	205	
	Wells	26			Ward	1419	
					Williams	143	

Source: ND Department of Public Instruction, 2010
Note: 2007 includes Regular School Year Session only, 2008 and 2010 include Regular and Summer Sessions

APPENDIX B. PRIVATE DRIVING SCHOOLS

School Name	Location
Mylo's Driving School	Bismarck
Don's Driving School	Bismarck
Driver Education Institute	Bismarck
G's Driving School	Minot
Paul's Behind the Wheel	West Fargo
Behind the Wheel	Carrington
AJM Behind the Wheel Driving	Page
Larry's Driving School	Dickinson
Dakota Driving School	Williston
Dave's Dakota Driving School	Minot
Xcell Driving School	Mandan
FM Driving Training	Fargo
The Right Way	Fargo
Forks Drive	Grand Forks

Source: ND Highway Patrol

APPENDIX C. REASONS TEENS DO NOT WEAR SEAT BELT, BY GEOGRAPHY, AGE, AND GRADES

When you do not wear a seat belt, what is your reason? (Check all that apply)

Geography	Rural	Urban			
Forget	23.9%	23.5%			
Peers Opinions	1.0%	0.9%			
Uncomfortable	19.1%	20.0%			
Don't Want To	22.2%	25.4%			
Short Trip	23.3%	18.8%			
Not Enough Seat Belts	3.5%	4.4%			
Back Seat	3.0%	3.4%			
Other	4.0%	3.6%			
Age	14	15	16	17	18
Forget	32.7%	23.7%	25.1%	21.8%	23.2%
Peers Opinions	3.5%	0.4%	0.6%	1.0%	1.1%
Uncomfortable	24.8%	18.7%	20.4%	18.1%	22.2%
Don't Want To	24.8%	23.7%	23.4%	25.7%	21.1%
Short Trip	6.2%	18.7%	18.3%	24.5%	23.2%
Not Enough Seat Belts	5.3%	5.8%	4.1%	3.2%	3.2%
Back Seat	0.0%	5.4%	3.8%	1.5%	2.2%
Other	2.7%	3.6%	4.1%	4.2%	3.8%
Grades	A	B	C	D	F
Forget	35.9%	24.1%	23.4%	19.7%	22.9%
Peers Opinions	1.3%	0.6%	0.6%	1.7%	5.7%
Uncomfortable	18.4%	19.3%	23.7%	23.9%	25.7%
Don't Want To	17.5%	22.2%	27.1%	34.2%	31.4%
Short Trip	19.3%	24.9%	19.4%	16.2%	5.7%
Not Enough Seat Belts	2.7%	3.6%	5.1%	1.7%	2.9%
Back Seat	1.8%	2.9%	0.3%	0.9%	0.0%
Other	3.1%	2.5%	0.3%	1.7%	5.7%