Alive at 25: Analysis for North Dakota Teen Drivers

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ABSTRACT

Novice drivers are a focus in traffic safety program efforts because of their relatively high crash risk. The National Safety Council *Alive at 25* course has been used by several states to promote teen driver safety. In a sample of 6,640 class participants, drivers had fewer crashes, traffic-related citations, and DUI arrests within a six-month and twelve-month period of completing the class. This was especially true for those who had obtained a driver's license before taking the class. Logistic regression models identified some determinants of dangerous driver behavior after completing the program and also demonstrate some deterrent effects on particular driver groups. The findings offer support for continued work with the *Alive at 25* workshop and need for expanded analysis of its impact on safety outcomes for novice drivers.

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1. INTRODUCTION

Teen drivers are an especially dangerous driver group in the United States. Teenage drivers have a disproportionately high number of crashes and fatal crashes when factoring for travel exposure (IIHS 2016). Considering that 5.4% of all licensed drivers in North Dakota are age 19 or younger, one of the highest proportions in the nation (FHWA 2015), this particular driver group represents a prominent risk on the state's roadways.

1.1 Crashes and Contributing Factors

The types of crashes caused by teen drivers are diverse. A study examining 16-year-old licensed drivers in Connecticut determined that 88% of crashes fell into one of three crash types: "rear end (35%), ran off road (30%), and violated right-of-way (23%)" (Braitman et al. 2008: 50). Curry et al. (2013) found that teens were more likely than adults to make a critical decision error for two types of crashes: going straight and crashing rear-end into another stopped vehicle and a right roadside departure stemming from crashing off the right edge of the road when negotiating a curve. A separate study reaffirmed these findings and noted that the top five crash scenarios for teen drivers "included: (1) going straight, other vehicle stopped rear end; (2) stopped in traffic lane, turning left at intersection, turn into path of other vehicle; (3) negotiating curve, off right edge of road, right roadside departure; (4) going straight, off right edge of road, right roadside departure; and (5) stopped in lane, turning left at intersection, turn across path of other vehicle" (McDonald et al. 2014: 304).

Reasons for crashes vary considerably across studies. In Connecticut, the most common contributing factors for crashes were "search and detection (39%), speeding (38%), lost control/slid (38%), slippery roadway (30%), evaluation (19%) and course (10%)" (Braitman et al. 2008: 50). Driver distraction is also common for the 16-19 year-old age group. A study representative of teen drivers across the nation concluded that "teenage drivers distracted by cell phones were more likely to be involved in rear-end collisions than fixed object collisions" (Neyens and Boyle 2007: 208-210). Distraction may also stem from the presence of others in the vehicle at the time of a crash. With regard to the most serious crash type, "16-year-old drivers, compared with drivers of other ages, were most likely to have been accompanied by one or more passengers at the time of their fatal crash involvement" (Preusser, Ferguson, and Williams 1998: 219). Teen drivers have been known to take more risks when traveling with passengers who exhibit risky behaviors (Simons-Morton et al. 2011). It has been posited that, since driver perceptions of risk are not a predictor of risky behaviors, risky friends may influence perceptions and thereby result in a driver taking more risks and exhibiting dangerous behavior on the roadway (Simons-Morton et al. 2012).

1.2 The 16-Year-Old Cohort

The 16-year-old age group appears to be an especially dangerous cohort due to inexperience on the roadway. This group has the highest crash rate per 1,000 licensed drivers (Ulmer, Williams, and Preusser 1997), the highest proportion of crashes involving a single vehicle (Ulmer, Williams, and Preusser 1997), the highest percentage of at-fault crash-involved drivers (Preusser, Ferguson, and Williams 1998), the highest daytime fatal crash rates (Ferguson, Teoh, and McCartt 2007) and an especially high crash rate per mile driven (Williams 2003). This same age group was found to be "3.28 times more likely to be involved in a fatal crash than drivers aged 30-59" (Preusser, Ferguson, and Williams 1998: 219) and had the greatest "proportion of fatal crashes involving a single vehicle" (Ulmer, Williams, and Preusser 1997: 99). These findings reaffirm that inexperience is common as single-vehicle crashes are generally considered a proxy for driver error.

1.3 Link between Experience and Safety

Driver age, experience, and the interaction between one's age and experience level have been found to have a direct effect on crash rates (Mayhew, Simpson, and Pak 2003). The time period immediately following licensure appears to be most dangerous for teens. Between the first and second month of licensure, crash rates per 100 licensed drivers declined significantly (McCartt, Shabanova, and Leaf 2003). A separate study noted that the crash rates per newly licensed drivers decline noticeably over the first six months and drop substantially once a driver has been licensed for two years (Mayhew, Simpson, and Pak 2003). Moreover, crash rates per 10,000 vehicle miles traveled decreased consistently for the first, second, and third 250 miles driven (McCartt, Shabanova, and Leaf 2003).

1.4 Parental Involvement

A study of parent-teen dyads in Michigan examined whether or not two interventions had an effect on g-force events by newly licensed drivers. The two groups were randomly separated with one receiving flashing red and green lights during g-force events and the other receiving via e-mail weekly driving report cards of the teens' risk relative to other drivers in the study in addition to the red and green flashing lights. Those receiving report cards had significantly fewer g-force events (Simons-Morton et al. 2013).

A separate study of parent-teen dyads examined the effectiveness of parent-teen driver agreements. The intervention consisted of visual aid charts, booklets, and recommendations for new drivers on how to navigate specific driving conditions such as nighttime driving, having teen passengers present, high-speed roads, and inclement weather. Those in the intervention group had greater restrictions on passengers, weekend night driving, and on high-speed roads. These same drivers also had less risky driving, were less likely to drive 20 miles per hour over the speed limit, and less frequently drove through intersections during yellow lights (Zakrajsek et al. 2013).

As a whole, parental involvement for new drivers results in safer driving practices. A study determined one factor, less parental driving restrictions, was a significant predictor of crashes in the first year of being licensed (McCartt, Shabanova, and Leaf 2003). Similarly, the presence of adult passengers in the vehicle with the new driver reduced rates of crashes, near crashes, and risky driving behaviors (Simons-Morton et al. 2011).

1.5 North Dakota Teen Drivers

Teen driver trends in North Dakota are similar to those found across the nation. One study determined that North Dakota teenage drivers with low seat belt use were more likely to have a crash history and a moving violation (Vachal, Malchose, and Benson 2010). The same study revealed that the likelihood of getting a ticket for a traffic violation was associated with one's academic performance: those drivers with low grades were 5.5 times more likely to have a ticket (Vachal, Malchose, and Benson 2010).

In North Dakota there are also geographical disparities in teen crash events. Those from urban counties were found to be approximately 2.5 times more likely to be involved in an injury or fatal crash during the first year of licensure (Malchose and Vachal 2011). A prior property-damage-only crash on a teenage driver's record was found to be a strong indicator of an injury and/or fatal crash during the first year of licensure (Malchose and Vachal 2011).

1.6 *Alive at 25* Program

The North Dakota Department of Transportation's Safety Division considers a wide range of program and intervention alternatives in its annual Highway Safety Plan. One important component is programming decisions made with regard to selecting strategies for youth/young adults (North Dakota Department of Transportation 2016). The goal of this study is to assess the efficacy of the *Alive at 25* program for improving teen driver safety outcomes. *Alive at 25* has received exposure and funding support from the NDDOT Safety Division.

The National Safety Council developed the *Alive at 25* driver education program to reduce risky behavior by teen drivers (NSC 2014). During the four-hour course, which is typically taught by law enforcement professionals, "young adults under the age of 25 take greater responsibility for their driving by focusing on behavior, judgment and decision making" (NSC 2014). The *Alive at 25* course is used by several states alone or in conjunction with graduated driver's license and violator programs. These states include California, Colorado, Idaho, North Dakota, Texas, Vermont, and Wyoming. The Colorado State Patrol reported in 2003 that 89% of 1,000 randomly surveyed respondents that had completed the course indicated they believed they would be a safer driver as a result of taking the class and that 92% believed the class helped them improve their driving knowledge and skills (NSC 2010).

2. METHOD

A limited assessment of the *Alive at 25* program for North Dakota was conducted via descriptive statistics, means testing, and logistic regression analysis. Quasi experimental design was used to devise driver cohort groups in the *Alive at 25* participant group. The North Dakota Safety Council provided the research team with a list of 9,918 *Alive at 25* course participants. The cleaned participant data included age, city of residence, gender, course completion date, and the last four digits of a participant's driver's license. The variable containing the last four digits of the license was used as a link to identify traffic records such as crashes and citation history.

This variable, however, was not available to *Alive at 25* participants holding a learner's permit or those enrolled in the program before obtaining a learner's permit. Individuals were linked to crash and citation records with probabilistic matching based on gender, date of birth, and city of residence. A second step was required to manually sort matched cases in the initial database.

Before the process of linking records began, 215 participants were eliminated from the study for having out-of-state addresses. The research team only had access to crash and conviction records in North Dakota. Therefore, tracking out-of-state participants was not within the scope of the study. As a result, 9,703 North Dakota participants were subjected to the data linking process.

Among course participants with the last four license digits identifier available, the matching rate was 92.5% as 3,861 crash and conviction records were successfully linked from 4,173 participants. Records for 312 participants with the last four digits identifier were unable to be matched. These records were added to a list of participants without the license identifier; this group totaled 5,842 drivers. A query which combined date of birth, gender, and city of residence was used to match participants in this group. The success rate for this process was 47.6% as 2,779 records were linked. The final data set consisted of 6,640 linked records for an overall matching rate of 68.4% (see Figure 2.1).

Enrollment in the *Alive at 25* program was treated as an intervention in the analysis. Although potential for bias exists related to risk with self-selection and/or court-ordered participation, many students participate in the course during school which would minimize these effects. Not all participants completed the program at the same time. Therefore, to track before-and-after changes in driver behavior, three cohorts were created to study driver performance. These cohorts identify pre-/post-intervention driver activity in six-month, twelve-month, and twenty-four-month intervals. This limits which individuals were included in the analysis. Traffic records, citation history, and crash data were only available through the 2014 calendar year. Therefore, some individuals in the final data set of 6,640 participants were purged from in-depth analysis. To be tracked for a minimum of six months, drivers were required to have completed the *Alive at 25* program by no later than June 30, 2014. Drivers tracked for twelve and twenty-four months needed to have completed the program by December 31, 2013, and December 31, 2012, respectively (Table 2.1). The before-and-after cohorts are not mutually exclusive. If a participant is capable of being tracked for twenty-four months, that individual can be assessed in the twelve-month and six-month intervals as well.

Table 2.1 Participant Cohorts

Before-and-After Cohort Length	Last Possible Course Date	Participants Included in Analysis
Six Months	June 30, 2014	5,557
Twelve Months	December 31, 2013	5,113
Twenty-Four Months	December 31, 2012	4,228

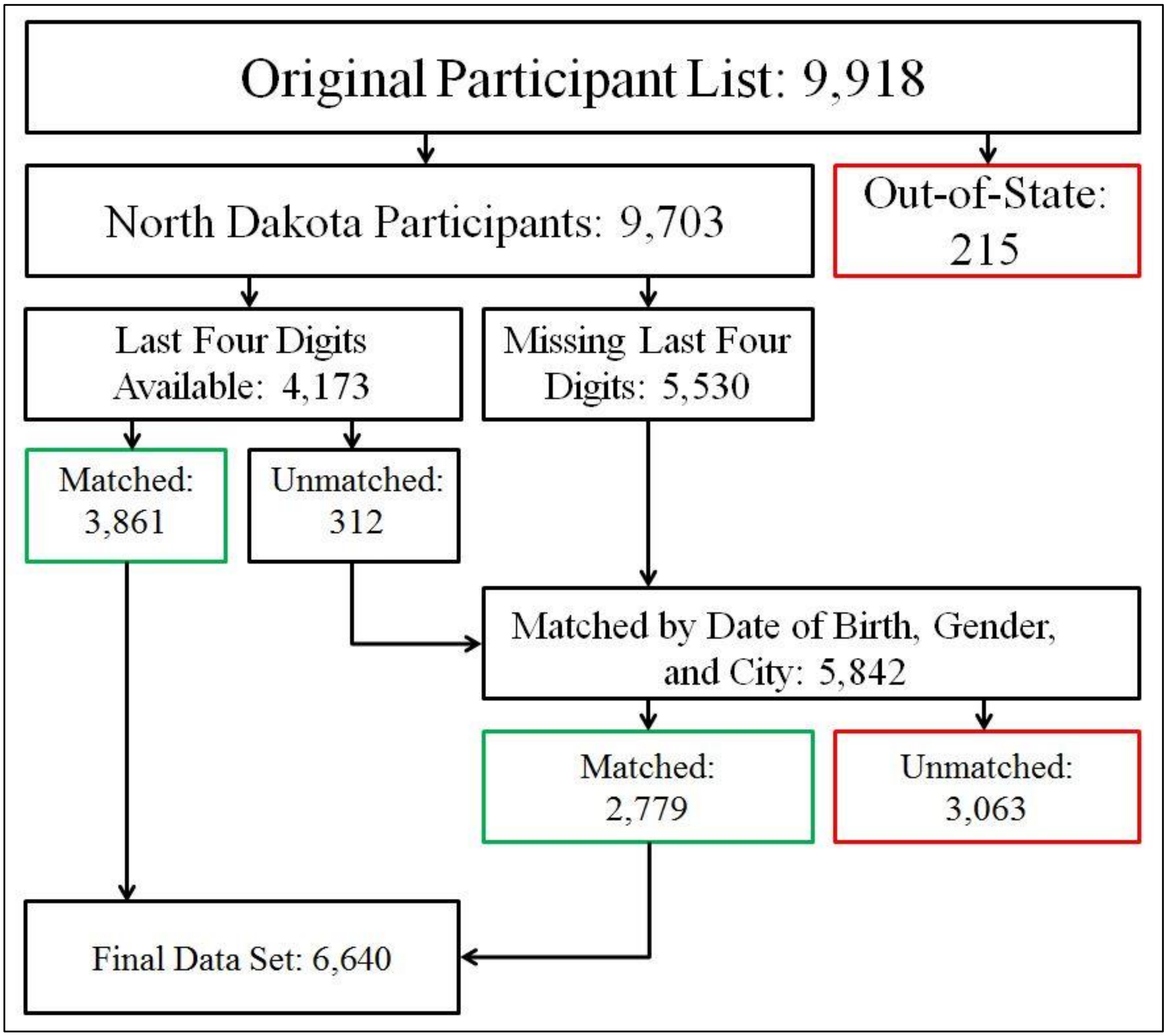

Figure 2.1 Matching Process

Paired-samples t-tests and independent-samples t-tests were employed to substantiate differences in safety performance between the cohort groups. In addition, responses factoring for variables such as age, gender, region, geography, and license status were considered in modeling safety outcomes. Multivariate regression analysis was conducted to better understand interconnected factors in novice driver safety. The logistic regression model provides measures for the independent variables while recognizing the simultaneous effects among terms in relation to the dependent variable. The model cannot be used to explain factors that lead to crashes or citations, but does produce log-odds ratios that provide an understanding of factors associated with these safety outcomes. This methodology has been applied in other systematic traffic safety assessments and provides valuable quantitative information that may be used in prioritizing activities and designing policies to improve public safety (see Chandraratna, Stamatiadis, and Stromberg 2006, Gonzales et al. 2005, and Gkritza et al. 2010).

The relative likelihood of crash, citation, or DUI arrest is the dependent variable. A dichotomous indicator for teens with at least one crash, citation, or DUI event distinguishes them from teens who do not report a crash, citation, or DUI arrest in their driving history. The observed values of this response variable were compared to the predicted variable obtained in the models with and without the variable in question based on a log likelihood function. The model is generally defined as:

$$P_n = \frac{e^{g(x)}}{1+e^{g(x)}}, \text{ so} \qquad \text{Equation 1}$$

$$P_s = 1 - P_n = 1 - \pi(x) = \frac{1}{1+e^{g(x)}} \qquad \text{Equation 2}$$

P_n = probability of no self-reported crash, citation, or DUI arrest and

P_s = probability of self-reported crash, citation, or DUI arrest,

where g(x) includes a set of independent variables related to driver and environment in

$$g(x) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n \qquad \text{Equation 3}$$

The maximum-likelihood technique was used to determine the coefficients that make the observed set of outcomes (crashes or citations) most likely.

3. RESULTS

The *Alive at 25* study looked at safety outcomes for participants across the state. The earliest course date provided in the sample took place on April 25, 2008. The last valid course date occurred on June 22, 2014. Crashes and citations were tracked for each participant for six, twelve, and twenty-four month intervals, when possible. Because the research team did not have access to crash data beyond the 2014 calendar year, not all participants were followed in the six, twelve, and twenty-four month cohorts. For example, for those participants who completed the program on June 22, 2014, these individuals were only tracked for six months before and six months after the intervention date; this is because crash data was only available through December 31, 2014 and comparing behavior for two years prior to course intervention and only six months after course intervention would not represent an equal interval for analysis. All participants in the six, twelve, and twenty-four month intervals were tracked for an equal duration before and after program completion.

3.1 Sample Descriptive Statistics

Course enrollment was not evenly distributed by gender. Whereas females accounted for only 43.1% of participants, males were 56.9% of those participating in the *Alive at 25* program. A majority (54.5%) of individuals were aged 14 or 15 at the time of course completion. A complete distribution of ages is presented in Table 3.1.

Table 3.1 Age at Course Date

Participant Age	Number of Participants	Percent of Total
12	15	0.2%
13	108	1.6%
14	1,898	28.6%
15	1,720	25.9%
16	982	14.8%
17	760	11.4%
18	470	7.1%
19	238	3.6%
20	184	2.8%
21	111	1.7%
22	68	1.0%
23	40	0.6%
24	41	0.6%
25	5	0.1%

Beyond age and gender, regional and geographic identifiers were created based on the city reported in the original data records. East and West regional identifiers and urban/rural geographic indicators were defined based on methods used in previous NDDOT Safety Division research. These definitions are based on state service regions and U.S. Census Bureau population designations for counties with urban roads (Figure 3.1). These residence indicators allow for control for possible local effects such as population density, roadway features, and attitudes.

The regional identifier indicates that a higher percentage (56.7%) of the sample lives in the eastern part of the state than in the western region (43.3%). Based on geographic definitions used in this study, more than two-thirds (68.9%) were from urban counties. As a result, participants were most commonly from urban counties in the eastern part of North Dakota; 35.9% of the sample met this categorization (Table

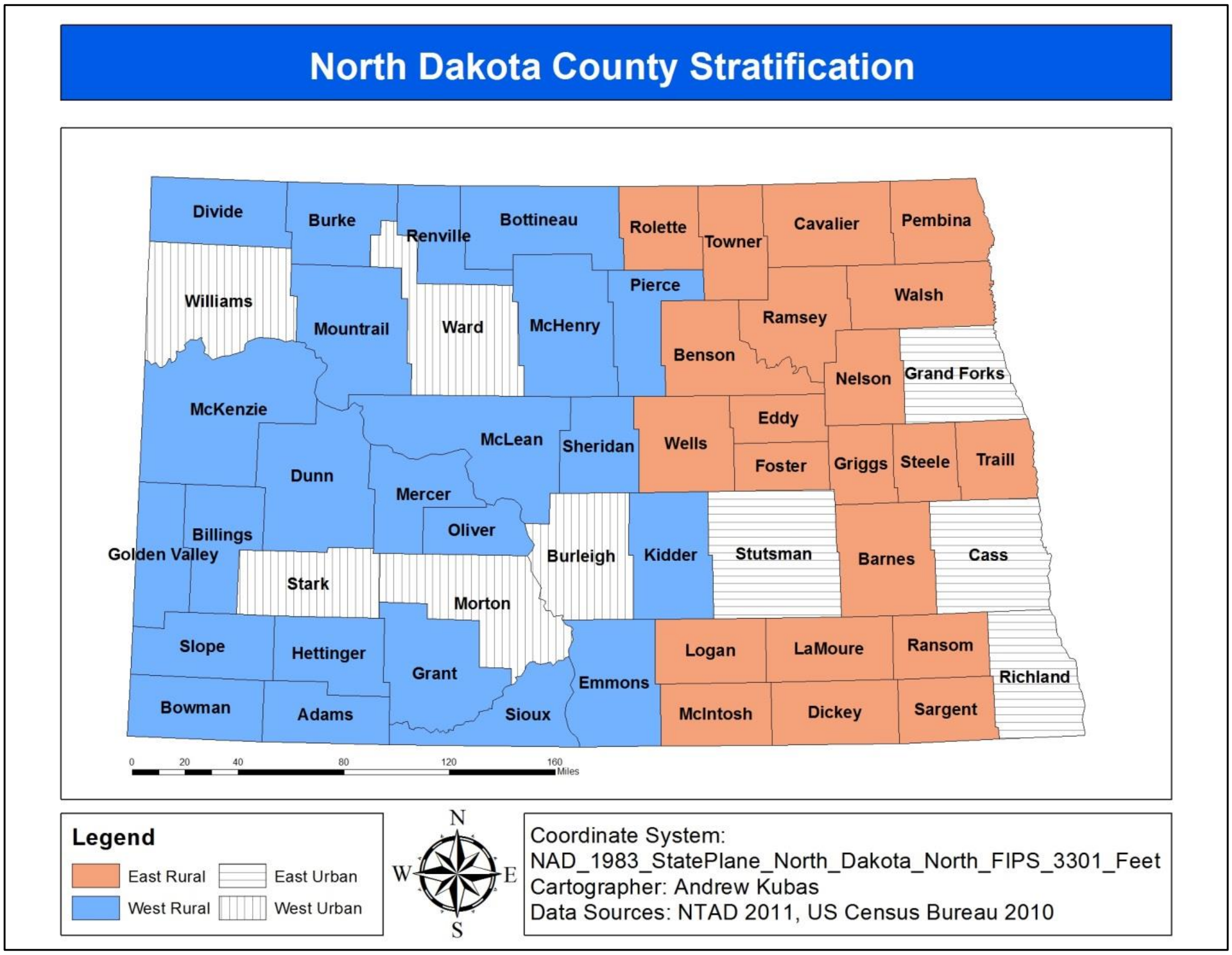

Figure 3.1 County Stratification Definitions

3.2). The least-represented group in terms of regional and geographic strata were those from rural counties in the western half of North Dakota; just 10.4% of the sample were from this background.

Table 3.2 Survey Response by Region and Geography

		GEOGRAPHY		
		Urban	Rural	**Total**
REGION	East	2,386 (35.9%)	1,377 (20.7%)	**3,763 (56.7%)**
	West	2,186 (32.9%)	689 (10.4%)	**2,875 (43.3%)**
	Total	**4,572 (68.9%)**	**2,066 (31.1%)**	**6,638**

Frequency Missing=2

3.2 Demographic Differences

Significant differences are found for crash and citation outcomes when considering region, geography, and gender. Independent-samples t-tests were performed to determine if the distribution of mean values across demographic groups were different. Drivers in the western part of the state were more likely to have had a crash (t=-8.656, df=5,553, p<0.001) and traffic-related citation (t=-9.842, df=5,553, p<0.001) in the six months prior to taking the *Alive at 25* course. These individuals were more likely to crash (t=-5.438, df=5,553, p<0.001) or receive a traffic-related citation (t=-6.256, df=5,553, p<0.001) in the six months following the course as well. Drivers from the east on average had more DUIs before taking the *Alive at 25* course (t=1.969, df=5,553, p=0.049) but there were no statistically significant differences by region after course completion. The same pattern occurred when examining crash, citation, and DUI patterns in the twelve months before and after taking the *Alive at 25* course.

There was one notable pattern difference with regard to DUI arrests when tracking participants for two years before and after course enrollment. Whereas drivers from the eastern half of the state had more DUI arrests on record before taking the class (t=2.463, df=4,224, p=0.014), drivers from the western half of the state had more DUI arrests on average after completing the course (t=-2.128, df=4,224, p=0.033). This suggests that, during a two-year period, the course has a greater impact on eastern drivers.

With regard to geography, urban drivers were more likely to crash in the six months following course completion (t=3.072, df=5,553, p=0.002). Their rural counterparts, however, were more likely to have had a DUI arrest on record in the six months before taking the class (t=-2.983, df=5,553, p=0.003). None of the other metrics were statistically significant across geography. This same trend occurred when analyzing the data in the twelve months before and after completing the class.

When addressing the data by two-year intervals before and after taking the *Alive at 25* program, trends differ slightly from the six-month and twelve-month examination periods. Urban drivers are more likely to crash both before (t=3.530, df=4,224, p<0.001) and after (t=3.574, df=4,224, p<0.001) completing the safety class. This does make some sense considering that urban travel typically has higher density and therefore a greater likelihood of a collision. These same urban drivers were more likely to have had a traffic-related citation on record before taking the class (t=2.742, df=4,224, p=0.006) which may stem from their greater propensity to be involved in a crash and subsequently charged with a driving violation. Once again, there was a pattern difference when factoring for alcohol-impaired driving: whereas rural drivers had more DUI arrests on average in the two years before taking the course (t=-2.553, df=4,224, p=0.011), there was no statistically significant difference between the two groups in the two years after finishing the class. This indicates that the course may have a stronger effect on rural drivers because they transformed from being worse than their urban counterparts to being on-par with their rates of impaired driving.

Males were more likely to have had a crash (t=2.600, df=5,555, p=0.009) and citation (t=8.045, df=5,555, p<0.001) in the six months before taking the *Alive at 25* class. They were also more likely to have a citation within six months after completing the program (t=6.928, df=5,555, p<0.001). With regard to DUI arrests, males on average had more DUIs on record in the six months before the intervention (t=3.396, df=5,555, p=0.001). There was no statistically significant difference after completing the class which suggests that it has a strong deterrent effect on males within the six months immediately following course completion: males went from being considerably worse than women for this traffic safety metric to being on-par with their rates of impaired driving.

When tracking participants in a year-long basis, results remained the same with the exception of impaired driving. Unlike the six-month deterrent effect, males were statistically more likely than females to have had a DUI arrest both before (t=4.516, df=5,111, p<0.001) and after (t=2.175, df=5,111, p=0.030) the *Alive at 25* workshop. This indicates that, somewhere between the sixth and twelfth month after taking the *Alive at 25* course, the deterrent effect on males diminishes to a point such that they begin to regress to this dangerous driving practice at a pace that exceeds their female counterparts.

The results from the two-year before-and-after period are noticeably different than the other time frames: males have a significantly higher rate of crashes, citations, and DUI arrests both before and after taking the *Alive at 25* course. It is clear that the deterrent effects which are present in the six and twelve-month intervals following class completion are no longer in place when a two-year interval is examined for novice North Dakota drivers. While differentiation by region and geography may control for some differences in driver exposure, two weaknesses throughout the assessment are the unknown vehicle miles driven exposure for all participants and license-status certainty for some participants.

3.3 Before-and-After Differences: All Drivers

The before-and-after results for crash, citation, and DUI arrest metrics were statistically significant for all three time periods, although changes were not always positive (Table 3.3). For the six-month and twelve-month intervals, drivers in the sample improved behavior for all three traffic safety metrics: the average number of crashes, citations, and DUI arrests were significantly fewer after completing the course.

When examining before-and-after trends, the two-year interval did not improve for two of the three metrics. On average, participants had more crashes (t=-3.651, df=4,227, p<0.001) and citations (t=-8.683, df=4,227, p<0.001) in the two years following course completion than they did prior to taking the driver safety class.

Table 3.3 Before-and-After Statistics

Metric	Six Months Before Course	Six Months After Course	Sig.
Total Crashes	355	211	**
Total Citations	1,552	975	**
Total DUI Arrests	152	46	**
Metric	Twelve Months Before Course	Twelve Months After Course	Sig.
Total Crashes	526	426	**
Total Citations	2,301	2,011	**
Total DUI Arrests	198	78	**
Metric	Twenty-Four Months Before Course	Twenty-Four Months After Course	Sig.
Total Crashes	625	769	**
Total Citations	2,773	3,825	**
Total DUI Arrests	213	143	**

**Statistically significant at the 1% level for paired samples t-test

It was posited that current licensure is a factor directly contributing to whether or not one has a crash, citation, or DUI arrest before and/or after taking the *Alive at 25* course. It is probable to assume that drivers with licenses travel more often than those in driver's education and/or holding permits. This may explain why the two-year cohort had worsening trends: in the two years before taking the class individuals may not have been driving whatsoever; therefore it would be reasonable to see a higher volume of crashes as these drivers may have obtained a permit and/or license shortly after taking the course. It is plausible to postulate that if one does not have a license during the time of the class but obtains it within the two years following program completion, the additional travel volume attributed to licensure may account for the increase in crashes. A major limitation of this study is that exposure data does not exist for each individual driver. The research team was unable to account for VMT before and after course enrollment to determine if the rate at which crashes, citations, and DUI arrests improved or worsened in any way. It is commonly accepted that as drivers pass through learning phases toward full licensure, they generally account for a greater percentage of vehicle miles traveled (USDOT Office of Highway Policy Information 2007) and therefore risk a higher likelihood of being involved in a crash. This is true in North Dakota where the youngest drivers travel considerably less than their 25-64 year-old counterparts (Vachal, Benson, and Kubas 2015). To separate the possibility of licensure skewing before-and-after data, a variable was created to identify whether an individual took the *Alive at 25* course prior to or after obtaining licensure. This variable, however, was not available to all program participants. The license records given to the research team started collating this information in the 2009 calendar year. Consequently, this information was unknown for any participant who took the *Alive at 25* course before January 1, 2009.

3.3.1 Before-and-After Differences Factoring for Licensure at Course Completion

Licensed drivers had a statistically significant reduction in both crashes and citations for the six-month, twelve-month, and twenty-four-month before-and-after intervals (see Table 3.4). Licensed drivers also significantly reduced the average number of DUI arrests in both the six-month (t=4.255, df=1,451, $p<0.001$) and twelve-month (t=3.215, df=1,347, p=0.001) before-and-after study periods. For licensed drivers, the twenty-four-month period was not statistically significant for impaired driving arrests (t=0.213, df=1,128, p=0.831) which suggests that any driver improvement effect stemming from the *Alive at 25* program likely diminishes somewhere between the thirteenth and twenty-fourth month after completing the course. With regard to impaired driving arrests, the same trend occurred for unlicensed program participants: there was no longer a statistically significant reduction in DUI arrests when drivers were tracked by a twenty-four-month before-and-after period (t=1.415, df=1,778, p=0.157).

Table 3.4 Before-and-After Data Factoring for Driver Licensure at Time of *Alive at 25* Course

Metric	6 Months Before Course	6 Months After Course	Sig.
Licensed Driver Crashes	221	107	**
Licensed Driver Citations	871	432	**
Licensed Driver DUI Arrests	37	8	**
Unlicensed Driver Crashes	36	54	
Unlicensed Driver Citations	211	196	
Unlicensed Driver DUI Arrests	42	16	**
Metric	12 Months Before Course	12 Months After Course	Sig.
Licensed Driver Crashes	323	168	**
Licensed Driver Citations	1,271	745	**
Licensed Driver DUI Arrests	45	18	**
Unlicensed Driver Crashes	61	143	**
Unlicensed Driver Citations	330	491	**
Unlicensed Driver DUI Arrests	54	24	**
Metric	24 Months Before Course	24 Months After Course	Sig.
Licensed Driver Crashes	357	257	**
Licensed Driver Citations	1,450	1,231	**
Licensed Driver DUI Arrests	39	37	
Unlicensed Driver Crashes	74	295	**
Unlicensed Driver Citations	395	1,162	**
Unlicensed Driver DUI Arrests	60	42	

**Statistically significant at the 1% level for paired samples t-test

Unlicensed drivers experienced opposite results with regard to crashes and citations than their licensed counterparts. In the six months before completing the *Alive at 25* class these drivers crashed (t=1.783, df=2,169, p=0.075) and received citations (t=0.605, df=2,169, p=0.545) at rates that were similar to six months after finishing the course. Moreover, when tracking unlicensed program participants by twelve-month and twenty-four-month before-and-after intervals, it is apparent that this group becomes significantly more dangerous after finishing the *Alive at 25* program. These drivers on average crash more than twice as often in the twelve months after taking the safety class (t=5.595, df=2,031, p<0.001) and roughly four times as often in the twenty-four months after completing the course (t=11.281, df=1,778, p<0.001). Compared to the twelve months and twenty-four months before taking the *Alive at 25* program, unlicensed drivers received traffic-related citations about one-and-a-half times more often in the year after finishing the course (t=3.943, df=2,031, p<0.001) and approximately three times more often in the two years after class completion (t=13.462, df=1,778, p<0.001). In terms of traffic crashes and traffic-related citations, it is clear that the course has a stronger influence on drivers who are licensed at the time of the course than those who are not licensed. It is reiterated that this may be a product of exposure and driver experience; those entering the *Alive at 25* class holding only a learner's permit or no driving experience whatsoever likely have less driving experience and therefore are predisposed to have fewer incidents on record. This may have resulted in the skewed results – access to exposure data would better explain if there are true underlying disparities between these two driver groups.

3.4 Logistic Regression Model

A final exercise in the assessment is the development of logistic regression models to better understand safety outcomes. This type of model measures the relationship between dependent and independent variables while recognizing simultaneous effects among the independent variables. The log-odd ratios provide measures of association that are indicative of the relative likelihood that drivers will exhibit safe behavior. The dependent and independent variables considered in the original model are presented in Table 3.5. The independent variables are gender, region, geography, and licensure status at the time of the course. The dependent variables are crashes, citations, and DUI arrests on record. Nine models were developed and represent the time of the study intervals (six-month, twelve-month, and twenty-four-month) and the safety outcome (crash, citation, DUI arrest). Since completion of the *Alive at 25* workshop was considered the intervention in this experimental design, safety outcomes were only modeled for the time periods after taking the class. This was the best indicator of which variables have an effect on safe driving behavior post-intervention.

Table 3.5 *Alive at 25* Safety Outcome Model Variables

Variable Name	Definition
Independent Variables	
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
Licensure Status	Not Licensed (0) or Licensed (1)
Dependent Variables	
Crash	No crashes (0) or One or More Crashes (1)
Citation	No citations (0) or One or More Citations (1)
DUI Arrest	No DUI arrests (0) or One or More DUI Arrests (1)

Of the crash, citation, and DUI arrest outcome models, crashes had the most change in the study intervals (Table 3.6). At the six-month study period, region, geography, and licensure status were significant determinants of crash likelihood; all were significant at the 1% level. Participants who took the class and lived in a western county were 1.948 times more likely to have a crash within six months of finishing the course (OR=0.513, 95% C.I. 0.360, 0.732). Urban drivers were 1.955 times more likely to have a crash in the same time frame (OR=1.955, 95% C.I. 1.245, 3.073). Those who had already obtained a license before completing the *Alive at 25* program were 2.658 times more likely to crash within six months (OR=2.658, 95% C.I. 1.861, 3.796).

Table 3.6 *Alive at 25* Crash Outcome Model

Six-Month$_1$ Interval After Course						
Parameter	Beta Value	S.E.	Wald	Sig.	Log Odds	95% C.I.
Gender	0.267	0.176	2.309		1.306	0.925-1.844
Region	-0.667	0.181	13.565	**	0.513	0.360-0.732
Geography	0.671	0.231	8.461	**	1.955	1.245-3.073
Licensure	0.978	0.182	28.908	**	2.658	1.861-3.796
Twelve-Month$_2$ Interval After Course						
Parameter	Beta Value	S.E.	Wald	Sig.	Log Odds	95% C.I.
Gender	0.165	0.129	1.635		1.179	0.916-1.518
Region	-0.614	0.132	21.527	**	0.541	0.418-0.701
Geography	0.266	0.151	3.076		1.304	0.969-1.755
Licensure	0.430	0.130	10.912	**	1.537	1.191-1.983
Twenty-Four-Month$_3$ Interval After Course						
Parameter	Beta Value	S.E.	Wald	Sig.	Log Odds	95% C.I.
Gender	0.142	0.104	1.883		1.153	0.941-1.412
Region	-0.618	0.106	34.084	**	0.539	0.438-0.663
Geography	0.189	0.117	2.620		1.208	0.961-1.518
Licensure	0.134	0.106	1.600		1.143	0.929-1.407

$_1$N=3,621; Nagelkerke R^2=0.072; model correctly classified 95.8% of cases
$_2$N=3,379; Nagelkerke R^2=0.036; model correctly classified 91.6% of cases
$_3$N=2,907; Nagelkerke R^2=0.029; model correctly classified 83.6% of cases
**Statistically significant at the 1% level

In the twelve months after finishing the class, only region and licensure status were significant determinants of a crash event; these were again statistically significant at the 1% level. Yet again, drivers in western counties were at higher risk for a traffic crash: these individuals were 1.848 times more likely to have crashed at least once in the year immediately following the class than their eastern counterparts (OR=0.541, 95% C.I. 0.418, 0.701). Similarly, those who obtained a driver's license before taking the course were 1.537 times more likely to crash (OR=1.537, 95% C.I. 1.191, 1.983).

A driver's region was once more a statistically significant determinant of crash likelihood when analyzing driver behavior in the two years following the course. Western drivers were 1.856 times more likely to have at least one crash (OR=0.539, 95% C.I. 0.438, 0.663).

Taken collectively, it is possible that the *Alive at 25* course has a longer-lasting deterrent effect on drivers from eastern counties as these individuals were less likely to crash in the six, twelve, and twenty-four months following program intervention. At some point between the thirteenth and twenty-fourth month after participating in the *Alive at 25* course, drivers who were unlicensed crash at rates that are comparable to those who were licensed before taking the program. It is possible that this disparity stems from experience and exposure: within the two-year time frame of completing the class, it is probable that the driver went on to obtain a driver's license and, due to his or her relative inexperience, may have crashed more often than in the six-month and twelve-month intervals. Considering this study was not able to factor for VMT, this is especially alarming as these newer drivers were probably traveling fewer miles compared to other older drivers (USDOT Office of Highway Policy Information 2007). The *Alive at 25* program appears to be more effective for rural drivers in the first six months following the class. This deterrent effect, however, dissipates at some point thereafter. It should be mentioned that crash events are often random in nature and stem from other external contributing variables such as time of day, driver action, distraction, and weather, among others (see Masten and Peck 2004). Therefore, the variables highlighted in this study should not be considered the sole determinants of crashes for drivers who completed the *Alive at 25* training.

The citation outcome model had consistent results across all three time intervals (Table 3.7). Gender, region, and licensure status were significant determinants of having at least one traffic-related citation after taking the safety training. In each study period, males were more likely to have a traffic-related citation than females. This follows research from McCartt, Shabanova, and Leaf (2003) which suggests that males on average receive traffic-related citations at a higher rate than females. Drivers from the western part of the state were more likely to get a traffic-related citation after completing the *Alive at 25* course. Those with a driver's license prior to taking the class more often had a citation afterward. However, note that the likelihood decreased from being 3.241 times more likely to receive a citation within six months of the safety training (OR=3.241, 95% C.I. 2.586, 4.061) to being 1.851 times more likely to have a traffic-related citation within two years of taking the class (OR=1.851, 95% C.I. 1.577, 2.172). It is clear that, regardless of the time frame studied after completing the class, males, western residents, and those with a driver's license pre-intervention have a greater propensity of receiving a traffic-related citation.

Table 3.7 *Alive at 25* Citation Outcome Model

Six-Month₁ Interval After Course						
Parameter	Beta Value	S.E.	Wald	Sig.	Log Odds	95% C.I.
Gender	0.558	0.116	23.025	**	1.747	1.391-2.193
Region	-0.569	0.113	25.313	**	0.566	0.454-0.707
Geography	-0.024	0.123	0.038		0.976	0.767-1.243
Licensure	1.176	0.115	104.379	**	3.241	2.586-4.061
Twelve-Month$_2$ Interval After Course						
Parameter	Beta Value	S.E.	Wald	Sig.	Log Odds	95% C.I.
Gender	0.468	0.091	26.534	**	1.597	1.337-1.909
Region	-0.467	0.091	26.450	**	0.627	0.524-0.749
Geography	-0.042	0.098	0.185		0.959	0.791-1.162
Licensure	0.890	0.090	98.549	**	2.435	2.042-2.902
Twenty-Four-Month$_3$ Interval After Course						
Parameter	Beta Value	S.E.	Wald	Sig.	Log Odds	95% C.I.
Gender	0.501	0.080	38.931	**	1.651	1.410-1.932
Region	-0.380	0.082	21.345	**	0.684	0.582-0.803
Geography	0.002	0.087	0.000		1.002	0.845-1.188
Licensure	0.615	0.082	56.736	**	1.851	1.577-2.172

$_1$N=3,621; Nagelkerke R^2=0.108; model correctly classified 88.5% of cases
$_2$N=3,379; Nagelkerke R^2=0.089; model correctly classified 78.7% of cases
$_3$N=2,907; Nagelkerke R^2=0.068; model correctly classified 62.8% of cases
**Statistically significant at the 1% level

With regard to impaired driving arrests after taking the course, gender was the strongest determinant of this dangerous behavior (Table 3.8) and was statistically significant across all three time intervals. In the six-month follow-up period, both gender (OR=4.067, 95% C.I. 1.179, 14.026) and region (OR=0.372, 95% C.I. 0.141, 0.978) were statistically significant at the 5% level. Male participants were 4.067 times more likely to commit at least one DUI violation within six months of completing the course than were women. Novice drivers from western North Dakota were 2.688 times more likely to have an impaired driving event than were their eastern counterparts.

For the twelve-month and twenty-four-month follow-up study periods, only gender was a significant determinant of DUI arrest. For these time periods, the metric was found to be significant at the 1% level. Within the first year of finishing the class, males were 3.269 times more likely to have at least one DUI arrest (OR=3.269, 95% C.I. 1.343, 7.956). Over a two-year follow-up period, the chances of being arrested for at least one DUI grew to 3.916 times that of female drivers (OR=3.916, 95% C.I. 1.984, 7.729). This evidence suggests that the *Alive at 25* program may have a stronger deterrent effect on females. This finding parallels other studies in North Dakota which indicate that males are more likely than women to have a DUI arrest on record after a safety intervention, even if the intervention is designed specifically to deter impaired driving (see Kubas, Kayabas, and Vachal 2015).

Table 3.8 *Alive at 25* DUI Arrest Outcome Model

Six-Month₁ Interval After Course						
Parameter	Beta Value	S.E.	Wald	Sig.	Log Odds	95% C.I.
Gender	1.403	0.632	4.934	*	4.067	1.179-14.026
Region	-0.989	0.493	4.017	*	0.372	0.141-0.978
Geography	0.239	0.569	0.176		1.270	0.416-3.876
Licensure	-0.464	0.491	0.894		0.629	0.240-1.645
Twelve-Month₂ Interval After Course						
Parameter	Beta Value	S.E.	Wald	Sig.	Log Odds	95% C.I.
Gender	1.185	0.454	6.812	**	3.269	1.343-7.956
Region	-0.527	0.369	2.037		0.590	0.286-1.217
Geography	-0.008	0.399	0.000		0.992	0.454-2.170
Licensure	0.136	0.364	0.140		1.146	0.562-2.339
Twenty-Four-Month₃ Interval After Course						
Parameter	Beta Value	S.E.	Wald	Sig.	Log Odds	95% C.I.
Gender	1.365	0.347	15.479	**	3.916	1.984-7.729
Region	-0.290	0.265	1.194		0.748	0.445-1.259
Geography	-0.008	0.281	0.001		0.992	0.572-1.721
Licensure	0.386	0.263	2.146		1.470	0.878-2.463

1 N=3,621; Nagelkerke R^2=0.048; model correctly classified 99.5% of cases
2 N=3,379; Nagelkerke R^2=0.032; model correctly classified 99.0% of cases
3 N=2,907; Nagelkerke R^2=0.046; model correctly classified 97.8% of cases
**Statistically significant at the 1% level
*Statistically significant at the 5% level

4. SUMMARY

Novice driver safety is a priority area for the NDDOT Safety Division and is emphasized in annual programming activities. In recent years, the National Safety Council *Alive at 25* training has been supported as a tool in assisting this area. The goal of this study was to use existing data sources to assess the viability of the *Alive at 25* program in improving novice driver safety. Paired-samples t-tests indicate that, when compared to driving behavior in the year before taking the class, there is a significant reduction in crashes, citations, and DUI arrests. This is especially true for those drivers who are recently licensed at the time of taking the course.

Logit modeling, used to analyze a sample of 6,640 driver records, shows that the course has a deterrent effect on novice drivers from the eastern portion of North Dakota with regard to traffic crashes. Crashes and citations are typically more common for drivers who are licensed at the time of taking the class, but this is likely attributed to exposure as non-licensed drivers are limited to practice driving and/or driver's education training only. The program has a stronger deterrent effect on females than males for both citations and DUI arrests. This follows other traffic safety intervention strategies in North Dakota and validates previous findings that indicate novice male drivers tend to engage in decisions at-odds with traffic safety goals and are more likely to exhibit dangerous driving behavior.

These results would be made more robust by future analysis that includes information about exposure, such as vehicle miles traveled. This would better explain if there are differences in crash rates as opposed to total crashes, which would provide better estimates about the holistic impact the program has on traffic safety.

The analysis would also be aided with better licensure status information. The data given to the research team only included information about the date on which drivers received their license dating back to 2009. Because a significant number of driver records were dated in 2008, it was unknown if these individuals were in the pre-permit, permit, or licensed stage of driving. As a result, these participants were evaluated for before-and-after results, but were excluded from the logistic regression models.

Moreover, methods for matching program participants to crash records, citation records, and license records were not ideal. Because some drivers in the sample were not yet licensed, they did not have the last four digit identifier of the unique alpha-numeric driver's license number given to every North Dakota driver. An alternative method of matching participants by available demographic information was effective for some participants, but nonetheless resulted in 3,278 participants who were unable to be matched for analysis in this study. Because this was such a large number, it was impossible to create a control group of non-*Alive at 25* drivers to study their driving behavior; the influence of the unmatched 3,278 drivers undoubtedly would have muddled the validity and reliability of any findings for the control group. Future analysis efforts would be improved if crash and conviction records included the same personal identifier information as was provided to the research team, but this would require extensive coordination across state agencies in addition to exhaustive efforts from the research team to ensure confidentiality for participants.

Note that a previous assessment of the *Alive at 25* program in North Dakota found positive results when including enrollment in the program as a key variable (see Vachal and Malchose 2010). Although this study could not be replicated due to data linking issues and expanded geography, the present evaluation introduced a new component into the assessment and found significant before-and-after effects which can be attributed to the program. This is a positive step in understanding the efficacy of the *Alive at 25* class: not only has a previous assessment determined that taking the course improves driver safety compared to those who do not participate, but this evaluation has further determined that the course has worthwhile before-and-after effects which result in making North Dakota roadways safer.

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