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Quantifying Vermont Transportation Safety Factors: Young Drivers and Departure from Lane

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Disclaimer

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1. Introduction

The Vermont Agency of Transportation (VTrans) and its partners have selected traffic safety priority areas in their Strategic Highway Safety Plan adopted in 2006. In this project, we focus on the following prioritized areas 1) keeping vehicles on the roadway and 2) young drivers (those under 21 years old).

1.1. Young Drivers

Nationwide, motor vehicle crashes are the leading cause of death for U.S. teenagers, accounting for 40% of total fatalities (Gonzales et al. 2005). In Vermont, between 1999 and 2003, 25 to 30% of major crashes involved young drivers under the age of 21 years. Young drivers are at increased risk for crashing due to their inexperience driving and propensity for risky behavior. In this research we identify factors which increase the likelihood of young drivers being at fault and those factors which contribute to more severe (fatal or incapacitating) crashes involving young drivers.

Previous research has found that the riskiest behaviors common among young drivers are alcohol use, not wearing seatbelts, and distracted driving due to teen passengers and cell phone use (NHTSA). Padlo et al. (2005) determined that in Connecticut, young driver propensity to be at fault increased at night, on freeways, and with an increased number of passengers. These risk factors have been confirmed by other research. Overall, however, while rates of crashes, especially fatal crashes, remain high among young drivers, nationally they have declined markedly in recent years, due presumably to the implementation of graduated driver licensing (GDL) programs in many states.

Consistently, research has found that GDL programs such as the one in Vermont are associated with reduced crash rates among young drivers (Shope 2007, Hartling et al. 2006; Hedlund et al. 2006). GDL programs are intended to remove young drivers from the riskiest driving situations until they have accrued a certain amount of experience driving. Such risky driving situations limited by GDL programs include driving at night and driving with other young (teenage) passengers who can serve as distractions and/or encourage risk-taking behavior.

1.2. Departure from Lane

We combined all drivers from single vehicle crashes and all at fault drivers involved in head-on collisions to create a departure from lane crash dataset. Because departure from lane crashes often involve vehicles colliding with fixed objects, this crash type is associated with a high degree of severity and is thus a priority for safety research. Our research objective is to identify factors that impact departure from lane crash severity.

Driver distraction is assumed to be an important factor in many crashes, including departure from lane. Addressing distracted driving is also a priority of the Vermont State Highway Safety Plan. It is a behavior that is difficult to define and measure, however, thus limited countermeasures are available to policymakers. Public education campaigns alone are rarely effective enough to change driver behavior and specific regulatory measures to address distraction are difficult to enforce.

Technology-related distractions receive a great deal of media attention, although they turn up as contributing factor to crashes a consistently small percentage of the time (1-4%; NHTSA). Such distractions do have clear countermeasures, however, including banning the use of cell phone use and or texting while driving. If enforced, these laws have been shown to reduce rates of cell phone use while driving but no clear effect of such laws on crash rates has been demonstrated yet. Addressing the effect of distracted driving, in addition to other contributing factors, on departure from lane crash severity was the second primary objective of this study.

2. Research Methodology

It is difficult for transportation researchers to measure exposure and thus estimate accurate levels of risk associated with particular road conditions or driver characteristics. Because in this database we have only crash data and no control data for comparison, we made comparisons within these data, to model the exogenous factors of crash fault and severity. We used logistic regression to produce odds ratios and identify risk factors associated with fatal and incapacitating injuries in departure from lane and young driver crashes, and fault in young driver crashes.

2.1 Data

We used the Vermont crash database (2003-2008) for our analysis (Table 1). This database includes all police-reported crashes (84,591) that occurred in Vermont and is aggregated by person (driver, passenger, owner, witness, etc). We limited our analysis to drivers and passengers, which resulted in a dataset of 172,142 people. From this dataset we constructed two more subsets: one containing all young drivers (those under 21 years old) and included variables about their passengers, and all at fault drivers involved in departure from lane crashes (departure from lane crashes include all single vehicle crashes and at fault drivers in head-on collisions). The number of both departure from lane and young driver crashes peaked in 2006 and then declined in 2007 and 2008 (Figure 1).

Table 1. Vermont police-reported crashes 2003-2008

	# crashes	%
Total Crashes	84,591	.
Total single-vehicle crashes	25,546	30.4
Total multi-vehicle crashes	58,168	69.5
Total departure from lane crashes	28,676	34.1
Total crashes involving large vehicles	5,220	6.2
Total crashes involving bicycles and pedestrians	1,457	1.7
Total crashes involving young drivers	20,186	23.9
Young drivers at fault	16,488	76.1
Total fatal crashes	420	0.5
Total fatal crashes involving young drivers	95	0.1

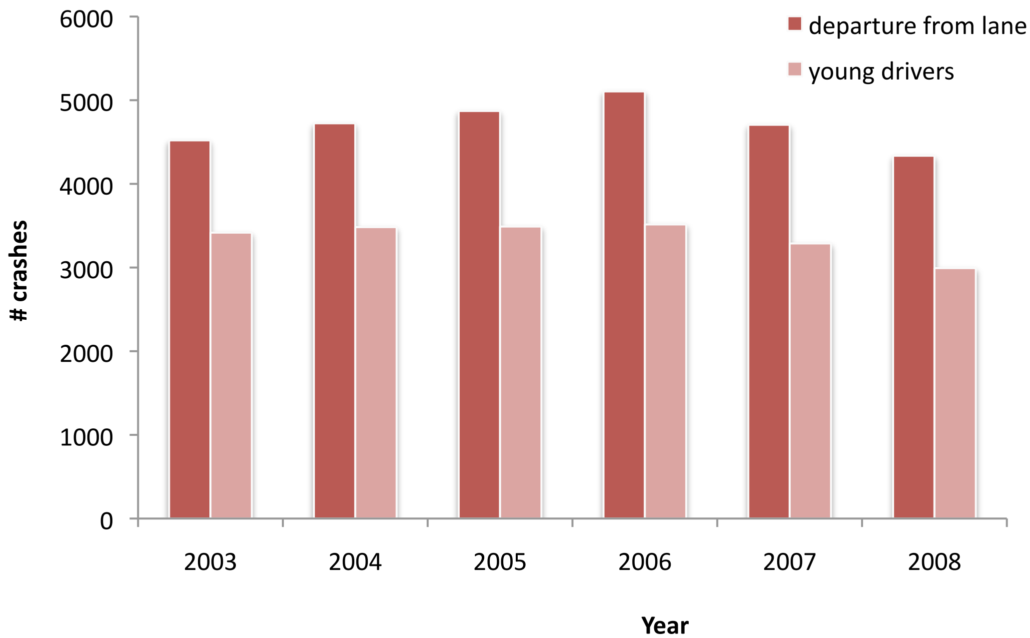

Figure 1. Total departure from lane crashes and young driver crashes in Vermont 2003-2008.

2.2 Crashes by County

Maps 1 through 4 present total drivers involved in crashes (crash-drivers) by county 2003-2008. Chittenden and Windsor County have the highest number of crash-drivers. Map 2 presents the number of departure from lane crash-drivers scaled to county vehicle miles traveled. We calculated the total number of crash drivers 2003-2008 for each county per VMT for that county. This fraction is expressed as a percent of the sum of those fractions for the state. VMT for each county was taken from the statewide travel demand model for the year 2000. This calculation allows comparison among counties, accounting for each county's VMT. After scaling the departure from lane crash data to VMT, Lamoille and Windsor counties have the highest levels of crash-drivers per VMT, and Chittenden County has among the lowest levels of crash-drivers per VMT.

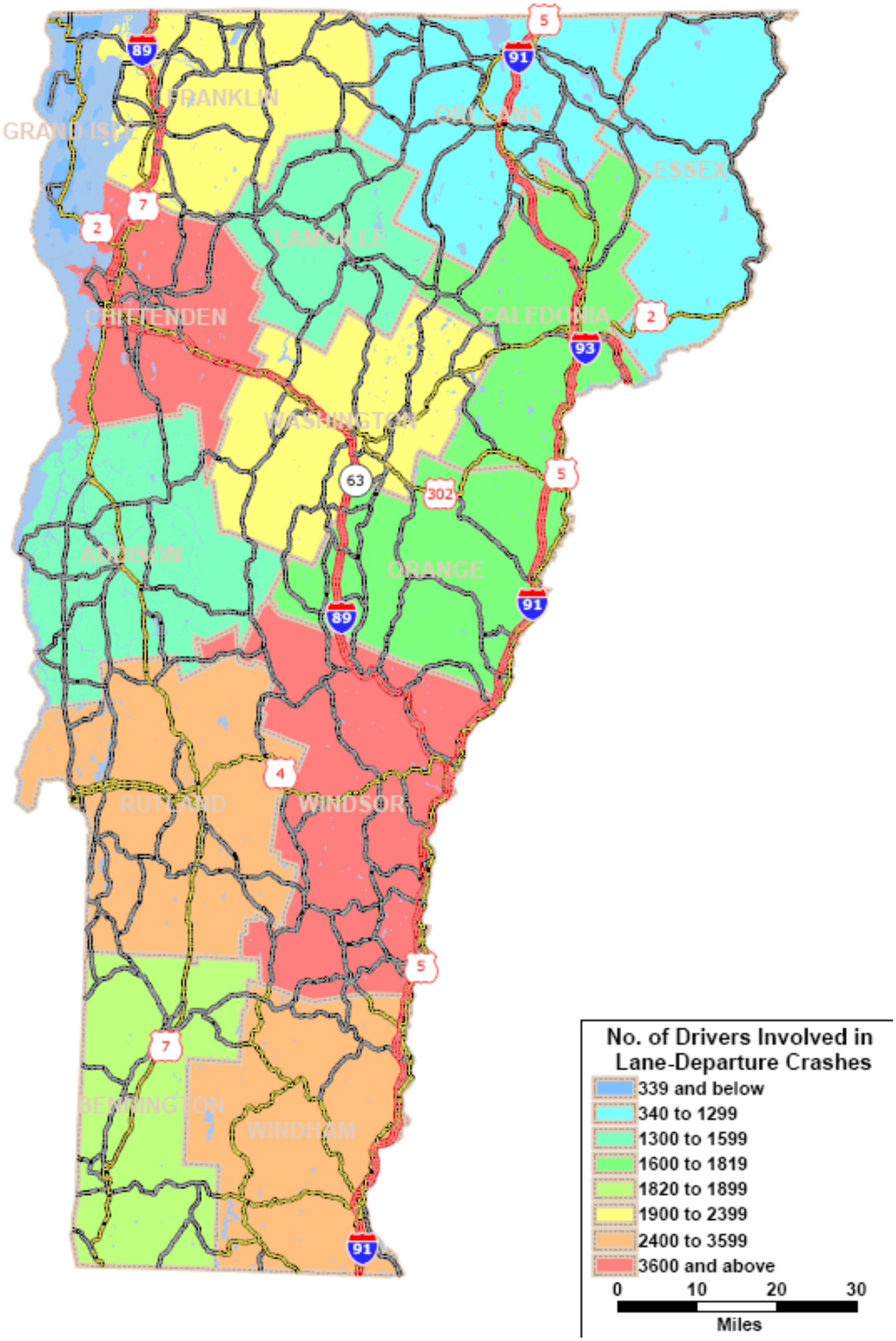

Figure 2. Total number of drivers involved in lane departure crashes by county 2003-2008.

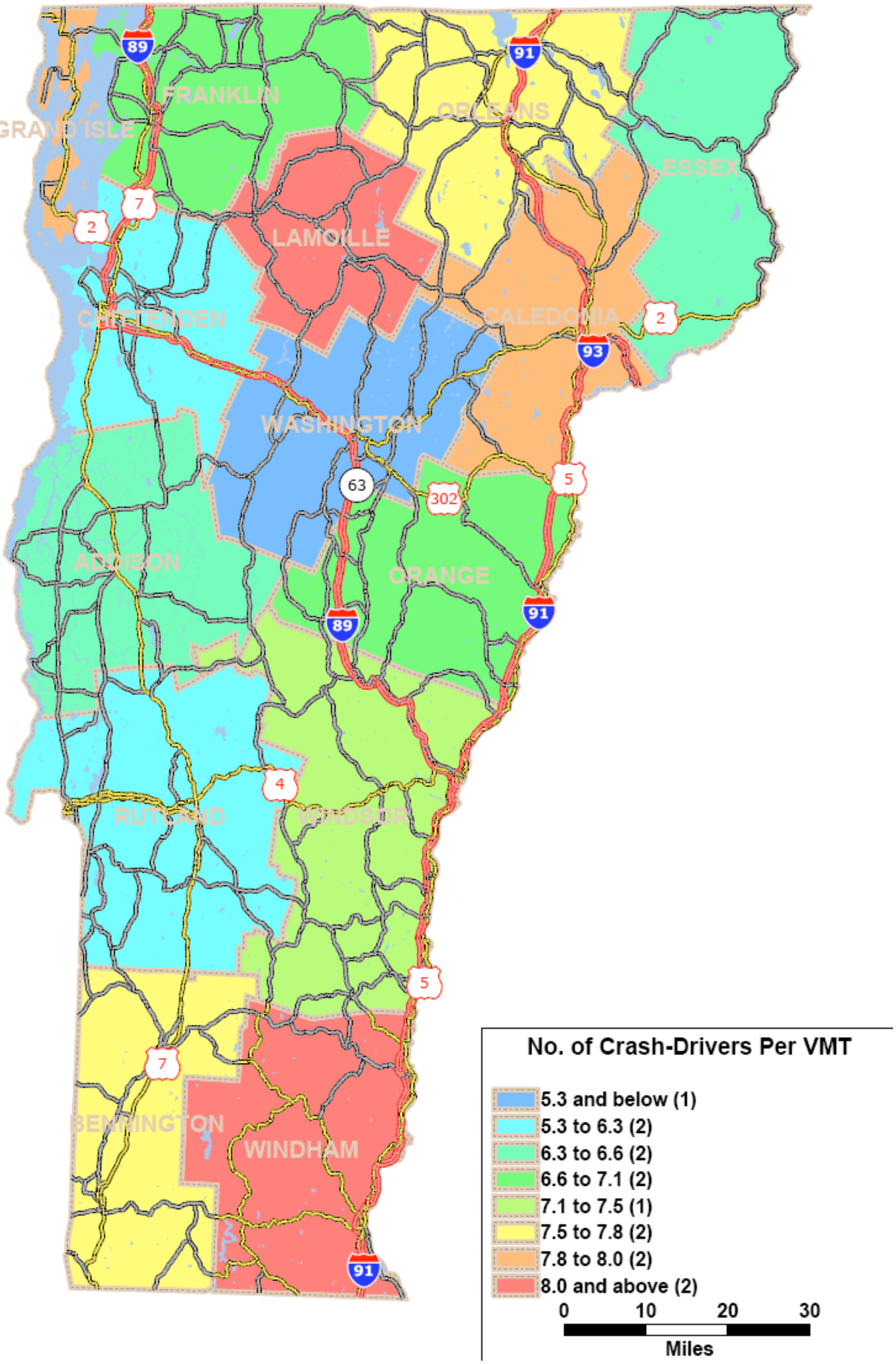

Figure 3. Number of drivers involved in departure from lane crashes 2003-2008 scaled by county VMT

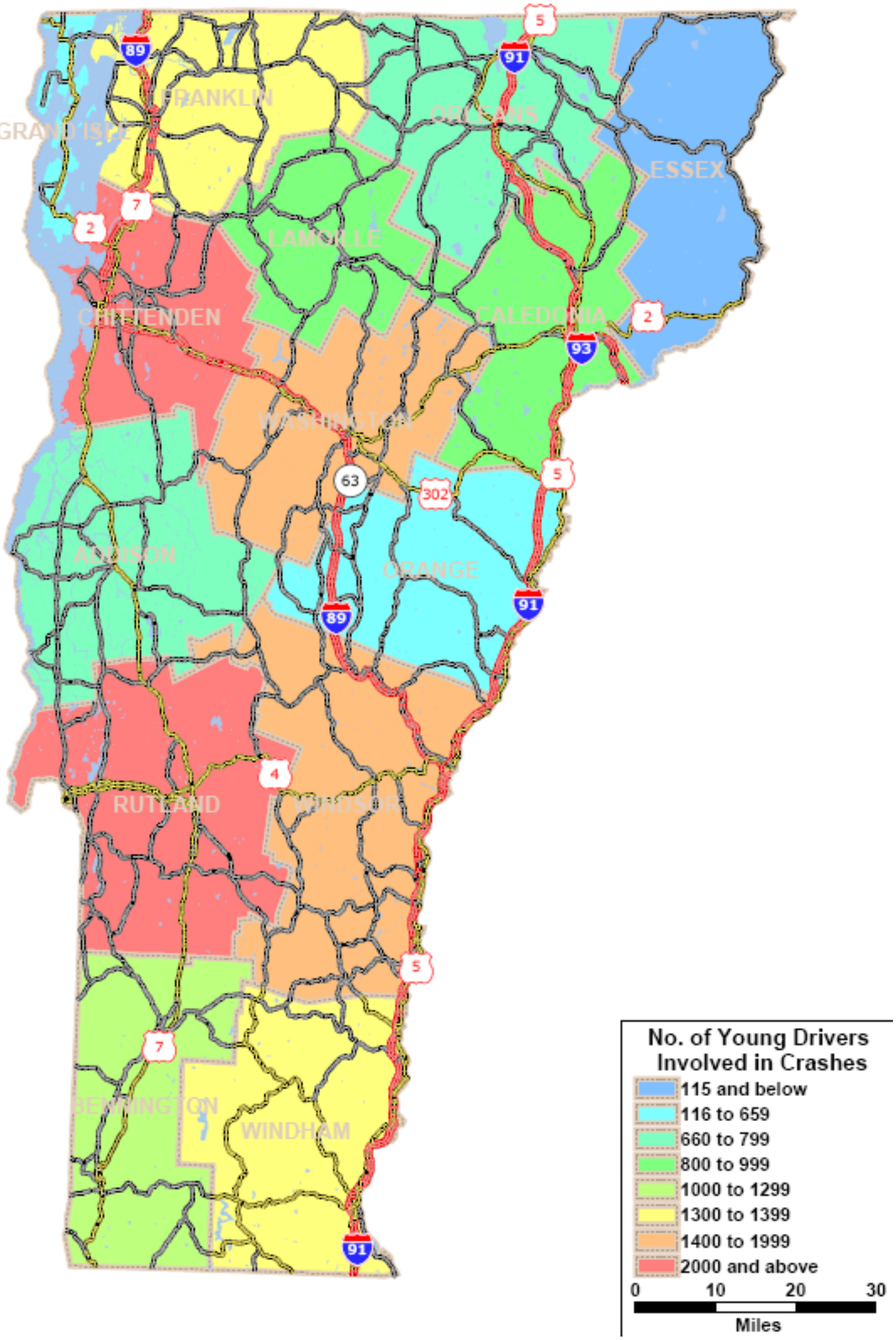

Figure 4. Total number of young drivers involved in crashes by county 2003-2008

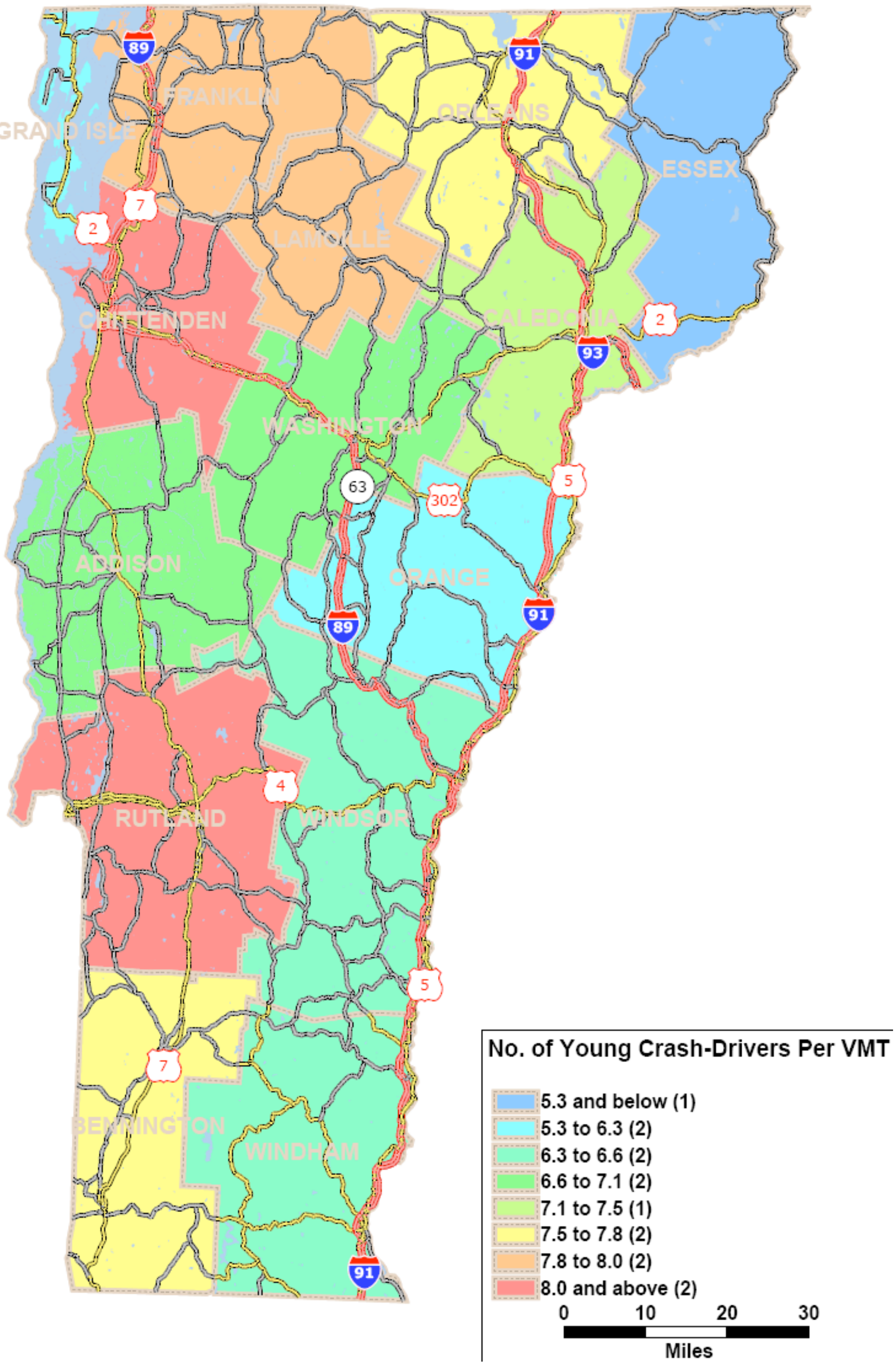

Figure 5. Number of young drivers involved in crashes 2003-2008 scaled by county VMT.

Chittenden and Rutland counties have the highest levels of young driver crash-drivers, even after accounting for VMT (Map 4).

2.2 Crash Contributing Factors

Proper assignment of fault in these crashes is crucial to our analysis. We assigned fault using the two ‘Contributing factor’ fields in the crash database. In most cases only one contributing factor was listed. If ‘no improper driving’ was listed as a contributing factor, then the driver was classified as ‘not at fault’. Otherwise, if factors such as ‘under the influence of drugs/alcohol/medication’, ‘excessive speed’, ‘failure to stay in lane’ were listed, the driver was classified as ‘at fault’. If no contributing factors were listed fault was ‘unknown’ and these records were excluded from the models (4.5%). If the contributing factor fields contradicted each other, then the driver was assumed to be at fault (e.g., if CONFACTOR1 stated ‘No improper driving’ and CONFACTOR2 stated ‘Under the influence of drugs/alcohol/medication,’ the driver was classified as ‘at fault’). All drivers involved in single vehicle crashes were assumed to be at fault.

Tables 2 and 3 list common contributing factors in departure from lane and young driver crashes. Excessive speed, failure to stay in lane, and inattention are common factors in both crash types. For comparison to young drivers, Table 3 also presents the proportion of total drivers involved in crashes for which these contributing factors were noted. Note that the crash database includes two contributing factors for each driver. In most cases, the ‘CONFACTOR2’ field was left blank (68% of records in the departure from lane dataset and 74% of records in the young driver dataset). Where information was provided, it was included in our analysis and in Tables 2 through 5 (thus drivers with more than one contributing factor listed are counted twice in these tables). The contributing factors ‘Excessive speed’ and ‘Going too fast for conditions’ were collapsed into the factor ‘Excessive speed.’

Table 2. Common contributing factors to departure from lane crashes

Contributing factor	# Drivers	%
Excessive speed	10,928	37.3
Failure to stay in lane	9,261	31.7
Inattention	2,231	7.6
Under the influence of medication/drugs/alcohol	2,182	7.6
Swerving to avoid slippery surface	1,436	4.9
Asleep, fatigued	1,407	4.8

Table 3. Common contributing factors to young driver crashes

Contributing factor	# Young drivers	%	% All drivers
Excessive speed	4,577	21.2	12.1
Inattention	3,884	18.0	15.3
Failure to stay in lane	2,992	13.8	9.6
Failed to yield right of way	2,126	9.8	8.3
Following too closely	1,764	8.2	5.9
Under the influence of medication/drugs/alcohol	399	1.8	2.4
No improper driving	4,930	22.8	36.0

Table 4. Common contributing factors to fatal departure from lane crashes

Contributing factor	# Drivers	%
Failure to stay in lane	181	54.3
Excessive speed	97	29.1
Under the influence of medication/drugs/alcohol	60	18.0
Operating vehicle carelessly	43	12.9

Table 5. Common contributing factors to fatal crashes involving young drivers

Contributing factor	# Young drivers	%	% All drivers
Excessive speed	41	43.1	20.9
Failure to stay in lane	41	43.1	34.2
Operating vehicle carelessly	16	16.8	9.3
Under the influence of medication/drugs/alcohol	9	9.5	11.1
No improper driving	15	15.8	31.7

2.3 Models

We used these two datasets to create three models: the departure from lane severity model, the young driver fault model, and the young driver severity model. In each of these models the sampling unit is driver. 473 drivers below the age of 10 years were excluded from analysis.

The departure from lane severity dataset includes 28,771 drivers and 28,676 unique crashes (some crashes involved more than one at fault driver). We used binary logistic regression to determine those factors that affect crash severity. In this model, severity is the dependent variable and is divided into two categories: 'fatal or incapacitating' and 'other'. 'Other' categories of severity include injury- not incapacitating, possible injury, no injury. This severity rating is a new variable derived from the crash database and assigns the highest severity rating of anyone involved in the crash to the crash as a whole. We used this variable instead of the variable 'SEVERITY.' The variable 'SEVERITY' includes only 3 levels: fatal, injury, and property damage only.

Because the number of fatal crashes is small, combining fatal and incapacitating crashes increased our sample size and statistical power, allowing more useful analysis with the relatively small Vermont dataset. Using this variable, we combined fatal, incapacitating, and untimely death crashes into a single category, allowing us to more effectively identify those factors contributing to severe run off the road crashes.

Binary logistic regression was also used to determine those factors that contribute to young drivers being at fault in crashes. In this model, fault is the response variable. The young driver severity model uses logistic regression to determine what factors contribute to fatal and incapacitating crashes involving young drivers. In this model, the dependent variable was severity: 'fatal/incapacitating' or 'other'. This severity rating was derived from the crash database as described above.

The complete list of explanatory variables tested for inclusion in the three models is found in Table 6. Those variables that were both statistically significant at an alpha level of 0.05 and had an odds ratio point estimate either less than 0.85 or greater than 1.15 (thus an approximate effect of at least 15% on the dependent variable) were included in the models. Variables in Table 6 listed as n/a were not tested for inclusion due to the reasons described below. To increase statistical power, data were grouped into two or three categories for most explanatory variables. For example, the variable light, which includes a number of levels in the original VTrans dataset, including light, dusk, dawn, dark- lighted roadway, dark- not lighted roadway, was classified as either light or dark. 'Dark' includes all non-light conditions, including dawn and dusk. Horizontal curvature was divided into straight and curved (all non-straight conditions). Three levels of intersection location classification were used: intersection (including all types: T, four-way, etc.), parking lot, and not at an intersection. Road surface conditions were divided into 'presence of ice, slush, or snow' and 'no ice, slush, or snow present.'

Table 6. Model effects

Effect	Included in young driver fault model?	Included in young driver severity model?	Included in departure from lane severity model?
Pavement (not paved vs. paved)	Y	N	Y
Horizontal curve (curved vs. straight)	Y	Y	Y
Vertical curvature (not level vs. level)	N	Y	N
Restraint worn	Y	n/a	n/a
Light (night vs. day)	Y	Y	N
Intersection (none vs. at intersection)	Y	Y	Y
Intersection (parking lot vs. intersection)	Y	Y	Y
Gender (women vs. men)	Y	N	Y
Young passenger present (presence of passenger under 21 vs. presence of passenger over 21)	Y	n/a	n/a
Young passenger present (presence of passenger under 21 vs. no passenger present)	N	n/a	n/a
Road surface conditions (presence of snow, ice, or slush)	N	Y	Y

The presence of passengers was also included as a factor in the young driver model. Passengers were totaled for each vehicle driven by a young driver and those passengers below 21 years old were flagged. In our analysis, we tested the effect of three levels of passenger presence on young driver likelihood of fault: no passenger present, young passenger present, and passenger over 21 present.

Previous research and preliminary analysis of these data suggest that presence of an older passenger reduces young driver crash rates, while the presence of a young passenger tends to have the opposite effect. In cases where both a young and older passenger were present in the same vehicle, we assumed that the presence of the older passenger would offset the effect of the young passenger. If passengers of both age categories were present in the same vehicle the passenger type was flagged as '21 and over'. Our model tests the effect of young passenger presence vs. no passenger and the effect of young passenger presence vs. older passenger presence.

Although this and previous research suggests that passenger presence can be an important aspect of young driver distraction, we included passenger presence as an explanatory variable only in the young driver fault model, not in the severity models. Our measure of severity in these models was associated with the crash as a whole and the presence of more people in the car may increase the likelihood of one of them being severely injured.

Similarly, seatbelt use was not included in either of the severity models because crash severity was not attached to the driver specifically but the crash as a whole. Seatbelt use can be used as a proxy for propensity of risk-taking behavior, as it is in the young driver fault model, but also has obvious impacts on injury severity of the driver and is not an appropriate factor to include when the dependent variable is overall crash severity.

Despite the prevelance of excessive speed as a contributing factor to crashes, it is not included in our models because it is not independent of the other model effects but in fact may be highly correlated or a result of effects such as verticle curvature, horizontal curvature, light, and intersection presence.

We developed our models using step-wise logistic regression and retained only those variables that were significant at an alpha level of $p \leq 0.05$. AIC values were used to assess goodness of fit of our models. Means are presented ± SD. All analyses were performed in SAS v9.2.

3. Results

3.1 Departure from Lane Crashes

<u>**Descriptive statistics**</u>

The departure from lane dataset included a total of 28,771 drivers and 28,262 unique crashes. The majority of drivers were involved in single vehicle crashes (Table 7). Mean age of these drivers was 36.3 ± 17.1 years and the majority of drivers involved in these crashes were men (61.3%, 17,557). The minimum age in this group of drivers was 10.8 years and the maximum age was 100.7 years. 473 drivers under 10 years were excluded from this dataset.

Table 7. Departure from lane crash types

Crash Type	# Drivers	%
Head On Collision	3,599	12.5
Single Vehicle Crash	25,172	87.5
Total	28,771	100

Only a small number of drivers were involved in fatal departure from lane crashes (331, 1.1%; Table 8). To increase sample size and statistical power, crashes resulting in fatal and incapacitating injuries were combined in the alternate classification. This alternate classification resulted in 1,765 drivers involved in fatal/incapacitating crashes (Table 9).

Table 8. Departure from lane crash severity

Severity	# Drivers	%
Fatal	331	1.1
Injury	9,430	32.8
Property Damage Only	18,812	65.4
Unknown	198	1.3
Total	28,771	100

Table 9. Departure from lane crash severity alternate classification

Severity	# Drivers	%
Fatal/Incapacitating	1,790	6.2
Other	26,654	92.7
Unknown	327	1.1
Total	28,771	100

Model results

Six factors were determined to significantly affect the likelihood of a departure from lane crash resulting in a fatality or incapacitating injury (Table 8). A total of 27,489 drivers were used in the analysis as only those records with no missing values were retained (e.g., if a record had no information on pavement surface but was complete otherwise, it was not used in the model).

We report an odds ratio point estimate ± 95% confidence interval for each explanatory variable. The odds ratio of a given variable is a measure of effect size and provides an estimate of how a variable impacts the likelihood of a certain outcome (the dependent variable). It is the ratio between the odds of an event in one group or circumstance occurring relative to the odds of it occurring in another group or circumstance. In this model, the odds ratios represent how the explanatory variables or model effects impact the likelihood of a crash being fatal or incapacitating. A value close to 1.0 indicates that a variable has little effect on crash severity. A value of less than 1.0 indicates a variable reduces the likelihood of a crash being severe, while a value greater than 1.0 indicates the opposite.

Horizontal curvature increased the likelihood of crash being severe by 41%. Crash occurrence at an intersection and on an unpaved road decreased the likelihood of a severe crash (by ~20% each). The presence of snow, ice, or slush on the road more than halved the likelihood of a severe crash, presumably due to slower driving. Women were nearly 20% less likely than men to be involved in a severe crash.

Table 10. Departure from lane severity model results (N=27,489)

Effect	Odds Ratio Point Estimate	95% Confidence Limits	
Horizontal curve (curved vs. straight)	1.41	1.28	1.56
Gender (women vs. men)	0.81	0.73	0.90
Intersection (at intersection vs. none)	0.80	0.92	0.71
Pavement (not paved vs. paved)	0.79	0.68	0.92
Intersection (parking lot vs. intersection)	0.45	0.30	0.70
Road surface conditions (snow/ice/slush vs. none)	0.40	0.46	0.36

3.2 Young Driver Crashes

Descriptive statistics

The young driver dataset included a total of 21,611 drivers and 20,186 (1,425 involved more than one young driver). Young driver mean age was 18.5 ± 1.4 years and ranged from 10.7 to 20.9 years. The majority of young drivers involved in crashes were determined to be at fault (Table 11). Most crashes resulted in property damage only, with only 0.4% of young drivers involved in fatal crashes (Table 12). Tables 11 through 15 are aggregated by driver, not crash; the 1,425 crashes involving more than one young driver are counted multiple times.

Of the 95 fatal crashes involving young drivers, 3 incidents were two car crashes where both drivers were young drivers. Of the 25 instances of young driver fatal crashes caused by failure to stay in lane, 11 of these incidents involved excessive speed. Proportionally, more young drivers are at fault in fatal crashes than total crashes overall (Tables 11 and 13).

Table 11. Young driver fault

Fault	# drivers	%
Yes	16,488	76.1
No	4,930	22.8
Unknown	233	1.1
Total	21,611	100

Table 12. Young driver crash severity

Severity	# drivers	%
Fatal	95	0.4
Injury	5,003	23.2
Property Damage Only	16,378	75.8
Unknown	135	0.6
Total	21,611	100

Table 13. Proportion of young drivers at fault in fatal crashes

Fault	# drivers	%
Yes	83	87.4
No	12	12.6
Total	95	100

In all age categories more, there were more male young drivers involved in crashes than female young drivers (Table 15). Of the 21,611 young drivers involved in crashes and included in our dataset, the youngest of these drivers were more likely to have fatal crashes (Figure 6). Drivers under 17 years comprised 15.1% of all young drivers in the dataset (Table 14) but comprise nearly 22% of those involved in fatal crashes.

Table 14. Young driver age distribution

Age Group (years)	N	%
Under 17	3,253	15.1
17-17.9	4,799	22.2
18-18.9	4,937	22.3
19-19.9	4,496	20.8
20-20.9	4,126	19.1
Total	**21,611**	**100**

Table 15. The sex (male vs. female) of young drivers (N=21,605)*

Age Group (years)	Male	%	Female	%
Under 17	1,706	52.4	1,545	48.0
17-17.9	2,490	51.9	2,308	48.1
18-18.9	2,834	57.4	2,103	42.6
19-19.9	2,469	54.9	2,026	45.1
20-20.9	2,254	54.6	1,870	45.3
Total	11,753	54.4	9,852	45.6

**Six young drivers had no sex recorded.*

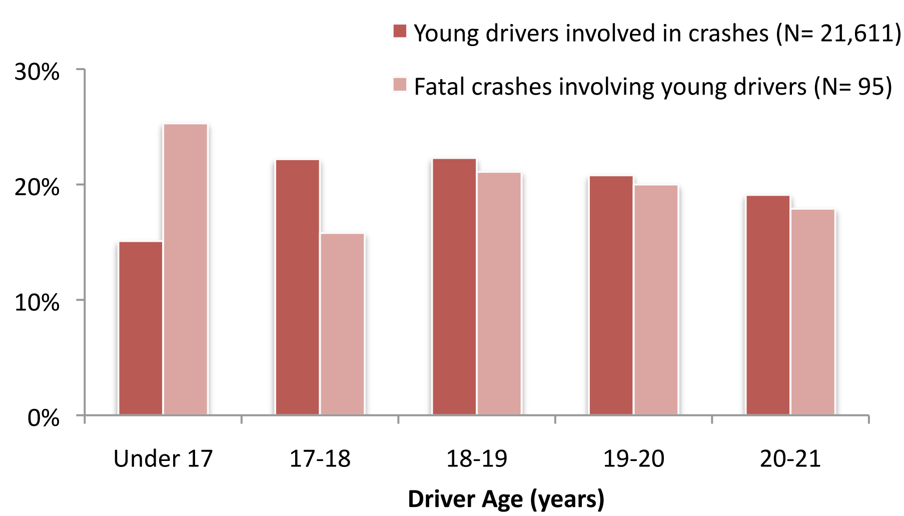

Figure 6. Frequencies of young drivers involved in all crashes and fatal crashes by age group.

<u>Passenger prevalence and age</u>

Of the young drivers in our dataset used for analysis, 75.2 % (16,092) of young drivers involved crashes were riding without passengers (Figure 3). The mean age of all passengers riding with young drivers was 19.2 ± 9.0 years (N= 6,244). Young passengers (those under 21) comprised 81.9% (5,117) of passengers riding with young drivers. The mean age of young passengers was 16.1 ± 3.8 years.

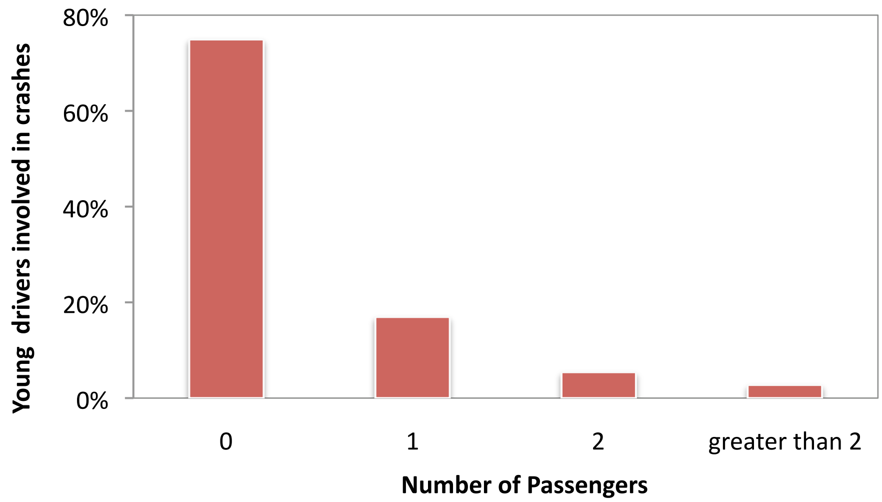

Figure 7. Proportion of young drivers involved in crashes that were carrying passengers.

3.3. Model Results

Young driver fault model

A total of 8 variables were determined to be significant contributing factors to the propensity of young drivers to be at fault (Table 15). Only those records with no missing values were used resulting in a total of 17,927 drivers being included in this model. Road type (paved or unpaved) was the most influential factor, increasing young driver likelihood of fault by nearly 2.5 times. Horizontal curvature increased the likelihood of young driver fault by 89% while those young drivers who failed to use a restraint were 64% more likely to be at fault. Driving with young passengers and at night also substantially increased the likelihood of young driver fault. Female young drivers were 20% less likely to be at fault than their male counterparts.

Table 16. Young driver fault model results (N= 17,927)

Effect	Odds Ratio Point Estimate	95% Confidence Limits	
Pavement (not paved vs. paved)	2.47	2.05	2.97
Horizontal curve (curved vs. straight)	1.89	1.71	2.08
Seatbelt (no vs. yes)	1.64	1.35	2.00
Young passenger present (presence of passenger under 21 vs. presence of passenger over 21)	1.50	1.26	1.79
Light (night vs. day)	1.30	1.19	1.42
Intersection (parking lot vs. intersection)	1.28	1.12	1.46
Gender (women vs. men)	0.80	0.74	0.86
Intersection (intersection vs. none)	0.58	0.54	0.62

Young driver severity model

A total of 6 factors were found to significantly affect the likelihood of a crash involving a young driver being fatal or incapacitating (Table 16). 20,017 young drivers were included in this model. Young driver crashes occurring at a curve in the road are more than twice as likely to be severe compared to those on straight sections of road. Both night driving and the presence of vertical curvature increased the chance of a severe young driver crash by ~30%. The presence of snow, ice, or slush on the road decreased the likelihood that a young driver crash will be severe by 45%.

Table 17. Young driver severity model results (N= 20,071)

Effect	Odds Ratio Point Estimate	95% Confidence Limits	
Horizontal curve (curved vs. straight)	2.14	1.80	2.54
Light (night vs. day)	1.30	1.10	1.55
Vertical curvature (level vs. not level)	1.26	1.06	1.51
Road surface (snow, slush, ice vs. none)	0.65	0.52	0.81
Intersection (intersection vs. none)	0.64	0.53	0.77
Intersection (parking lot vs. intersection)	0.33	0.17	0.63

4. Discussion

In both the young driver dataset and the departure from lane dataset, excessive speed was among the most commonly cited contributing factor to crashes. As mentioned earlier, all variations of excessive speed were combined into a single factor in these tables (Tables 2-5). The three logistic regression models determined many of the same effects to be significant in contributing to the likelihood of young driver fault, young driver crash severity, and departure from lane crash severity. Again, in many of these effects, especially the severity models, speed was a common underlying factor. This is an important finding because countermeasures exist to address speeding, including reduced speed limits and increased enforcement. Further analysis could address the exact location of these severe crashes to facilitate such measures.

One factor that had somewhat contrasting effects among models was pavement (not paved vs. paved). In the departure from lane model, unpaved roads decreased the likelihood of a severe crash by 21% while pavement was the most influential factor in the young driver fault model, increasing the odds of a young driver being at fault by 2.47 times. Pavement was not a significant factor in the young driver severity model.

Departure from lane

The two severity models (departure from lane and young driver) yielded similar results, with road curvature and road surface conditions emerging as important factors in both models. In the departure from lane model, gender was determined to be a significant factor, with women being 20% less likely to be involved in a severe crash.

An initial goal of this research was to address distracted driving and technology-related distractions. Inattention was cited as a contributing factor in nearly 8% of departure from lane crashes, thus this factor may merit further study. Inattention was more commonly cited in the departure from lane dataset than the young driver dataset, suggesting that inexperience rather than distraction is a greater factor in young driver crashes.

Despite research showing that technology-related distractions (cell phone use, texting, etc.) can significantly impair driving ability (Blomberg et al. 2005), technology-related distractions were only referenced as a contributing factor in 0.5% of total reported crashes in this study, suggesting that either this factor is under-reported or simply not a major cause of crashes in the state. If crash rates decline following the recent passage of legislation banning texting while driving in Vermont, and banning all electronic devices for junior operators, this might provide some evidence that technology-related distractions are an important factor in road safety. As discussed earlier, there are few direct, effective countermeasures that can be taken to address distracted driving in general.

Young drivers

Our analysis revealed that the youngest drivers (those under 17 years) were involved in a disproportionately high number of fatal crashes. Further, young driver crashes were 11% more likely to be fatal crashes. The majority of young drivers were carrying no passengers at the time they crashed, although passenger presence affected likelihood of fault as expected: the presence of a passenger under 21 years old substantially increased the likelihood of young driver fault relative to the presence of an older passenger. This result is in contrast somewhat to those of Padlo et al. (2005) who found the number of passengers to be more influential than passenger age, and report a positive association between total number of passengers and likelihood of young drivers to be at fault. We did not test directly the effect of total number of passengers on likelihood of young driver fault in part due to small sample size.

Padlo et al. (2005) also reported that 60% of young drivers were driving alone when they crashed, while in Vermont, 75% of young drivers were driving alone. This difference may be due to the fact that the graduated license program had not yet been implemented in Connecticut in the years analyzed in the Padlo at al. study. Similar to Padlo, the majority of passengers riding with young driver in this Vermont study were under 21 years.

In the young driver severity model, as in the departure from lane severity model, horizontal road curvature and road surface conditions had the greatest impact on crash severity. However, although young male drivers were more likely than young female drivers to be involved in fatal or incapacitating crash, gender did not significantly affect this probability.

Graduated license programs, such as the one in Vermont, have been shown to be one of the most effective means of reducing young driver crashes. These programs have strict regulations regarding drug and alcohol violations and other traffic violations. At present in

Vermont, drivers under 18 years are limited in the type and number of passengers that they can carry, and the type of driving that they are allowed to do (e.g., not for employment).

Further study

We are currently seeking access to confidential crash data from the Vermont DMV, including exact crash location derived from GPS data and further information on driver attributes. Driver attributes of interest include home address, which would allow us to determine distance to the crash location, and previous involvement in crashes. For young drivers we also intend to examine the length of time between date of license issue and crash date. More information about these drivers in addition to the crash circumstance will allow for more powerful analysis and better policy recommendations.

When scaled to VMT, young driver crash rates are highest in Chittenden and Rutland counties and departure from lane crash rates were highest in Lamoille and Windsor counties. Furth study could explore what geographic and demographic factors contribute to these patterns.

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