

**Graduated Driver Licensing Laws and
Insurance Collision Claim Frequencies
of Teenage Drivers**

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ABSTRACT

Objectives. This study examined the effect of different graduated driver licensing (GDL) laws on collision claim frequencies of licensed and insured teenage drivers.

Method. Automobile insurance collision claim frequencies were computed by year (1996-2008) and state for drivers ages 16-19. Poisson regression models were used to estimate the effect of GDL laws on claim frequencies. The claim frequency for drivers ages 35-55 was used as a covariate to control for non-GDL state and year variation in motor vehicle crashes.

Results. Compared with GDL laws rated poor, laws rated good reduced collision claim frequencies of 16 year-olds by an estimated 20 percent. Laws rated fair and marginal reduced claim frequencies by 15 and 10 percent, respectively. Claim frequencies also were reduced for older teenage drivers, although to a smaller extent. Analyses of GDL components showed increasing license age, requiring practice driving, restricting passengers to one or fewer, and a strong nighttime driving restriction significantly reduced claim frequencies of 16-year-old drivers.

Conclusions. GDL laws are reducing collision claim frequencies of young drivers, and stronger laws are having larger effects.

INTRODUCTION

Young drivers have collision claim frequencies approximately double those of drivers ages 35-55.¹ The higher crash rates among young drivers result from both immaturity and lack of driving experience. Teenagers have particularly high crash rates during their first months of licensure.^{2,3} Collision risks are especially high at night and when carrying passengers.⁴⁻¹⁰ To reduce the high collision rates among young drivers, many states have adopted graduated driver licensing (GDL) programs. GDL is designed to delay full licensing while allowing beginning drivers to gain experience under lower risk conditions. There are three stages of GDL: learner, intermediate, and unrestricted. During the learner stage, a person may drive only while supervised by a licensed driver. Before obtaining a driver's license, a person in the learner stage may be required to hold the permit for a minimum length of time and/or complete a minimum number of hours practicing driving. The intermediate stage begins with passing the driving test. All states have minimum age restrictions for a driver's license. During the intermediate stage,

there may be restrictions on nighttime driving and/or restrictions on the number of passengers. The length of these restrictions can be a function of time (e.g., 6 months) or age (e.g., until age 17). At the completion of the restrictions, the person enters the unrestricted stage.

Florida is credited with enacting the first GDL program in the United States beginning July 1996. Since that time numerous studies have been conducted on the effectiveness of GDL. Shope evaluated 27 recent GDL studies and found typical reductions ranging from 20 to 40 percent for young drivers.¹¹ Studies based on licensed drivers had smaller reductions than those based on population.

In the current study, collision claim frequencies of young drivers were related to the strength of state graduated licensing laws and to individual GDL provisions. Results expanded on earlier studies both in determining which GDL components are most effective in reducing claim frequencies and in using the metric collision claim frequency. Using insured driver claim frequency, as opposed to a population-based crash rate, means the subject group contained only licensed drivers.

METHODS

Data Source

The Highway Loss Data Institute (HLDI) is a nonprofit research organization that gathers and analyzes automobile insurance coverage and loss data. Twenty-nine insurers currently supply data to HLDI. These insurers account for approximately 80 percent of privately insured passenger vehicles. Collision insurance covers first party physical damage to a vehicle from a crash and can be from a single- or multiple-vehicle crash. Minor crashes that do not exceed the insured driver's deductible are not included because no payment would be made. Claim frequency is computed by taking the ratio of the number of claims (crashes) for a group to the amount of exposure for the group. Exposure is the amount of time an individual vehicle is insured. For example, if vehicle A was insured for 6 months and vehicle B was insured for 12 months, they would combine for 1.5 insured vehicle years of exposure.

Collision claim frequencies were computed by state and calendar year (1996-2008) for 0-3-year-old passenger vehicles. Only newer vehicles were used due to data availability. All states except Massachusetts and New Jersey were included. These two states were excluded due to incomplete data. The combination of 48 states and 13 calendar years produced 624 observations. A GDL law was assigned to a state-year if the law went into effect before October 1 of that year. Laws going into effect

October 1 or later were assigned to the following year. A fourth quarter cutoff was used because laws going into effect late in the year were expected to have little or no effect on that calendar year's results.

Driver age in these analyses was the age of the driver assigned to a vehicle by the insurer. This driver is the one who typically, for insurance purposes, is considered to represent the greatest loss potential for the insured vehicle. Although this is generally the primary driver of the vehicle, the actual driver at the time of the crash is unknown (the information is not available in the HLDI database). Also, because only the year of birth is provided to HLDI, the exact age of the rated driver is unknown. A January 1 birth date was assumed, resulting in a 2-year range in the actual age for a given rated driver. For example, the assigned age of 16 in this study includes teenager ages 15 and 1 day to 16 and 364 days. Similarly, the assigned age of 17 includes teenager ages 16 and 1 day to 17 and 364 days, and so on. These issues contribute some imprecision in the estimated crash rates, but it is anticipated that this imprecision is distributed across all states and unrelated to specific licensing provisions.

State GDL Laws

The provisions of GDL laws vary significantly by state. Some states have enacted many GDL provisions (i.e., California added a 6-month holding period, 50 hours of practice driving, a midnight nighttime restriction, and no passengers for the first 6 months in 1998). Other states have enacted minimal GDL restrictions (i.e., North Dakota added a 6-month holding period in 1999). State GDL components vary not only in their presence or absence but also in their strength. For example, the 1 a.m. nighttime restriction in Missouri would not be expected to have the same impact as the 9 p.m. restriction in North Carolina.

These variations in laws have been summarized in a rating system by the Insurance Institute for Highway Safety (IIHS), which assigns a rating of good, fair, marginal, or poor depending on the number and strength of the GDL provisions.¹² Table 1 lists the GDL components and their corresponding points. A detailed list of the state GDL laws is available on the IIHS website (<http://www.iihs.org>).

Table 1 Ratings of State Graduated Licensing Systems

Graduated Licensing Law	Requirement	Points
Permit age	16 or older	1 point
	less than 16	0 points
Permit holding period	6 or more months	2 points
	3-5 months	1 point
	less than 3 months	0 points
Required practice hours	30 or more hours	1 point
	less than 30 hours	0 points
Restriction on night driving	10 pm or earlier	2 points
	after 10 pm	1 point
	no restriction	0 points
Restriction on number of passengers	1 or fewer passengers	2 points
	2 passengers	1 point
	3 or more passengers	0 points
Duration of night restriction	12 months or more from minimum licensing age	1 point
	less than 12 months	0 points
Duration of passenger restriction	12 months or more from minimum licensing age	1 point
	less than 12 months	0 points
Graduated Licensing Rating	Points	
Good	6 or more points	
Fair	4-5 points	
Marginal	2-3 points	
Poor	less than 2 points	

Notes: Regardless of point totals, no state was rated above marginal if licensing age could be younger than 16 or it allowed unrestricted driving before age 16, 6 months.

Where completion of driver education changed a requirement, point values were determined for the driver education track.

Analysis Methods

Poisson regression was used to model the effect of GDL on the collision claim frequencies of young rated drivers. This method was selected because claim frequencies have a skewed distribution, are never negative, and follow a Poisson process (the number of times an event occurs in a fixed period of time; in this case, the number of claims occurring in an insured vehicle year). The analyses were run in SAS using the PROC GENMOD procedure with a log link function.

In estimating the overall relationship between strength of state GDL provisions and teenage crashes, the IIHS ratings were used as the independent variable, with the rating of poor as the reference value. Analyses were run for assigned ages of 16, 17, 18, 19, 16-17, and 16-19. Effects of GDL on older

teens (18-19 years) were analyzed in two ways: with law effective dates identical to those of younger teens and with law effective dates delayed by 2 and 3 years (for 18 and 19 year-olds, respectively). This lagging of 2-3 years corresponds to the time when 18-19 year-olds who had been under GDL provisions would have graduated from the restrictions. The first regression looked for any change in risk to older teen as younger teens became subject to GDL, including the possibility of increased crash risk from substitute driving for younger teens whose own driving was delayed by GDL. The second set of analyses looked for long-term effects of GDL, including the possibility that delayed experience with risky driving situations might increase older teens' crash risk when they graduated from GDL.¹³

In a second set of analyses, estimating the specific effects of different GDL components, minimum permit age, holding period, practice hours, license age, nighttime restrictions, and passenger restrictions were entered as independent variables predicting teenage crashes. For passenger restriction, "no restriction or 2+ passengers" was used as the reference value. All other variables were treated as continuous. Nighttime driving restriction was measured in the number of restricted hours with 5 a.m. set as the morning cutoff. For example, a nighttime driving restriction of 1 a.m. was coded as 4 hours, and a nighttime driving restriction of 10 p.m. was coded as 7 hours of restriction. No restriction was coded as 0 hours. These analyses were produced only for the ages most affected by GDL: 16, 17, and 16-17.

All models included the collision claim frequency of rated drivers ages 35-55 as a covariate to control for non-GDL state and time period factors such as long-term trends in collision claim frequencies, changes in companies comprising the insurance database, and differing patterns by state due to economic trends, weather, or non-GDL laws. Ages 35-55 were selected as the control because it provided a large stable group that was sufficiently separated from young and senior rated drivers (both groups having high collision claim frequencies). Using state and calendar year variables in the model as opposed to the covariate was considered but rejected for several reasons. A calendar year variable would assume uniform changes across time for each state and hence would not account for unique state variations such as changes in speed limits or severe weather. A state variable would diminish the effect of GDL laws that are present through most or all of the study period such as New York's 9 p.m. nighttime driving restriction.

RESULTS

Effect of State GDL Ratings on Collision Claim Frequencies

The predicted percentage change in collision claim frequencies for good, fair, and marginal GDL ratings compared to poor ratings are shown in Table 1. The percentages were computed from Poisson regression analyses parameter estimates and their corresponding 95 percent confidence intervals. All of the percentages are statistically significant ($p < 0.05$).

Table 2 Percent Change in Collision Claim Frequencies (95% Confidence Interval) Compared to Poor GDL Ratings based on Poisson Regression Analyses of State GDL Ratings, 1996-2008

Rated Driver Age	State GDL Rating			
	Good	Fair	Marginal	Poor
16	-19.8 (-23.9,-15.4)	-15.5 (-19.2,-11.5)	-9.9 (-14.8,-4.7)	0.0
17	-12.6 (-15.7,-9.4)	-10.6 (-13.4,-7.6)	-8.3 (-12.0,-4.5)	0.0
18	-10.1 (-12.8,-7.4)	-7.8 (-10.3,-5.3)	-5.3 (-8.5,-2.1)	0.0
19	-7.4 (-9.7,-5.0)	-5.4 (-7.5,-3.1)	-5.1 (-7.7,-2.3)	0.0
16-17	-15.2 (-18.3,-12.0)	-12.4 (-15.3,-9.4)	-8.9 (-12.6,-5.0)	0.0
16-19	-10.7 (-13,-8.3)	-8.3 (-10.5,-6.0)	-6.3 (-9.0,-3.5)	0.0

Note: State GDL Ratings are from the Insurance Institute for Highway Safety and are based on the number and strength of state GDL laws. Rated driver age is the age of the driver assigned to a vehicle for insurance purposes. Although this person is typically the primary driver of the vehicle, the actual age of the driver at the time of the crash is unknown.

In each age group, good ratings had the largest percentage change from poor ratings. Rated drivers age 16 with good GDL ratings had the greatest estimated decrease in claim frequencies of 20 percent. The effect of GDL decreased as age increased, with estimated reductions for good GDL ratings of 13 percent for age 17, 10 percent for age 18, and 7 percent for age 19. When the crash risk for 18 and 19 year-olds was re-examined with law effective dates lagged to reflect when they had graduated from GDL, results were similar to those shown in Table 2: crash risk was lower for stronger GDL laws (table not shown).

Effectiveness of Individual GDL Components

Poisson regression analyses were run using collision claim frequency for ages 16, 17, and 16-17 as the dependent variable and the individual GDL components (permit age, holding period, practice hours, licensing age, nighttime restrictions, and passenger restrictions) as the independent variables. The predicted percentage change in collision claim frequencies based on the Poisson regression results are shown in Table 3.

Table 3 Percent Change in Collision Claim Frequencies (95% Confidence Interval) based on Poisson Regression Analyses of GDL Components, 1996-2008

GDL Component	Rated Driver Age		
	16	17	16-17
Increasing permit age by 3 months	-0.9 (-2.1,0.2)	-0.7 (-1.6,0.1)	-0.8 (-1.7,0.0)
Increasing permit age by 6 months	-1.9 (-4.2,0.5)	-1.5 (-3.1,0.3)	-1.7 (-3.4,0.0)
Increasing permit age by 12 months	-3.7 (-8.2,1.0)	-2.9 (-6.2,0.5)	-3.3 (-6.6,0.1)
Increasing required practice driving by 20 hours	-7.3 (-9,-5.6)	-4.5 (-5.6,-3.3)	-5.3 (-6.6,-4.1)
Increasing required practice driving by 40 hours	-14.1 (-17.1,-11.0)	-8.8 (-11.0,-6.6)	-10.2 (-12.7,-8.1)
Lengthening permit holding period by 3 months	3.6 (1.7,5.5)	2.5 (1.2,3.8)	2.7 (1.4,4.0)
Lengthening permit holding period by 6 months	7.3 (3.5,11.2)	5.0 (2.4,7.7)	5.5 (2.8,8.2)
Increasing license age by 3 months	-2.4 (-4.5,-0.2)	-0.7 (-2.3,0.9)	-1.3 (-2.9,0.3)
Increasing license age by 6 months	-4.7 (-8.9,-0.4)	-1.4 (-4.6,1.9)	-2.6 (-5.7,0.7)
Increasing license age by 12 months	-9.2 (-17,-0.7)	-2.8 (-8.9,3.8)	-5.1 (-11.1,1.4)
Setting a nighttime restriction of midnight	-7.5 (-11,-3.9)	-3.9 (-6.5,-1.2)	-5.1 (-7.7,-2.5)
Setting a nighttime restriction of 11 pm	-9.0 (-13.1,-4.7)	-4.7 (-7.7,-1.5)	-6.1 (-9.2,-3.0)
Setting a nighttime restriction of 10 pm	-10.4 (-15.1,-5.4)	-5.4 (-9,-1.7)	-7.1 (-10.6,-3.4)
Setting a nighttime restriction of 9 pm	-11.8 (-17.1,-6.2)	-6.2 (-10.2,-2)	-8.1 (-12,-3.9)
Setting a restriction of 1 or fewer passengers	-6.3 (-9.7,-2.8)	-4.0 (-6.3,-1.6)	-4.8 (-7.2,-2.4)

Note: Rated driver age is the age of the driver assigned to a vehicle for insurance purposes. Although this person is typically the primary driver of the vehicle, the actual age of the driver at the time of the crash is unknown. Nighttime restriction is based on the length of restriction assuming a 5 a.m. cutoff. Passenger restriction uses 2 or more passengers (including no restriction) as the reference value.

Required practice driving, nighttime restrictions, and passenger restrictions significantly ($p=0.05$) reduced claim frequencies for ages 16 and 17. Increasing the licensing age significantly reduced frequencies for age 16 but not age 17. Increasing the permit age reduced the collision risk but was not significant. Increasing the holding period proved counterproductive, with results showing an increase in claim frequencies. The increase for holding period may be a statistical artifact resulting from the relationship of holding period to permit age, licensing age, and required practice driving. Graduated licensing had a larger effect for drivers age 16 than age 17 as expected.

DISCUSSION

Earlier studies have shown the effectiveness of GDL in reducing teenage crash risk by roughly 20 to 40 percent.¹¹ Results from this study confirm the benefits of GDL. States with the strongest laws (those rated good by IIHS) have reduced insurance collision claim frequencies by 20 percent among 16 year-olds, compared to states with the weakest laws (those rated poor). The reductions shown for marginal ratings indicate that even weak GDL laws reduce crash risk somewhat among licensed teens.

Crash risk was reduced for 18 and 19 year-olds as well. The reductions estimated concurrent with the introduction of stronger restrictions on younger teens were unexpected but could reflect the fact that fewer high-risk 16-17 year-olds are driving vehicles insured for their older siblings. The reductions estimated when law effective dates were lagged suggest that some of the benefits of GDL extend to drivers after they graduate from GDL.

Crash risk reduction for 16 year-olds in this study is smaller than the 41 percent reduction found in a nearly identical study using fatal crash involvements.¹⁵ The difference in findings are likely due to the study population and metric used. The current study is one of the few to focus on insurance claims. Insurers see many low-severity crashes that are never reported to police and hence would have been excluded from most previous research. The smaller benefits estimate may indicate that GDL is having a greater benefit for the more serious crashes (e.g., those happening at night and with teenage passengers where serious injury and fatality are more likely) than it is for the more numerous everyday crashes that tend to dominate insurance claims data (e.g., front to rear commuter crashes). It is to be expected, then, that insurers may see smaller benefits from GDL programs than suggested by the reductions in injury and fatal crashes.

Another substantive difference between this study and most others is that, because teenagers must be licensed to be insured drivers, this study is inherently an examination of GDL's effect on licensed drivers, not on the teenage population as a whole. Using only licensed drivers allows this study to isolate the safer driving practices effect of GDL from any reduced exposure effects due to delayed licensure. In other words, the reductions in collision claim frequencies seen in this study are due purely to safer driving, not due in part to fewer teenagers licensed to drive. In contrast, population-based studies are estimating the combined effects of safer driving practices and delayed licensure. Shope found that reductions in crash risk per driver were smaller than per teenage population; the crash reduction estimated for good GDL laws here (20 percent) is impressive in that context.¹¹

The second group of analyses confirmed that most of the GDL components that have been thought to contribute to effective GDL programs do indeed reduce the crash risk of licensed teenage drivers. Higher learner's permit and driver's license ages, required practice hours during the learner period, and restrictions on nighttime driving and teenage passengers all were associated with lower crash

risk for 16-year-old drivers, although the effect for learner's permit did not attain traditional levels of statistical reliability. The single exception is that having a mandatory holding period for the learner's permit did not reduce risk for teenagers once they were licensed. In fact, once any effect of the holding period on minimum licensure age had been taken into account, increasing the mandatory holding period was associated with a statistically significant increase in crash risk for teenage drivers. This is an unexpected finding. Even if a mandatory holding period does not change the minimum age at which a license can be obtained, it could still delay licensure for teenagers who neglected to obtain the learner's permit in time. This could mean fewer teens licensed at the minimum age, so that the average teen is a little older and a little less crash-prone. A longer holding period also means there is more time for the teen to gain supervised experience in driving, experience that also could reduce risk once licensed. Whatever the explanation, these results indicate that longer mandatory permit holding periods have no benefit beyond their implicit effect on the minimum licensure age.

There were some limitations to this study. Using rated driver age as opposed to actual driver age results in some insurance coverage and claims assigned to an incorrect age. It is impossible to know the extent of this problem, but similar data have been shown to produce expected age relationships in other analyses. For example, other HLDI studies have consistently found higher collision claim frequencies for the youngest and oldest rated drivers.^{1,16,17,18,19} Only knowing the year of birth also introduces some uncontrolled variation in the analyses, but this imprecision would not be expected to bias the analysis of GDL components in any way. Moreover, including younger drivers in an age group (i.e., assigned age of 16 includes 15 and 16 year-olds) would not adversely impact the overall results because the younger drivers would be subject to the same or more GDL provisions. Finally, collision data were available historically only on relatively new vehicles, but analysis of older vehicle data in calendar years 2005-06 found nearly identical relative claim frequencies by rated driver age for vehicles up to 9 years old.¹

In conclusion, states could do well to examine their current GDL provisions and align them more closely with the strongest provisions. Each of the provisions studied, with the exception of mandatory learner's permit holding period, confer independent and additive effectiveness to GDL laws. Contrary to some hypotheses that GDL might increase risk among older teenagers, these analyses found GDL benefits extended into the later teens.^{13,14}

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