



Associations Between Selected State Laws and Teenagers' Drinking and Driving Behaviors

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Background: We examined the associations between selected state-level graduated driving licensing (GDL) laws and use-and-lose laws (laws that allow for the suspension of a driver's license for underage alcohol violations including purchase, possession, or consumption) with individual-level alcohol-related traffic risk behaviors among high school youth.

Methods: Logistic regression models with fixed effects for state were used to examine the associations between the selected state-level laws and drinking and driving behaviors youth aged 16 to 17 years (obtained from the Youth Risk Behavior Surveillance System (YRBSS); responses dichotomized as "0 times" or "1 or more times") over an extended period of time (1999 to 2009).

Results: A total of 11.7% of students reported having driven after drinking any alcohol and 28.2% reported riding in a car with a driver who had been drinking on 1 or more occasions in the past 30 days. Restrictive GDL laws and use-and-lose laws were associated with decreased driving after drinking any alcohol and riding in a car with a driver who had been drinking alcohol.

Conclusions: Restrictive GDL and use-and-lose laws may help to bolster societal expectations and values about the hazards of drinking and driving behaviors and are therefore partly responsible for the decline in these alcohol-related traffic risk behaviors.

Key Words: Drinking and Driving, Policy, Teenage Risk Behaviors.

TEENAGE DRIVERS ARE overrepresented in motor vehicle-related accidents and fatalities in this country (Shope and Bingham, 2008). In fact, motor vehicle accidents are the leading cause of death among people aged 13 to 19 years (Shope, 2010; Shope and Bingham, 2008). Teenage drivers make up less than 5% of the total licensed drivers but comprise 20% of all motor vehicle crashes (NHTSA, 2009). In addition, nearly 5,500 vehicle-related deaths and 20,000 vehicle-related hospitalizations occur among teenagers each year (Centers for Disease Control and Prevention, 2010, 2011).

In an effort to lessen the high collision rates among teenage drivers, many states have adopted graduated driving licensing (GDL) laws (Karaca-Mandic and Ridgeway, 2010). GDL laws consist of supervised driving, driver education, restrictions on the number of passengers, restrictions on

nighttime driving, and stipulations on the duration of restrictions for young, newly licensed drivers (Hedlund and Compton, 2005; Shope and Molnar, 2003). An optimal GDL system, as defined by the Insurance Institute for Highway Safety (IIHS; 2011), provides a permit to a driver at age 16 or older, sets a learning stage for 6 months with a parent certifying at least 30 hours of supervised driving, and stipulates that an intermediate state of driving will last until age 18 with strict night driving and passenger restrictions (i.e., curfew at 9 or 10 PM and ≤ 1 passenger allowed).

GDL laws are meant to enable novice drivers to gain experience in less risky driving situations while advancing toward full licensure (Hedlund and Compton, 2005). Beginning with Florida in 1996, GDL laws have been implemented in all U.S. states and many studies suggest that GDL laws are associated with fewer motor vehicle fatalities among teenage drivers (Dee et al., 2005; Foss et al., 2001; Masten et al., 2011; Morrissey and Grabowski, 2006; Shope et al., 2001). For instance, restrictive GDL laws were associated with substantial reductions in teenage fatal crashes (30% lower) when compared against lenient GDL laws (McCartt et al., 2010). Furthermore, a review of 27 recent GDL studies report that drivers' crash risk was reduced by approximately 20 to 40% because of GDL laws (Shope, 2007). On the contrary, GDL programs have been found to adversely affect fatal crash rates among 18-year-old drivers, who are not directly subject to GDL laws (Masten et al., 2011). Thus, further investigation is needed to better understand the actual mechanisms through which these reductions are accomplished. One intriguing question is if the change behind the crash reduction is a decrease in

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alcohol-related driving risk behaviors. Drinking and driving greatly increases the risk for motor vehicle accidents among teenagers and is a relatively common occurrence despite that all states now have 21-year-old minimum drinking age laws. For example, in 2008, nearly 25% of teenage drivers who died in motor vehicle accidents had a blood alcohol concentration (BAC) of 0.08 g/dl or higher (considered to be alcohol-impaired) and 31% had detectable BAC (National Highway Traffic Safety Administration, 2008). Yet, no known studies have yet examined if GDL laws actually impact self-reported risk behaviors such as driving after drinking any alcohol and/or riding in a car with a driver who has been drinking alcohol.

Like GDL laws, use-and-lose laws might also impact the driving risk behaviors of youth. Initiated in the mid-1980s, use-and-lose laws allowed for the suspension of the driver's license for 30 days to as much as 5 years for underage alcohol violations (i.e., purchase, possession, or consumption of alcohol) (Alcohol Policy Information System, 2011). Disabling the driving behaviors of youth caught using alcohol (or other substances) was the selected punishment given the common viewpoint that driving is an important step toward gaining independence. A potential consequence of use-and-lose laws might be the lowering of alcohol-related driving risk behaviors due in part to convicting youth who are likely to engage in driving after drinking alcohol. In the 1 known study on this topic, use-and-use laws were found to be associated with a significant 5% reduction in underage drinking drivers in fatal crashes (Fell et al., 2009).

It may be useful to understand how GDL and use-and-lose laws are associated with the driving behaviors of youth.

Accordingly, our goal was to study the impact of GDL and use-and-lose laws that potentially address the driving risk behaviors of youth. Specifically, the primary purpose of this study was to examine the associations between the GDL laws and use-and-lose laws and 2 alcohol-related traffic risk behaviors among high school youth—namely, driving after drinking any alcohol and riding in a car with a driver who has been drinking alcohol. We utilized data from 45 states and over an extended period of time (1999 to 2009).

MATERIALS AND METHODS

To rate the multidimensional state licensing regulations of GDL laws, we utilized an existing scoring system developed by the IIHS. The IIHS system assigns a rating of good, fair, marginal, or poor depending on the number and strength of the GDL provisions (Fell et al., 2008). In particular, the ratings give credit for strong or optimal restrictions on the initial license phase and restrictions lasting well beyond the 16th birthday. A detailed list of the state GDL laws is available on the IIHS web site (<http://www.iihs.org>).

We also utilized an existing rating system that assigned points to use-and-lose state laws. Scores ranged from 0 (no use-and-lose law) to 8 (license sanction is mandatory for all 3 violations—purchase, possession, and consumption; minimum length of license suspension is 91+ days, and law applies to all individuals under 21 years of age) (Fell et al., 2008). The primary source of data for use-and-lose state laws in the United States is the National Institute on Alcohol Abuse and Alcoholism Alcohol Policy Information System data set (1999 to 2009). Additional details of the use-and-lose scoring system are published elsewhere (Fell et al., 2008) and summarized in Table 1.

The individual-level alcohol-related traffic risk behaviors for 1999 to 2009 were from the state-level Youth Risk Behavior Surveillance System (YRBSS). Each state that participates in the YRBSS

Table 1. Scoring System of Graduated Driving Licensing Laws and Use-and-Lose Laws

I. Graduated driving licensing laws (IIHS, 2011):

This law consists of supervised driving, driver education, restrictions on the number of passengers, restrictions on nighttime driving, and stipulations on the duration of restrictions for young, newly licensed drivers*

Learner's entry age	1 point for learner's entry age ≥ 16
Learner's holding period	2 points for ≥ 6 mo; 1 point for 3 to 5 mo; none for < 3 mo
Practice driving certification	1 point for ≥ 30 hr; none for less than 30 hr
Driver education	Where completion of driver education changed a requirement, point values were determined for the driver education track.
Passenger restriction	2 points for ≤ 1 underage passenger; 1 for 2 passengers; none for 3; where supervising driver may be < 21, point values were determined including the supervising driver as a passenger
Night driving restriction	2 points for 9 or 10 PM; 1 point for after 10 PM
Duration of restrictions	1 point if difference between minimum unrestricted license age and minimum intermediate license age is 12 or more months; night driving and passenger restrictions were valued independently

II. Use-and-lose laws (Fell et al., 2008):

This law allows for the suspension of the driver's license for underage alcohol violations (i.e., purchase, possession, or consumption of alcohol).

License sanction applicable to underage:	+2.0 points if mandatory; +1.0 point if discretionary for each violation
a) purchase	
b) possession	
c) consumption	
Upper age limit <21	-1.0 point
Minimum length of suspension	0 points for \leq 30 days; +1.0 point for 31 to 90 days; +2.0 points for \geq 91 days

Scores range from good (≥ 6 points), fair (4 or 5), marginal (2 or 3), to poor (≤ 2 points).

*Regardless of point totals, no state was rated above "marginal" if intermediate license holders could be younger than 16 or if it allowed unrestricted driving before 16 years 6 months.

Scores range from 0 (no use-and-lose law) to 8.0 (license sanction is mandatory for all 3 violations—purchase, possession, and consumption; minimum length of license suspension is 91+ days, and law applies to all minors).

Table 2. Demographic and State Policy Variables by Risky Drinking and Driving Behaviors

Variable	Percentage driving after drinking alcohol ^{a,b}			Percentage riding in a car with a driver who had been drinking alcohol ^{a,b}		
	Total N = 221,362	No N = 193,333	Yes N = 28,029	Total N = 212,856	No N = 152,113	Yes N = 60,743
Gender						
Male	50.3	48.9	60.6	50.6	50.3	51.3
Female	49.7	51.1	39.5	49.4	49.7	48.7
Race/ethnicity						
Caucasian	64.2	63.2	71.5	64.0	64.7	62.1
African-American	17.3	18.4	10.0	17.7	18.0	16.9
Hispanic	13.2	13.2	13.2	13.2	12.2	15.8
Asian	1.6	1.7	1.0	1.5	1.6	1.1
Other	3.6	3.5	4.3	3.6	3.4	4.1
Age (years)						
16	52.9	54.2	43.2	52.8	53.4	51.4
17	47.2	45.8	56.8	47.2	46.6	48.6
GDL						
Poor	11.0	10.5	15.0	11.3	10.2	14.0
Marginal	10.3	10.0	11.8	10.6	10.5	10.6
Fair	38.2	38.1	39.1	40.5	40.2	41.4
Good	40.5	41.4	34.1	37.7	39.1	34.1
Use-and-lose						
0	30.4	30.6	28.8	27.3	27.7	26.1
1 to 2	3.9	3.8	4.4	3.3	3.1	3.8
3 to 4	32.3	32.5	31.1	33.1	33.9	31.1
5 to 6	25.5	25.0	28.5	28.1	26.9	31.2
7 to 8	7.9	8.0	7.2	8.2	8.3	7.9

^aPercentages are weighted.^bParticipants are asked if they engaged in the behavior at least once in the last 30 days.**Table 3.** Associations of State Policies with 2 Alcohol-Related Traffic Risk Behaviors

Variable	Driving after drinking alcohol ^a	Riding in a car with a driver who had been drinking alcohol ^a
	Multivariable adj OR (95% CI)	Multivariable adj OR (95% CI)
GDL		
Poor	1.54 (1.39 to 1.71)***	1.34 (1.24 to 1.45)***
Marginal	1.13 (0.96 to 1.33)	1.04 (0.93 to 1.18)
Fair	1.19 (1.08 to 1.32)**	1.06 (0.99 to 1.14)
Good	1.0	1.0
Use-and-lose		
0	1.75 (1.25 to 2.44)**	1.25 (1.00 to 1.56)*
1 to 2	1.55 (1.06 to 2.25)*	0.99 (0.76 to 1.29)
3 to 4	1.68 (1.17 to 2.40)**	1.07 (0.83 to 1.38)
5 to 6	1.54 (1.11 to 2.14)**	1.11 (0.90 to 1.38)
7 to 8	1.0	1.0
Gender		
Male	1.62 (1.55 to 1.69)***	1.04 (1.01 to 1.07)*
Female	1.0	1.0
Race/ethnicity		
Caucasian	1.0	1.0
African-American	0.47 (0.44 to 0.51)***	0.96 (0.91 to 1.01)
Hispanic	0.84 (0.78 to 0.91)*	1.24 (1.17 to 1.30)***
Asian	0.50 (0.43 to 0.59)***	0.70 (0.63 to 0.77)***
Other	1.04 (0.96 to 1.13)	1.23 (1.16 to 1.31)***
Age (years)		
16	0.64 (0.61 to 0.66)***	0.92 (0.89 to 0.95)***
17	1.0	1.0

adj OR, adjusted odds ratio.

^aParticipants are asked if they engaged in the behavior at least once in the last 30 days.**p* < 0.05, ***p* < 0.01, ****p* < 0.001.

employs a 2-stage, cluster sample design to produce representative samples of students in grades 9 to 12 in their jurisdiction (Grunbaum et al., 2004). Most state samples include only public schools. State surveys that have a scientifically selected sample, appropriate documentation, and an overall response rate >60% are weighted. A weight is applied to each record to adjust for student nonresponse and the distribution of students by grade, gender, and race/ethnicity in each state. Upon receiving permission from state representatives, we obtained weighted data from the Center for Disease Control (CDC) for 1999 to 2009 (6 YRBSS years: 1999, 2001, 2003, 2005, 2007, and 2009) for 45 states. The 5 states for which data were not available included California, Minnesota, Oregon, Virginia, and Washington. Data were available for 11 states for all 6 years, 8 states for 5 years, 11 states for 4 years, 7 states for 3 years, 5 states for 2 years, and 3 states for 1 year. We matched individual-level behavior data with state-level policy data for the pertinent year.

Individual-level alcohol-related traffic risk behaviors were the outcomes of interest and were obtained from the following state YRBSS items: (i) "During the past 30 days, how many times did you drive a car or other vehicle when you had been drinking alcohol?" and (ii) "During the past 30 days, how many times did you ride in a car or other vehicle driven by someone who had been drinking alcohol?" Responses to both items included "0 times," "1 time," "2 or 3 times," "4 or 5 times," and "6 or more times." Because we were interested in associations of state laws with even the minimum level of drinking and driving behavior, we dichotomized responses as "0 times" or "1 or more times."

Statistical Analysis

Logistic regression models were used to examine the associations between the selected state-level laws and the dichotomous drinking and driving behaviors, and fixed effects were included for state. We first examined the association between scores for each state policy

(GDL, use-and-lose) with each drinking and driving behavior in univariate analyses. We then ran a multivariable model that included both types of state policy (GDL and use-and-lose) and adjusted for student demographics (age, gender, and race/ethnicity). We restricted all analyses to students aged 16 to 17 years, because this is the legal age that many obtain a driver's license in most states. All analyses were conducted using SAS-callable SUDAAN (Research Triangle Institute, 2008) to account for the complex sample design of the YRBSS. Weights were applied in all analyses. $p < 0.05$ was considered significant.

RESULTS

The total number of participants was 221,362. Note, the sample sizes for riding in a car with a driver who has been drinking alcohol is slightly different because of missing data on this response. More information is provided in Table 2.

GDL laws became considerably more restrictive over time. In 1999, 51% of the states in our study had poor GDL laws and 4% had good GDL laws. By 2009, no state had poor GDL laws and over 56% had good GDL laws. Use-and-lose laws also increased in strength over time, but not to the same extent as GDL laws. In 1999, 40% of states in our study had a score of 0 for use-and-lose laws, 24% had a score of 3 to 4, and 9% had a score of 7 to 8. By 2009, 24% had a score of 0, 36% had a score of 3 to 4, and 13% had a score of 7 to 8 (see Figs 1 and 2).

Overall, 12.3% (95% confidence interval, 12.0 to 12.6%; $n = 28,029$) of students reported having driven after drinking any alcohol on 1 or more occasions in the past 30 days. Reports of having driven after drinking significantly decreased from 18.1% in 1999 to 10.1% in 2009 ($p < 0.001$; see Fig. 3). In addition, approximately 28.3% (95% CI, 27.9 to 28.6; $n = 60,743$) of students reported riding in a car with a driver who had been drinking on 1 or more occasions in the past 30 days. Reports of riding in a car with a driver who had been drinking significantly decreased from 34.7% in 1999 to 26.3% in 2009 ($p < 0.001$; see Fig. 3).

GDL laws and use-and-lose laws were significantly associated with driving after drinking any alcohol in the multivariable model, controlling for gender, race/ethnicity, and age (which was similar to univariate analysis). Specifically,

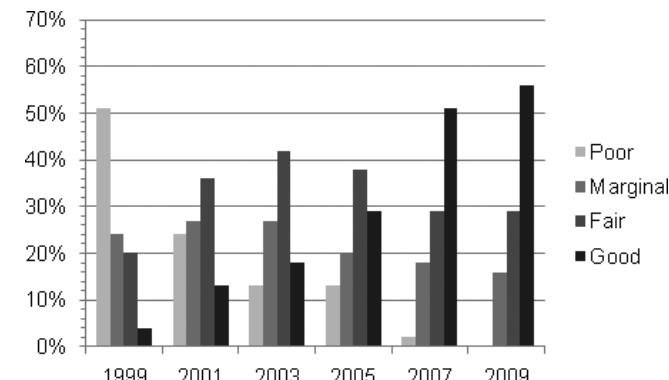


Fig. 1. State GDL grades from 1999 to 2009 (includes only the 45 states used in analysis).

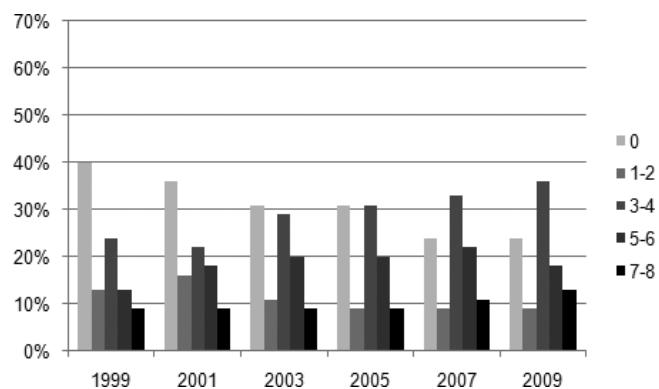


Fig. 2. State use-and-lose scores from 1999 to 2009 (includes only the 45 states used in analysis).

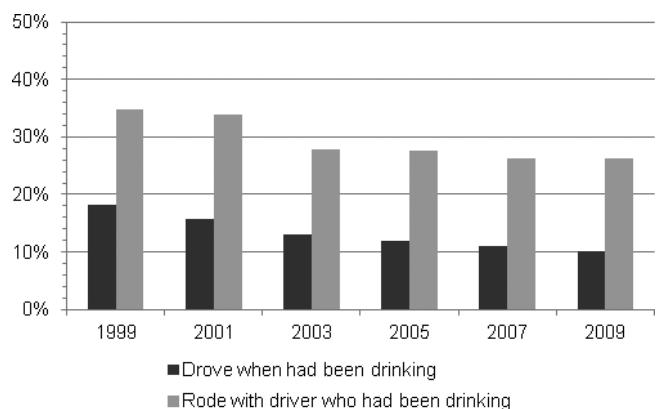


Fig. 3. Percent of students age 16 to 17 years old who engaged in risky driving and drinking behaviors from 1999 to 2009.

students in states with *poor* or *fair* GDL laws were associated with significantly more reports of driving after drinking any alcohol (adjusted odds ratio [adj OR], 1.54; 95% CI, 1.39 to 1.71 and adj OR, 1.19; 95% CI, 1.08 to 1.32, respectively) versus students in states with *good* GDL laws. Moreover, the adj OR was highest for students in states with *poor* GDL laws. In addition, students in states with the least restrictive use-and-lose laws (i.e., assigned 0, 1 to 2, 3 to 4, or 5 to 6 points) were significantly more likely to report driving after drinking any alcohol (adj OR, 1.75; 95% CI, 1.25 to 2.44; adj OR, 1.55; 95% CI, 1.06 to 2.25; adj OR, 1.68; 95% CI, 1.17 to 2.40; adj OR, 1.54; 95% CI, 1.11 to 2.14, respectively) versus the students in states with the most restrictive use-and-lose laws (i.e., assigned 7 to 8 points). See Table 3 for additional details.

In multivariable analysis (which was similar to univariate analysis), controlling for gender, race/ethnicity, and age, students in states with *poor* GDL laws were significantly more likely to report riding in a car with a driver who had been drinking on 1 or more occasions in the past 30 days (adj OR, 1.34; 95% CI, 1.24 to 1.45) versus students in states with *good* GDL laws. In addition, students in states with the least restrictive use-and-lose laws (i.e., assigned 0 points) were significantly more likely to report riding in a car with a driver who had been drinking (adj OR, 1.25; 95% CI, 1.00 to 1.56)

versus students in states with the most restrictive use-and-lose laws (i.e., assigned 7 to 8 points).

DISCUSSION

In the present study, a student in a state with the strongest GDL and use-and-lose laws would be approximately half as likely as a student in a state with the weakest GDL and use-and-lose laws to drive after drinking. The potential for reducing teen drinking and driving fatalities is an important implication. In 1999, the number of 16- to 20-year-old drivers in fatal crashes with a BAC of ≥ 0.08 was 1,357 (National Highway Traffic Safety Administration, 2009). In 2009, that number dropped to 960. Assuming that the reduction in teen drunk driving fatalities is proportional to the reduction in self-reports of drinking and driving, this number could have been reduced to 678 had all states adopted the strongest GDL and use-and-lose laws by 2009.

A potential explanation to our findings is that GDL laws have helped to indirectly promote safe driving norms. For instance, our findings may be due in part to driving curfews, which are a prominent feature of GDL laws and require teenagers to return home at a time when social activities that involve alcohol might be more apt to occur. Therefore, GDL laws might assist with inadvertently reducing teenagers' opportunities to partake in not only alcohol-related behaviors but drinking and driving risk behaviors. Whatever the cause, our findings suggest that one way in which GDL laws reduce motor vehicle-related accidents and fatalities among teenage drivers is via their association with reduced drinking and driving behaviors.

Our findings further suggest that states with the least restrictive use-and-lose laws were associated with increased reports of driving after drinking any alcohol and riding in a car with a driver who has been drinking alcohol. It may be that states with higher rates of underage drinking have recognized the need to implement stricter policies to combat this behavior. While past studies document penalties entailing license revocation as more effective than treatment or rehabilitation alternatives in DWI cases (Preusser et al., 1976; Sadler et al., 1991) and/or driver improvement educational programs with repeat traffic offenders (McKnight and Tippetts, 1997), our study is the first to document the impact of use-and-lose laws on self-reported, hazardous, teenage alcohol-related traffic behaviors. And while there are legitimate concerns about the efficacy and expense of enforcing legal penalties for adolescent substance use (Cartwright, 2008; Kunz et al., 2009; Nadelmann, 1989; Reuter and Kleiman, 1986; Rosen et al., 2008) our findings legitimize the efforts of use-and-lose laws.

The findings are limited by several factors. Foremost, the data rely on self-report. Underreporting is an issue when dealing with self-reports of behaviors that contribute to social stigma with potential legal ramifications. However, the YRBSS is administered by questionnaire rather than by personal interview, which helps to mitigate the problem of

underreporting stigmatized behaviors. In addition, most states did not sample students attending private schools. However, our findings are highly relevant for the majority of youth in this country given that approximately 90% of students attend public schools (Snyder and Dillow, 2011).

Our study demonstrated a gradual but impressive reduction in adolescent drinking and driving behaviors from 1999 to 2009. Related, GDL laws and use-and-lose laws concurrently became more restrictive over the past decade (although much progress can still be made for use-and-lose laws). Even though there is no direct linkage between the adolescent drinking and driving and GDL laws and use-and-lose laws, our findings suggest that these laws could, in part, be responsible for the decline in these hazardous behaviors. Thus, while we acknowledge that GDL laws and use-and-lose laws are not the cure-all for reducing all risky youth driving behaviors, we, nevertheless, assert that restrictive GDL laws and use-and-lose laws have potentially helped to bolster societal expectations and values about the hazards of drinking and driving behaviors. Whether or not the associations we found between GDL laws and use-and-lose laws and adolescent drinking and driving behaviors will persist or decrease over time as new norms are adopted is an important question that remains unanswered.

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