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Association of Graduated Driver Licensing With Driver, Non-Driver, and Total Fatalities Among Adolescents

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Abstract

Introduction—Graduated driver licensing systems typically require an extended learner permit phase, and create night-time driving or passenger restrictions for adolescent drivers. Restricted driving might increase the use of alternative transportation to replace driving and consequently increase crashes and injuries for passengers, bus riders, pedestrians, and bicyclists. This study examined whether graduated driver licensing increases non-driver fatalities among adolescents, and whether it reduces total traffic fatalities combining drivers and non-drivers.

Methods—Longitudinal analyses were conducted using data from the 1995–2012 U.S. Fatality Analysis Reporting System. Adjusted rate ratios were estimated for being fatally injured in a crash according to: (1) presence/absence of a graduated driver licensing system; and (2) four levels of graduated driver licensing systems (absent, weak, medium, strong). Analyses were conducted in 2015.

Results—Among adolescents aged 16 years, graduated driver licensing was not associated with increased passenger fatalities (adjusted rate ratio, 0.96; 95% CI=0.90, 1.03) or pedestrian and bicyclist fatalities (adjusted rate ratio, 1.09; 95% CI=0.85, 1.39), but was associated with an 11% reduction in total traffic fatalities. Among those aged 17 years, graduated driver licensing was not associated with increased fatalities as passengers, pedestrians, or bicyclists, and was not associated with reduced total traffic fatalities.

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Conclusions—In general, graduated driver licensing systems were not associated with increased fatalities as passengers, pedestrians, bicyclists, and bus riders. Graduated driver licensing systems were associated with reduced total fatalities of adolescents aged 16 years.

Introduction

Motor vehicle crashes are a major source of morbidity and mortality worldwide, causing 20–50 million injuries and 1.2 million fatalities annually,[1] and are the leading cause of death among people aged 15–29 years globally.[1,2] Young novice drivers have the highest crash rate; per miles driven, the fatal crash rate per miles driven for drivers aged 16 years was approximately six times that for drivers aged 30–54 years in the U.S. in 2008–2009.[3,4] This excess crash risk is mainly due to inexperience and risky driving behaviors.[5–7] To address this public health issue, states have implemented graduated driver licensing (GDL), a phased approach to initiating driving, which was first introduced in Florida in 1996.[8,9] By January 2012, all states and the District of Columbia (DC) had implemented some form of GDL.[8,9] In general, it requires drivers aged younger than 18 years to proceed through three phases: an *extended learner permit phase* with supervised driving for 3–12 months; an *intermediate phase,* which allows unsupervised driving under low-risk conditions such as daylight, but restricts night-time driving and, in many states, limits the number of passengers a novice young driver can have in their vehicle; and a *full licensure phase* that permits unsupervised driving at all times.[10]

Previous studies have suggested that GDL is typically associated with a 15%–40% reduction in crash rates of drivers aged 16 years.[9,11–24] However, few studies have considered the outcomes involving adolescents aged 16–17 years traveling as passengers, bicyclists, pedestrians, and bus riders.[12,23,25] Adolescents in California were reported to use the following transportation alternatives to adapt to the night-time and passenger restrictions: have a parent or older adult as a supervising passenger; use of walking, biking, and bus; move their travel time to daytime; driving separately instead of one teenage driver with passengers; or violate the restriction.[26]

Shifting to riding with parents or use of bus would be far safer, as would driving alone in the daytime by rearranging the time or event.[27,28] However, shifting travel to walking or biking could be dangerous based on per trip fatality rates.[29] Similarly, the increased use of alternative transportation (riding as a passenger with parents or other adults, use of public transportation, bicycling, and walking) might increase crashes and injuries for passengers, bus riders, pedestrians, and bicyclists, canceling out the reduced driver injuries. A New York study suggested that pedestrian and bicyclist injuries might increase after GDL implementation.[23] However, this study was limited by a small sample size and a limited ability to control for confounding. Therefore, longitudinal analyses were conducted using traffic fatalities in all 50 states and DC to overcome previous methodologic difficulties and examine whether GDL was associated with fatalities among adolescents aged 16–17 years who traveled as passengers, bicyclists, and pedestrians. The authors also examined the association with total fatalities among those aged 16–17 years, including fatalities to drivers, passengers, bicyclists, pedestrians, and bus riders.

Methods

Measures

The Fatality Analysis Reporting System is maintained by the National Highway Traffic Safety Administration and contains data for all motor vehicle crashes that result in at least one fatality within 30 days of the crash on public roads in the U.S.[30] Counts of fatalities were obtained among adolescents aged 16–17 years who were in a crash as passengers in passenger vehicles, bicyclists, pedestrians, bus riders, and drivers of passenger vehicles by state, year (1995–2012), and quarter. The National Highway Traffic Safety Administration's definition was applied to identify passenger vehicles, which includes passenger cars, light trucks, vans, and utility vehicles.[30] Pedestrians and bicyclists were combined in analysis. Owing to the limited number of fatalities, bus riders were not analyzed as a separate group and instead were grouped with passengers, pedestrians, and bicyclists as non-drivers.

The GDL systems were classified in two ways:

1. presence/absence; and
2. with four levels (absent, weak, medium, strong) for each U.S. state for each quarter year of the 18-year study period.

The presence/absence of GDL was defined with a learner's permit phase of at least 3 months, plus an intermediate phase restriction on either night driving or the number of young passengers.[8] Further, GDL systems were classified as weak, medium, and strong based on whether they had none, one, or at least two of the following three components, respectively:

1. an intermediate phase night-time driving restriction that begins by 10:00PM;
2. an intermediate phase passenger restriction of no more than one passenger; and
3. a minimum entry age for the intermediate phase of 16.5 years.

Midyear population estimates by state, age, and year were obtained from the U.S. Census Bureau, and quarterly values were interpolated linearly.[31]

The presence of other traffic safety laws may confound the relationship between GDL and fatalities. States' impaired driving laws (i.e., minimum blood alcohol concentration of 0.08 g/dL or 0.10 g/dL, zero tolerance laws, and mandatory license suspensions for driving under the influence offenses), maximum speed limits (i.e., 55, 65, 70, or ≥75 miles per hour), and seatbelt laws (i.e., no law, primary enforcement law, secondary enforcement law) were obtained from two sources. The first source, Dr. Scott Masten,[32] provided a data set of these laws spanning 1986–2008 in his previous research. Additional data were obtained from the Insurance Institute for Highway Safety (IIHS).[33] As a national authority on traffic laws, IIHS tracks transportation legislations and makes data freely available in the public domain on a continuing basis. The IIHS website can be searched to obtain accurate information on each state's traffic law changes.

Quarterly unemployment rates were obtained for each state from the U.S. Bureau of Labor Statistics.[34] Quarterly per capita income estimates were obtained for each state from the

U.S. Bureau of Economic Analysis.[35] The national annual Consumer Price Index was used to adjust for inflation.[36] The annual unleaded gasoline price for each state was obtained from the Energy Information Administration,[37] and then adjusted for inflation using the national annual Consumer Price Index.

Statistical Analysis

To estimate per person year rates of fatality, fatalities counts were divided by population estimates.

Adjusted fatality rate ratios (ARRs) in the presence of a GDL system compared with no GDL system were estimated using Poisson regression. The outcome was the quarterly count of fatalities with an offset equal to the log of the population for that quarter. Generalized estimating equations were used to account for the repeated measures from each state over the study period, and an autoregressive working correlation structure was employed. Regression models included terms for year (linear spline terms with knots at 2001 and 2004), quarter (three indicator variables for four quarters), age (0 for 16 years, 1 for 17 years), and GDL (0 for absence, 1 for presence), as well as an interaction for age and GDL to allow examination of whether the association between GDL and fatality rates vary by age. The following traffic laws were included in the model:

1. rural interstate speed limits (55, 65, 70, or ≥75 miles per hour);
2. seat belt laws (none, primary enforcement law, secondary enforcement law);
3. blood alcohol concentration limit for driving (0.08 g/dL or 0.10 g/dL);
4. zero-tolerance laws for people aged <21 years to drive with any detectable blood alcohol concentration; and
5. immediate administrative license suspension for driver with a blood alcohol concentration that exceeds the legal limit.[17]

The model further included the state economic factors (quarterly unemployment rate, quarterly per capita income, and annual gasoline price).

The number of adolescents aged 16 years whose fatalities were prevented in the post-GDL period was estimated. First, the authors estimated the number of fatalities that would have been predicted if GDL had not been implemented (i.e., the number of actual fatalities in the post-GDL period divided by the ARR). Then, the authors deducted the number of actual fatalities from the number of predicted fatalities to estimate the number of prevented fatalities. Analyses were conducted in 2015 using SAS, version 9.4. The study was approved by West Virginia University’s IRB.

Results

There were a total of 3,672 state quarters for fatalities: 18 years × 4 quarter × 51 states including DC (Table 1). GDL was absent for 41% of quarters, weak GDL was present for 13% of quarters, medium GDL for 33% of quarters, and strong GDL for 12% of quarters. Each state and DC had at least one quarter during the study period (1995–2012) without a

GDL system, 14 states had at least one quarter with a weak system, 37 states had at least one quarter with a medium system, and 18 states had at least one quarter with a strong system. Figure 1 shows the temporal implementation of GDL systems among U.S. states from 1995 through 2012. In 1995, no states had implemented GDL, and 1996 was the first year that GDL was implemented. In 2012, GDL was absent for 8 (4%) of 204 state quarters, weak GDL was present for 6% of state quarters, medium GDL 55% of state quarters, and strong GDL 35% of state quarters. GDL was absent in two states (New Hampshire and Wyoming) in 2012 because a 3-month learner permit was not required despite having adopted night-time and passenger restriction.

Table 2 shows counts of traffic fatalities among adolescents aged 16–17 years; there were 12,766 passengers of passenger vehicles, 1,662 pedestrians, 436 bicyclists, 35 bus riders, and 15,270 drivers of passenger vehicles. When GDL was classified as presence/absence, its presence was not associated with increased fatality rates for passengers. For pedestrians and bicyclists, the ARR was 1.09 (95% CI=0.85, 1.39) for age 16 years and 1.21 (95% CI=1.00, 1.47) for age 17 years. GDL was associated with reduced fatality rates for drivers aged 16 years but not for those aged 17 years. For adolescent passengers, bicyclists, pedestrians, bus riders, and drivers combined, the ARR was 0.89 (95% CI=0.83, 0.96) for age 16 years and 1.01 (95% CI=0.94, 1.08) for age 17 years. Based on 7,818 fatalities occurring after GDL implementation among adolescents aged 16 years during the 18-year study period, 966 lives (95% CI=326, 1601) were saved because of GDL implementation among 16-year-olds.

Among adolescents aged 16 years, GDL systems were associated with reduced driver fatalities when classified as four levels (absent, weak, medium, strong) (Table 3). The ARR for driver fatality was 0.86 (95% CI=0.73, 1.01) for weak GDL, 0.80 (95% CI=0.69, 0.94) for medium GDL, and 0.74 (95% CI=0.54, 1.02) for strong GDL, relative to when GDL was absent. GDL systems were not statistically associated with passenger fatalities; the ARR was 1.01 (95% CI=0.90, 1.12) for weak GDL, 0.96 (95% CI=0.89, 1.03) for medium GDL, and 0.87 (95% CI=0.74, 1.03) for strong GDL. GDL systems were not statistically associated with pedestrian and bicyclist fatalities. When combining passengers, bicyclists, pedestrians, bus riders, and drivers, weak GDLs were associated with a non-significant 6% reduction in fatalities (ARR=0.94, 95% CI=0.83, 1.03), medium GDLs were associated with a 15% reduction (ARR=0.85, 95% CI=0.79, 0.91), and strong GDLs were associated with a 17% reduction (ARR=0.83, 95% CI=0.75, 0.92). Among adolescents aged 17 years, the associations between GDL and drivers, passengers, and total fatalities were all near null or included null in 95% CIs. For pedestrians and bicyclists, the ARR was 1.33 (95% CI=0.97, 1.80) for weak GDL, 1.11 (95% CI=0.90, 1.37) for medium GDL, and 1.09 (95% CI=0.80, 1.47) for strong GDL, relative to GDL absence.

Discussion

This study found that GDL systems were not associated with increased fatalities for 16-year-old passengers, pedestrians, bicyclists, and bus riders combined, and associated with reduced total fatalities (drivers and non-drivers) for adolescents aged 16 years. Seventeen-year-olds generally did not experience substantial increase or decrease in fatalities after GDL implementation.

This study found that GDL systems were not associated with increased fatalities for adolescents aged 16 and 17 years as passengers. In comparison, a study in New York State reported the rate ratio of fatal and incapacitating passenger injuries comparing before and after GDL was 1.19 (95% CI=0.77, 1.84) for age 16 years and 0.93 (95% CI=0.61, 1.43) for age 17 years[23]; the CIs were wide because of small sample sizes. Restricted driving due to GDL could increase instances of adolescents riding as passengers with parents, and subsequently increase passenger fatalities. However, several reasons could explain the lack of an increase in adolescent passenger fatalities after GDL implementation. First, riding with parents is much safer than riding with an adolescent driver.[27] Second, given GDL passenger restrictions, there are likely fewer passengers riding with adolescent drivers, who have elevated crash rates. Third, riding with an adolescent driver under GDL becomes safer for passengers, because the adolescent driver would have more driving experience. In addition, the frequency of riding as a passenger might not substantially increase after GDL implementation. A California survey found the following ways adolescents adapted to the night-time driving restriction: 58% drove earlier; 59% rode with a parent or an older adult; 31% walked or rode a bicycle or bus; 44% violated the night-time restriction; and 45% rearranged the event.[26] The same survey found the following ways they adapted to the passenger restriction: 49% drove alone; 44% rode with a parent or an older adult; 18% walked, rode a bicycle, or took a bus; 31% violated the passenger restriction; and 21% rearranged the event.[26] This suggested that some trips restricted by GDL were still carried out by adolescent drivers who either moved the trip to daytime or had a parent or an older adult as a supervising passenger, thereby reducing the need to ride as a passenger. Some adolescents simply did not comply with GDL and violated driving restrictions.

For pedestrians and bicyclists, the association for age 16 years was not statistically significant, but it was approaching statistical significance for age 17 years when comparing GDL presence with absence. Further examination for age 17 years shows that a possible increase in pedestrian and bicyclist fatalities was suggested in weak GDL, but not apparent in medium and strong GDL. The potential increase for age 17 years might be due to chance finding, and needs further confirmation in future studies. In comparison, a study in New York state reported the rate ratio of fatal and incapacitating pedestrian and bicyclist injuries comparing before and after GDL was 1.53 (95% CI=0.89, 2.62) for age 16 years and 1.75 (95% CI=0.91, 3.34 years) for age 17 years[23]; the CIs were wide because of small sample sizes.

When examining total fatalities including passengers, bicyclists, pedestrians, bus riders, and drivers, the authors found that GDL was associated with an 11% reduction for age 16 years (medium GDL, 15% reduction; strong GDL, 17% reduction), but not for age 17 years. In a cross-sectional analysis of 2003 motor vehicle driver and passenger fatalities using the Web-based Injury Statistics Query and Reporting System from 33 states and the IIHS classification system, Presley et al.[25] reported that fatality rates for adolescents aged 15–17 years were 26% lower for good GDL, 7% lower for fair GDL, and 23% lower for marginal/poor GDL, compared with no GDL. Another study of severe traffic injuries in 2001 and 2005 including drivers, passengers, bicyclists, and pedestrians in New York State reported that the rate ratio was 0.92 (95% CI=0.70, 1.20) for age 16 years and 0.99 (95% CI=0.78, 1.26) for age 17 years before and after the implementation of GDL.[23] A study of 1992–2002

Fatality Analysis Reporting System (FARS) data reported that good GDL reduced the total traffic fatalities (driver, passenger, bicyclists, and pedestrians) by 19% and fair GDL by 6% among adolescents aged 15–17 years using the classification system by the IIHS.[12] In comparison, this study showed that whereas 16-year-olds benefited from GDL, 17-year-olds did not. Previous studies have also suggested heterogeneity between adolescents aged 16 and 17 years.[17,38] Adult supervision or restrictions on night driving and number of underage passengers, all of which should be most common among adolescents aged 16 years, but as adolescents become older and these restrictions are removed, the influence of GDL on 17-year-olds could be less. In addition, graduation from GDL is possible at age 17 years in most states, particularly if the adolescent takes a driver education course.[10]

This study found that GDL existence was associated with a 19% reduction in driver fatalities among 16-year-olds. The estimate was consistent with the 15%–40% reduction in crash rates as drivers reported in previous studies.[9,11–24]

Limitations

A strength of this study is the longitudinal analysis of adolescent fatalities from all 50 states and DC for 18 years. Additionally, confounding was adjusted for temporal trend, seasonal factors, traffic laws, and economic factors that could influence travel behaviors and traffic fatalities. The current study also examined fatalities among adolescent passengers, bicyclists, pedestrians, and total adolescent fatalities (including drivers), which have not been well studied before. The authors also believe they have taken into account the primary confounders; however, it is still possible that unobserved, unknown, or hard-to-measure confounders may bias effect estimates. One limitation of this study is that the licensure status of adolescents was unknown; thus, the authors were not able to estimate the effects of individual GDL components (extended learner permit, night-time restriction, passenger restriction), and were limited to age-based analyses to estimate the summary effects for age 16 and 17 years. The study had a relatively small sample size, particularly for pedestrians and bicyclists; thus, they were not analyzed separately but grouped together.

Conclusions

This study found that GDL systems were generally not associated with increased fatalities as passengers, pedestrians, or bicyclists. Adolescent total traffic fatalities reduced after GDL implementation. If targeted efforts are planned and implemented to strengthen state GDL systems from weak to medium, and from medium to strong, further reduction in driver fatalities and total fatalities would be expected.

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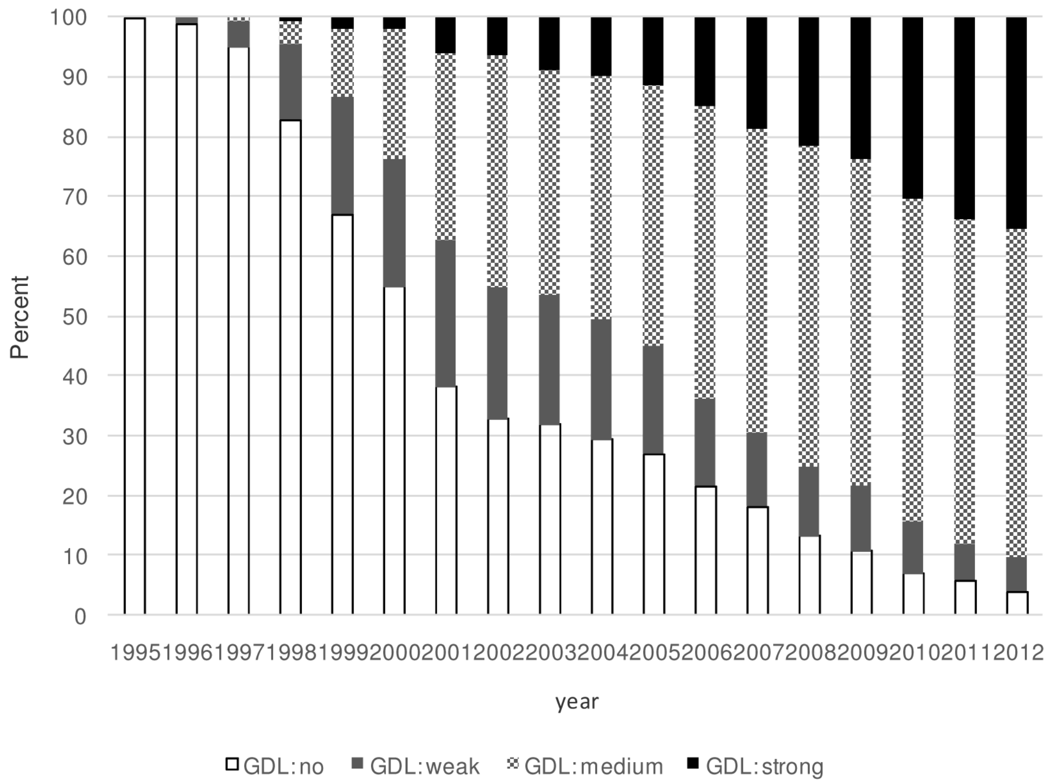

Figure 1.

Distribution of graduated driver licensing systems among U.S. states, 1995–2012.

Notes: The presence/absence of GDL systems was defined by a learner permit phase of at least 3 months, plus an intermediate phase restriction on either night driving or the number of young passengers. Further, GDL systems were classified as weak, medium, and strong based on whether they had none, one, or at least two of the following three components, respectively: (1) an intermediate phase night-time driving restriction that begins by 10:00 pm; (2) an intermediate phase passenger restriction of no more than one passenger; and (3) a minimum entry age for the intermediate phase of 16.5 years. GDL, graduated driver licensing

Table 1

Graduated Driver Licensing (GDL) Classification, Number of Quarters, and Number of Unique States, U.S., 1995–2012

GDL classification[a]	Number (%)	
	Quarters (n=3,672)	**Unique states[b] (n=51)**
None	1,507 (41%)	51 (100%)
Weak	481 (13%)	14 (27%)
Medium	1,226 (33%)	37 (73%)
Strong	458 (12%)	18 (35%)

[a]The presence/absence of GDL systems was defined by a learner permit phase of at least three months, plus an intermediate phase restriction on either night driving or the number of young passengers. Further, GDL systems were classified as weak, medium, and strong based on whether they had none, one, or at least two of the following three components, respectively: (1) an intermediate phase night-time driving restriction that begins by 10:00PM; (2) an intermediate phase passenger restriction of no more than one passenger; and (3) a minimum entry age for the intermediate phase of 16.5 years.

[b]The number of unique states contributed at least one quarter to each category of GDL.

Table 2

Counts, Rates, and Rate Ratios for Fatalities by Presence/Absence of Graduated Driver Licensing (GDL), U.S., 1995–2012[a]

Person type	Age (yr)	Graduated driver licensing system [b]	No. of fatalities	Rate per 100,000 person-year	Crude rate ratio per person-year (95% CI)	Adjusted rate ratio per person-year (95% CI) [c]
Passenger in	16	Absent	2,462	10.6		
passenger		Present	3,585	7.0	0.66 (0.62, 0.69)	0.96 (0.90, 1.03)
vehicle	17	Absent	2,674	11.5		
		Present	4,045	7.8	0.68 (0.65, 0.71)	1.00 (0.93, 1.09)
Pedestrian	16	Absent	369	1.6		
& bicyclist		Present	663	1.3	0.81 (0.71, 0.92)	1.09 (0.85, 1.39)
	17	Absent	354	1.5		
		Present	712	1.4	0.90 (0.80, 1.03)	1.21 (1.00, 1.47)
Passenger,	16	Absent	2,843	12.3		
pedestrian,		Present	4,263	8.3	0.68 (0.64, 0.71)	0.97 (0.90, 1.05)
bicyclists,	17	Absent	3,031	13.1		
& bus rider		Present	4,762	9.2	0.71 (0.67, 0.74)	1.02 (0.95, 1.10)
Driver of	16	Absent	2,969	12.8		
passenger		Present	3,555	6.9	0.54 (0.51, 0.57)	0.81 (0.72, 0.91)
vehicle	17	Absent	3,543	15.3		
		Present	5,203	10.1	0.66 (0.63, 0.69)	1.00 (0.91, 1.09)
Passenger,	16	Absent	5,812	25.1		
pedestrian,		Present	7,818	15.2	0.61 (0.59, 0.63)	0.89 (0.83, 0.96)
bicyclists, bus	17	Absent	6,574	28.4		
rider, & driver		Present	9,965	19.3	0.68 (0.66, 0.70)	1.01 (0.94, 1.08)

[a]Data from the 1995–2012 Fatality Analysis Reporting System.

[b]The presence/absence of GDL systems was defined with a learner permit phase of at least 3 months, plus an intermediate phase restriction on either night driving or the number of young passengers.

[c]Adjusted rate ratios were estimated using Poisson regression, compare the rates per person-year for persons exposed to GDL with those not exposed, adjusted for repeated measures within each state with generalized estimating equation, year, quarter, age, traffic laws (speed limit law, seat belt laws, blood alcohol concentration limit for driving, zero-tolerance laws for persons under age 21 years to drive with any detectable blood alcohol concentration, and immediate administrative license suspension for driver with a blood alcohol concentration that exceeds the legal limit), and state economic factors (unemployment rate, per capita income, and gasoline price).

Table 3

Rate Ratios for Fatality by Strength of Graduated Driver Licensing System, U.S., 1995–2012 [a]

Person type	Age (yr)	Graduated driver licensing system[b]	Crude rate ratio per person- year (95% CI)	Adjusted rate ratio per person-year (95% CI) [c]
Passenger	16	weak	0.87 (0.82, 0.94)	1.01 (0.90, 1.12)
in		medium	0.64 (0.61, 0.68)	0.96 (0.89, 1.03)
passenger		strong	0.40 (0.36, 0.45)	0.87 (0.74, 1.03)
vehicle	17	weak	0.83 (0.78, 0.89)	0.96 (0.88, 1.05)
		medium	0.68 (0.64, 0.72)	1.02 (0.94, 1.10)
		strong	0.48 (0.44, 0.53)	1.04 (0.93, 1.17)
Pedestrian	16	weak	1.02 (0.86, 1.21)	1.24 (0.86, 1.79)
and		medium	0.75 (0.65, 0.87)	0.95 (0.76, 1.18)
bicyclist		strong	0.70 (0.57, 0.87)	1.04 (0.72, 1.48)
	17	weak	1.09 (0.92, 1.29)	1.33 (0.97, 1.80)
		medium	0.88 (0.76, 1.02)	1.11 (0.90, 1.37)
		strong	0.74 (0.59, 0.91)	1.09 (0.80, 1.47)
Passenger,	16	weak	0.89 (0.84, 0.95)	1.03 (0.94, 1.15)
pedestrian,		medium	0.66 (0.62, 0.69)	0.95 (0.88, 1.03)
bicyclists,		strong	0.44 (0.40, 0.49)	0.90 (0.76, 1.07)
& bus rider	17	weak	0.86 (0.81, 0.92)	1.00 (0.90, 1.10)
		medium	0.70 (0.67, 0.74)	1.02 (0.95, 1.10)
		strong	0.51 (0.47, 0.55)	1.04 (0.92, 1.17)
Driver	16	weak	0.79 (0.74, 0.85)	0.86 (0.73, 1.01)
of		medium	0.51 (0.48, 0.54)	0.80 (0.69, 0.94)
vehicle		strong	0.30 (0.27, 0.34)	0.74 (0.54, 1.02)
passenger	17	weak	0.88 (0.83, 0.93)	0.95 (0.86, 1.06)
		medium	0.64 (0.61, 0.67)	1.01 (0.90, 1.14)
		strong	0.45 (0.41, 0.49)	1.10 (0.96, 1.26)
Passenger,	16	weak	0.84 (0.80, 0.88)	0.94 (0.86, 1.03)
pedestrian,		medium	0.58 (0.56, 0.60)	0.85 (0.79, 0.91)
bicyclists, bus		strong	0.37 (0.35, 0.40)	0.83 (0.75, 0.92)
rider, & driver	17	weak	0.87 (0.83, 0.91)	1.02 (0.97, 1.08)
		medium	0.67 (0.64, 0.69)	0.99 (0.93, 1.06)
		strong	0.48 (0.45, 0.50)	0.99 (0.90, 1.07)

[a] Data from the 1995–2012 Fatality Analysis Reporting System.

[b] The presence/absence of GDL systems was defined by a learner permit phase of at least three months, plus an intermediate phase restriction on either night driving or the number of young passengers. Further, GDL systems were classified as weak, medium, and strong based on if they had none, one, or at least two of the following three components, respectively: (1) an intermediate phase night-time driving restriction that begins by 10:00PM; (2) an intermediate phase passenger restriction of no more than one passenger; and (3) a minimum entry age for the intermediate phase of 16.5 years.

[c]Adjusted rate ratios were estimated using Poisson regression, compare the rates per person-year for persons exposed to GDL with those not exposed, adjusted for repeated measures within each state with generalized estimating equation, year, quarter, age, traffic laws (speed limit law, seat belt laws, blood alcohol concentration limit for driving, zero-tolerance laws for persons under age 21 years to drive with any detectable blood alcohol concentration, and immediate administrative license suspension for driver with a blood alcohol concentration that exceeds the legal limit), and state economic factors (unemployment rate, per capita income, and gasoline price).