

Graduated Driver Licensing in Wisconsin: Does It Create Safer Drivers?

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ABSTRACT

Objectives: The purpose of this study was to measure the effectiveness of Wisconsin's graduated driver licensing law and determine whether a reduction in crash rates was due to reduced exposure, safer driving, or both.

Methods: General population crash rates for 16 and 17 year olds were computed for years before and after graduated drivers licensing. The induced exposure method was used to measure exposure and compute the odds ratio of at-fault crash involvement.

Results: For 16 year olds, general crash rates declined 13.8% while injury crash rates declined 15.6%. For 17 year olds, crash rates declined 6.2% for all crashes and 5.8% for injury crashes. There was no statistically significant change in the odds ratio of at-fault crash involvement for 16- or 17-year-old drivers, relative to the reference group. After graduated drivers licensing, 16-year-old drivers were more likely to have at least 1 adult present and less likely to carry 2 or more teen passengers. There was no statistically significant effect on driving habits by time for 16 year olds.

Conclusions: Graduated driver licensing in Wisconsin has resulted in a drop in the general population crash rates for 16 and 17 year olds. This decrease is the result of reduced exposure to the risk of collision rather than safer driving by teens.

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INTRODUCTION

While novice drivers of all ages are at increased risk for motor vehicle crashes, and the risk of crash is highest during the first few months of driving,¹ young drivers have the highest crash rates owing not only to inexperience but also immaturity and risk-taking behavior.² However, the only way to become a safe driver is through accumulating on-the-road experience.³

Graduated driver licensing is a 3-stage system that was developed to allow novice teenage drivers to gain experience driving in lower-risk situations before attaining unrestricted driving privileges. While graduated driver licensing has been shown to reduce crash rates for teen drivers, it is not known to what extent decreased crash risk is due to reduced exposure rather than to safer driving or some combination of both.⁴ Exposure to the risk of a collision is reduced for the new driver because graduated licensing results in an extended period of supervised driving, less driving overall, and less driving in higher risk situations, such as late at night or with passengers. The 3-stage system of graduated licensing is also intended to produce safer, more skillful drivers once licensure has been reached.⁵

The purpose of this study was to compare Wisconsin crash data before and after implementation of graduated driver licensing to determine the following: (1) the law's effectiveness in reducing crash rates for young drivers, and (2) whether reduction in crash rates was due to reduced exposure, safer driving, or both. To address the lack of exposure data, the induced exposure method, which uses not-at-fault drivers to estimate driving exposures, was employed.

WISCONSIN'S GRADUATED DRIVER LICENSING LAW

Having adopted the policy in 2000, Wisconsin is now 1 of 42 states (plus the District of Columbia) with some version of 3-stage graduated driver licensing.⁶ Wisconsin's system requires learners to be at least 15.5 years of age when they acquire a learner's permit for driving under the supervision of an experienced adult,

Table 1. Driver Factors as Possible Contributing Circumstances to a Crash

Exceeding the speed limit
Speeding too fast for conditions
Failure to yield right-of-way
Inattentive driving
Following too close
Improper turning
Driving left of center
Disregarding traffic control
Improper overtaking
Unsafe backing
Failure to have control
Driver condition
Driver physically disabled
Other

and to hold that permit for a minimum of 6 months, rather than the previous 7 days. Another new requirement is 30 hours of practice driving, including 10 nighttime hours. During the new 9-month intermediate stage, young drivers cannot drive between midnight and 5 AM unless they are accompanied by an adult or are driving between work, school, and home. Passengers are also restricted during this time to only 1 unrelated passenger less than 21 years of age. Violation of these restrictions or a moving traffic violation conviction may result in an extension of these restrictions.

METHODS

Data Sources

Data on crashes were obtained from the database maintained by the Wisconsin Department of Transportation of all “Motor Vehicle Accident Reports” filed with the state for the years 1999, 2002, and 2003. Wisconsin law requires a report be filed in all crashes that result in injury or property damages over \$1000. Data from 2000 and 2001 were not included because the law was not fully implemented until September 2000. Graduated driver licensing did not affect all drivers who were 16 years old during those years and did not affect all 17 year olds until 2003. Mid-year population estimates were obtained from the Applied Population Laboratory, UW-Madison/Extension.⁷

For multiple vehicle crashes, a driver was considered at-fault if the investigating officer selected 1 or more of 14 driver factors (Table 1) as possibly contributing to the crash. Drivers in single vehicle crashes were also considered to be at-fault. All other drivers were considered to be not-at-fault. The state report form designates 3 categories of crash severity: fatal, injury (incapacitating, non-incapacitating, or pos-

sible), or property damage only. Analysis was done on all reportable crashes (“all crashes”) and on those in which at least 1 person was killed or injured (“injury crashes”). The unit of analysis was driver involvement in a collision.

Analysis was done using Stata, version 8.0.⁸ Results were considered statistically significant if the *P* value was <.05.

Crash Rates

To facilitate comparison with findings from other studies, general population crash rates and population crash rate ratios were computed using the statistical analysis method described in Ulmer et al.⁹ Those drivers aged 25-59 were used as a reference group to control for factors other than graduated driver licensing that could have affected a change in crash rates. Crash rates per driver were not computed because the Wisconsin accident report form does not distinguish between licensed drivers and those holding only a learner’s permit.

Induced Exposure

The method of induced exposure, which is comparable to a case-control analysis, was used to estimate both exposure to the risk of a collision and relative crash propensity. Not-at-fault drivers (“controls”) were assumed to make up a random sample of drivers on the road,¹⁰ and the number of not-at-fault drivers in any group was assumed to be proportional to that group’s exposure to the risk of a collision.¹¹ At-fault drivers, as determined by information included in crash report forms, were “cases.”

Relative Risk of At-Fault Crash Involvement

Although the relative risk of crash propensity could not be computed directly, the odds ratios of being at-fault compared to not-at-fault were calculated in each year as an estimate of the relative risk of crash propensity, using drivers aged 25-59—who are generally considered to be the safest drivers—as the control group

Changes In Driving Habits

Not-at-fault 16-year-old drivers were used to examine changes in driving habits between 1999 and 2002. Tabulation by passenger category was done for each year to determine the percent of not-at-fault drivers. For passenger categories, adults were defined as those age 25 and older and teen passengers were defined as those aged 15-18. Similarly, tabulation by time of day for not-at-fault teen drivers was computed to determine any change in the percent of teens driving after midnight.

RESULTS

For all crashes, the crash rate per 10,000 16 year olds, relative to the age 25-59 reference group, declined 11% between 1999 and 2002, and 13.8% between 1999 and 2003 ($P<.001$) (Table 2). For 17 year olds, there was a decline of 6.2% ($P<.001$) for crash rates between 1999 and 2003.

The injury crash rate for 16 year olds declined 15.3% between 1999 and 2002, and 15.6% between 1999 and 2003 ($P<.001$) (Table 3). For 17 year olds, there was a decline of 5.8% ($P<.001$) between 1999 and 2003. Although not statistically significant ($P=.22$), there was a 2.3% drop in injury crash rates by 2003 for 18 year olds.

In each year, 16-year-old drivers were approximately 2.5 times as likely to be at-fault as those age 25-59 for all crashes and 3.5 times as likely for injury crashes (Table 4). For 17 year olds, the odds ratios were close to 2 for all crashes and 2.5 for injury crashes. From 1999 to 2003, there was no statistically significant change in the odds ratios of at-fault crash involvement for teen drivers.

In both 2002 and 2003, as compared with 1999, 16-year-old drivers were more likely to have at least 1 adult present (an increase of 1.7 % in 2002 and 1.6% in 2003) and less likely to carry 2 or more teen passengers (a decrease of 4.9% in 2002 and 5.2% in 2003) (Table 5).

There was no statistically significant change in the driving habits by time for 16 year olds (Table 6). In each year, less than 3% of not-at-fault 16-year-old drivers were driving after midnight.

DISCUSSION

The implementation of graduated driver licensing in Wisconsin has reduced teens' risk of being involved as a driver in a motor vehicle collision. The statistically significant drop in the general population crash rate for 16 year olds, relative to the age 25-59 reference group was 11% by 2002 and almost 14% by 2003 for all crashes and over 15% for injury crashes in each of these years. By 2003, the first year in which graduated driver licensing would have affected all 17 year olds, there was a decline in 17 year olds' crash rates of over 6% for all crashes and almost 6% for injury crashes. These findings are consistent with those of other states,⁴ and within the reported range of 9% in Florida, 23% in North Carolina, and 25% in Michigan soon after adoption of a graduated driver licensing system.^{2,9,12}

The 2 factors that can account for these decreases in crash rates are reduced exposure and safer driving. The reduction in this study appears to be due solely to reduced exposure, as there was no statistically significant change in the odds ratio of at-fault crash involvement

Table 2. Crash Rates per 10,000 Population, Crash Rate Ratios, and Percent Change in Crash Rate Ratios

	1999	2002	2003
25-59 year old population	2,546,012	2,616,251	2,633,034
Crashes	123,899	119,141	120,278
Crash rate per 10,000	486.64	455.39	456.80
16 year old population	80,676	83,568	82,312
Crashes	9075	7828	7492
Crash rate per 10,000	1124.87	936.72	910.20
Crash rate ratio*	2.31	2.06	1.99
Change in crash rate ratio [†]		-11.01% [‡]	-13.80% [‡]
17 year old population	80,379	83,495	84,063
Crashes	9428	9109	8678
Crash rate per 10,000	1172.94	1090.96	1032.32
Crash rate ratio*	2.41	2.40	2.26
Change in crash rate ratio [†]		-0.61%	-6.24% [‡]
18 year old population	81,691	81,639	83,985
Crashes	9230	8595	8824
Crash rate per 10,000	1129.87	1052.81	1050.66
Crash rate ratio*	2.32	2.31	2.30
Change in crash rate ratio [†]		-0.43%	-0.94%

*Crash rate ratios adjust the crash rate for crash rate changes in 25-59 year olds. Crash rate ratio=crash rate/crash rate for 25-59 year olds.

[†] Change is from 1999.

[‡] $P<.001$

Table 3. Injury Crash Rates per 10,000 Population, Crash Rate Ratios, and Percent Change in Crash Rate Ratios

	1999	2002	2003
25-59 year old population	2,546,012	2,616,251	2,633,034
Crashes	41,205	38,717	38,200
Crash rate per 10,000	161.84	147.99	145.08
16 year old population	80,676	83,568	82,312
Crashes	3,238	2,599	2,499
Crash rate per 10,000	401.36	311.004	303.60
Crash rate ratio [†]	2.48	2.10	2.10
Change in crash rate ratio [†]		-15.26% [‡]	-15.62% [‡]
17 year old population	80,379	83,495	84,063
Crashes	3,264	3,080	2,884
Crash rate per 10,000	406.08	368.88	343.08
Crash rate ratio*	2.51	2.49	2.36
Change in crash rate ratio [†]		-0.7%	-5.75% [‡]
18 year old population	81,691	81,639	83,985
Crashes	3,263	3,028	2,917
Crash rate per 10,000	399.43	367.24	347.32
Crash rate ratio*	2.47	2.48	2.39
Change in crash rate ratio [†]		+5.55%	-2.30%

*Crash rate ratios adjust the crash rate for crash rate changes in the 25-59 year-old population. Crash rate ratio=crash rate/crash rate for 25-59 year olds.

[†] Change is from 1999.

[‡] $P<.001$

Table 4. Odds Ratios of At-Fault Crash Involvement by Age of Driver

Age	1999		2002		2003	
	OR	95% CI	OR	95% CI	OR	95% CI
All Crashes						
16	2.45	2.33 - 2.58	2.51	2.37 - 2.65	2.45	2.32 - 2.59
17	1.91	1.83 - 2.01	1.95	1.86 - 2.04	2.01*	1.91 - 2.11
18	1.80	1.72 - 1.89	1.84	1.75 - 1.93	1.97	1.87 - 2.07
19-24	1.49	1.45 - 1.53	1.49	1.45 - 1.53	1.53	1.49 - 1.56
25-59	1.00	Reference	1.00	Reference	1.00	Reference
60-69	1.01	.98 - 1.05	.94	.91 - .98	.97	.94 - 1.01
70+	1.51	1.45 - 1.57	1.49	1.44 - 1.56	1.42	1.37 - 1.48
Injury Crashes						
16	3.76	3.44 - 4.11	3.53	3.21 - 3.89	3.51†	3.17 - 3.88
17	2.46	2.27 - 2.66	2.65	2.44 - 2.88	2.66‡	2.44 - 2.90
18	2.37	2.19 - 2.57	2.42	2.23 - 2.63	2.57	2.36 - 2.80
19-24	1.74	1.67 - 1.81	1.80	1.73 - 1.88	1.85	1.78 - 1.93
25-59	1.00	Reference	1.00	Reference	1.00	Reference
60-69	1.07	1.00 - 1.14	.93	.87 - .99	.96	.90 - 1.03
70+	2.05	1.92 - 2.19	1.98	1.85 - 2.12	1.84	1.71 - 1.97

*Age 17, 1999 vs 2003: chi2 test for homogeneity P=.17
 †Age 16, 1999 vs 2003: chi2 test for homogeneity P=.30
 ‡Age 17, 1999 vs 2003: chi2 test for homogeneity P=.19

Table 5. Percent of 16-Year-Old Not-At-Fault Drivers by Passenger Category and Change Since 1999

Passengers	1999		2002		2003		
	%	%	Change	P value*	%	Change	P value*
Driver alone	47.52	49.16	+ 1.64	.31	49.45	+ 1.93	.24
1 teen only	22.31	26.09	+ 3.78	.01	25.55	+ 3.24	.02
2+ teens only	9.40	4.54	- 4.86	.01	5.24	- 4.16	.01
At least 1 adult	4.53	6.23	+ 1.70	.02	6.16	+ 1.63	.03
Other	16.24	13.98	- 2.26	.05	13.60	- 2.64	.03

* 2-sided test using the 2 sample test of equality of proportions for large sample statistics

Table 6. Number and Percent of 16-Year-Old Not-At-Fault Drivers by Time

Time	1999		2002		2003	
	Freq.	%	Freq.	%	Freq.	%
5 AM-3 PM	803	38.70	639	37.22	605	36.89
3 PM-6 PM	713	34.36	643	37.45	613	37.38
6 PM-10 PM	396	19.08	318	18.52	312	19.02
10 PM-midnight	114	5.49	87	5.07	77	4.70
Midnight-5 AM	49	2.36	30	1.75	33	2.01

for 16- or 17-year-old drivers between 1999 and 2002 or 2003. We cannot say that graduated driver licensing has led to safer driving by teens.

Reduced Exposure

Reduced exposure comes about in several ways. First, the requirement to hold a learner's permit for a longer period of time results in delayed licensure. Teens holding a learner's permit are required to have a qualified

adult as a passenger and are known to have a low risk of crash.¹³ Not only are teens less likely to be involved in a crash when an adult is present, but they are limited to driving only when it is convenient for an adult to accompany them. Studies reporting a decrease in the crash rate per population following implementation of graduated driver licensing have generally attributed the decrease to the greater amount of time spent holding a learner's permit.⁵ This has been demonstrated more directly by the experiences of Kentucky and Nova Scotia, where crash rates fell by 83% and 51% respectively during newly established 6-month periods when new drivers who previously could have obtained a license were required to remain in the learner's stage.^{14,15} While the earliest age to obtain a license in Wisconsin remains at 16, the minimum amount of time required to hold a learner's permit increased from 7 days to 6 months. Also, as measured by the percent of not-at-fault drivers, the data show that there was an increase

in the percent of 16 year olds driving with an adult passenger.

Restrictions in place during the second stage of driver licensing reduce exposure to the risk of crash by reducing driving in risky situations as well as reducing driving overall. In Wisconsin these restrictions are in place for 9 months. An examination of driving habits by passengers showed a statistically significant decrease in the number of 16 year olds driving with 2 or more teens. Previous studies suggest that such a decrease could have contributed to the overall drop in crash rates.^{16,17} The prohibition against driving after midnight probably had little impact on overall crash risk because there was no statistically significant change in driving habits for 16 or 17 year olds with respect to time of day. Furthermore, the number of young teens driving after midnight was low even prior to implementation of graduated driver licensing.

Safer Driving

McKnight and Peck have pointed out that there are 4 elements of graduated driver licensing systems that are intended to result in safer driving by novices.⁵ The first of these is extended learning. In Wisconsin the new teen driver is required to remain in the learner phase for at least 6 months. The law also requires adult certification of 30 hours of practice driving, including 10 at night, although it is possible that this requirement is not always met.

Their second element is early intervention for traffic violations. In Wisconsin, even before graduated driver licensing, teen drivers had a lower threshold than adults for the number of traffic violations that could result in suspension of a license. Although graduated driver licensing resulted in some changes in point assessments for teens, there is probably not much greater general deterrence than before.

The third element is making advancement to the next stage of licensing contingent upon violation-free driving. During the second phase of graduated driver licensing, violation of the nighttime driving and passenger restrictions or a moving traffic violation conviction may result in an extension of these restrictions, thus giving young beginning drivers added incentive to drive safely.

The final element is one that has been proposed by the National Highway Traffic Safety Administration but has not been adopted in Wisconsin. A 2-stage driver education system requires basic instruction in the learner's stage and additional instruction focused on safety in the intermediate stage.¹⁸ However, there is little evidence that driver education reduces the risk of crash.¹⁹

It has been noted that graduated driver licensing programs may have little carryover effect after full licensure,²⁰ but the experience gained during the first 2 phases of graduated driver licensing may allow new drivers to become better drivers in the future. However, older teens and young adults may acquire less total driving experience on average than before the implementation of graduated driver licensing, and it is possible that the risk of crash will actually go up, not down. Although not statistically significant ($P=.17$), the odds ratio for being at-fault rose for 17 year olds in 2003. This could be because, as a group, they were less experienced drivers than 17 year olds in 1999.

Induced Exposure

The induced exposure method is a useful way to measure crash propensity. Crash rates per population are inadequate to measure unsafe driving because the more that members of a group drive, the greater their exposure and thus the greater their risk of crash. Even crash rate per mile may not be the best measure of crash propensity because mileage is only 1 component of exposure to risk and crashes per mile may overstate or exaggerate risk for low-mileage groups.²¹ Exposure to crash risk depends on a number of other factors as well, including road type, length of trip, traffic density, speed, weather, rural versus urban area, time of day, etc.²²

The induced exposure method has the advantage of using readily available data that comes from the crash database itself rather than from an external database such as the Nationwide Personal Transportation Survey.²² Stamatiadis and Deacon analyzed all reported crashes in Kentucky that occurred during 1990 to 1992 to examine the validity of the induced exposure method and found this method of analysis to be "a powerful technique for measuring relative exposures of groups of drivers . . . to accident hazard as well as for estimating their relative accident propensities."¹⁰ The induced exposure method has also been used to examine nighttime driving and the presence of passengers as risk factors for teen driver crashes.^{17,23}

Study Limitations

The induced exposure method has several limitations. While this method relies on the assumption that drivers in crashes either are or are not responsible, fault is not always easy to determine. Using information on crash report forms means relying on the opinion of the officer filling out the report. For 88% of 2-car crashes in Wisconsin in 1999 (results not shown), only 1 driver was listed at fault. In actuality, it may be a much smaller proportion of crashes in which 1 driver is 100% at-fault.

Induced exposure may also fail to adequately take into account defensive driving. A group of drivers that does not drive as defensively as another group will be involved in more not-at-fault crashes. If we assume that 16-year-old drivers are less likely to drive defensively than those in other age groups, their apparent exposure will be inflated and thus their risk understated.¹⁹ It is also possible that police officers may be more likely to assign blame to young, inexperienced drivers, thus overstating the at-fault number. However, any bias or misclassification should be comparable when comparing at-fault percentages in similar driving circumstances from 2 different years in the same state.

CONCLUSION

Graduated driver licensing is intended to reduce exposure to collisions and increase safer driving by teens. This study shows that the reduction in crash rates for 16- and 17-year-old drivers after the adoption of graduated driver licensing in Wisconsin is due to reduced exposure, not safer driving. The benefits of graduated driver licensing appear to be due to delayed licensure, less driving in risky situations, and less driving overall.

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