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The impact of driver education on self-reported collisions among young drivers with a graduated license

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Abstract

In this study, we assess the impact of driver education on the risk of collisions in a Graduated Licensing System (GLS). Ontario's GLS requires all new drivers to successfully pass through two stages of graduated license (referred to as G1 and G2, respectively) before full licensure is granted. Surveys of driving behaviour and related factors were administered to Grades 11 and 12 students with a graduated license in seven Ontario schools in 1996 and 1998. A total of 1533 students completed the survey in 2 years. Multivariate logistic regression analysis revealed a significantly lower odds of self-reported collision involvement among G1 license holders with driver education (OR: 0.31, 95% CI: 0.12–0.83). No significant effects were observed for G2 license holders. Other significant predictors of collisions include sex of driver, months of licensure and kilometers driven for G2 license holders. These results suggest that the impact of driver education may be dependent on the stage of driver learning in which it occurs.

Keywords: Collisions; Driver education; Graduated licensing

1. Introduction

Young drivers are over-represented in collisions in every jurisdiction in the world, where reliable data have been collected (Boase and Tasca, 1998). In Ontario, in 1993, the percentages of drivers aged 16 and 17 years involved in collisions were 15.1 and 11.1%, higher than at any other age (Ontario Ministry of Transportation, 1993). Driver education is often proposed as a means to reduce collision involvement in this group (e.g., Ontario Ministry of Education, 1977).

The purposes of driver education include helping young drivers become safe and responsible drivers by teaching the skills and attitudes necessary for safe driving. Driver education courses are often a prerequisite for early licensure and for a reduction in insurance premiums (Society for Adolescent Medicine, 1984). In Ontario, approved driver training courses must offer at least 25 h of classroom training and 10 h of behind-the-wheel training. Driver training schools provide the majority of driver training in Ontario and about 65% of the students at driving schools in the province are young new drivers (Silverman et al., 1995).

A Graduated Licensing System (GLS) was introduced in Ontario in April 1994. Graduated driver licensing systems were first suggested a quarter of a century ago (Waller, 1974; Williams, 1997) and the first Graduated Licensing System was introduced in New Zealand in 1987 (Frith and Perkins, 1992). More recently, GLS programs have been introduced in various parts of Australia, Canada and the United States and available evidence indicates that these programs can reduce traffic safety problems among young and new drivers (Frith and Perkins, 1992; Mann et al., 1997; Boase and Tasca, 1998; Begg et al., 2000; Bouchard et al., 2000; McCartt et al., 2000; Williams, 1997). Ontario's program is similar to others and was designed to reduce the risk of collisions among

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new drivers by requiring them to progress through a two-stage licensing system before full licensure (Boase and Tasca, 1998). In the beginner (G1) level, five restrictions apply to enable the license holder to learn and practice driving skills away from the major causes of collisions. A G1 license holder must not drive alone, must not drink any alcohol if going to drive, must not drive between midnight and 5 a.m., must not drive on limited access highways or high-speed expressways and each person in the vehicle must wear a seat belt. The G1 licensing period lasts at least 12 months, but a G1 license holder can reduce the minimum time at the G1 stage to 8 months by completing an approved driver education course. The second (G2) level of Ontario's program lasts at least a further 12 months and two important conditions still apply. A G2 license holder must have a zero blood alcohol content (BAC) level while driving and each person in the vehicle must use a seat belt. All new drivers must progress through both levels before they can be considered for full licensure. It, therefore, takes a minimum of 20 months for novice drivers with appropriate driver education and 24 months for other novice drivers, from the time the driver first obtains a G1 license to the time the driver can take the final driving test to earn full driving privileges (i.e., a class G license).

In principle, driver education should reduce collisions. Some early evaluations seemed to show that the courses were effective, but these studies were subject to methodological problems that reduced confidence in the results (Haddon et al., 1964). Since that time, many studies on the impact of taking a driver education course on the risk of collisions among young drivers have been published (Seaver et al., 1979; Strang et al., 1982; Stock et al., 1983; Levy, 1988, 1990; Davis, 1990). However, the results are mixed and only a few studies have reported that driver education may have a beneficial effect on collisions (e.g., Stock et al., 1983). In Ontario, Boase and Tasca (1998) in an analysis based on aggregate collision data, reported that 16- to 19-year-old G2 novices with driver education had a collision rate that was 45% higher than G2 novices of the same age without driver education. These effects may be linked to exposure and experience differences between drivers who do and do not take driver education.

Studies have shown collisions to be associated with a variety of factors; factors with particularly strong associations include driving experience and driving exposure, alcohol and drug use and demographic measures, such as gender and age (e.g., Chipman, 1982; Mann et al., 1991). Thus, in Ontario's system, if a driver takes driver education during his or her G1 licensure and moves to a G2 license early, he or she likely has less driving experience, at least in terms of total time with a license, than drivers who do not take driver education. Thus, G2 drivers with driver education are probably less experienced drivers than those without driver education and this difference may account for the higher collision rate associated with driver education observed by Boase and Tasca (1998).

Most previous studies of driver education have not been able to control for these influences and it is, thus, possible that they have confounded the effects of driver education observed in previous work. The purpose of this study is to assess the effect of driver education on collisions when driving exposure and other factors affecting the risk of collisions are controlled. We predicted that, under these conditions, driver education will be associated with reduced collision risk.

2. Materials and methods

2.1. Data

The data used in this study were from two surveys conducted in seven Ontario secondary schools in 1996 and 1998. The surveys were conducted to obtain information on drinking and driving, collisions and related factors among student drivers in Grades 11 and 12 who had either a G1 or G2 license. Both surveys were administered in the first 3 months of the calendar year. Students in seven schools from two school boards in different regions of the province participated. Both boards had a mix of schools serving both urban and rural students. A total of 699 students completed the survey in 1996 and 835 students in the same schools completed the survey in 1998. The response rates were 68.4% in 1996 and 71.9% in 1998.

A self-administered questionnaire requiring about 30 min to complete was used on each occasion. All students in Grades 11 and 12 in the participating schools who had a graduated license were invited to participate. A parental consent form including a description of the study and a copy of the questionnaire were given to eligible student drivers. They were told to return the signed consent form and questionnaire to the study administrator, who was available in each school for 3 days following distribution of the questionnaires. Upon submission of a signed parental consent form and questionnaire, the student was paid Can$ 5.

Table 1 presents the characteristics of the sample, combined over 1996 and 1998 administrations of the survey. Slightly more than half (53.9%) of the sample was male and the modal age (48.4%) was 17 years. A majority of the respondents (55.2%) had a G1 license, 77.5% lived in an urban centre (population > 5000) and 77.0% were from the southern part of the province. A majority (67.3%) reported taking a driver education course and 9.1% reported a collision in the previous year. Both G1 and G2 license holders reported having their current license for about 7 months on average.

2.2. Statistical analyses

Multivariate logistic regression modeling was used to estimate the impact of taking a driver education course on collisions, adjusting for other variables following the guidelines of Hosmer and Lemeshow (2000). Conditional logistic regression analysis procedures were used since this analysis is the most common sparse-data fitting model for stratified

Table 1
Characteristics of the sample

Variables	G1 holders		G2 holders		Total	
	N	%	*N*	%	*N*	%
Age (years)						
16	497	58.7	87	12.7	584	38.1
17	288	34.0	455	66.2	743	48.4
18	62	7.3	145	21.2	207	13.5
Gender						
Female	391	46.2	316	46.0	707	46.1
Male	456	53.8	371	54.0	827	53.9
Location of residence						
Urban (population > 5000)	640	76.9	531	78.2	1171	77.5
Rural (population < 5000)	192	23.1	148	21.8	340	22.5
Geographic region of the province						
South	652	77.1	528	76.9	1180	77.0
North	194	22.9	159	23.1	353	23.0
Lives with parents						
Yes	684	81.0	576	84.0	1260	82.4
No	160	19.0	110	16.0	270	17.6
Takes school bus to school						
Never or rarely	506	60.1	439	64.2	945	61.9
Sometimes/always	336	39.9	245	35.8	581	38.1
Use of public transportation in the past 12 months						
Yes	757	89.5	592	86.4	1349	88.1
No	89	10.5	93	13.6	182	11.9
Percent of driving spent on rural roads						
<50%	527	62.2	456	66.4	983	64.1
50% or more	320	37.8	231	33.6	551	35.9
Type of vehicle most often driven						
Car	602	73.1	496	72.6	1098	72.9
Other (e.g., truck, motorcycle)	222	26.9	187	27.4	409	27.1
Driving frequency in the past 12 months						
Once per week or less	387	45.7	80	11.6	467	30.4
2–6 days per week	414	48.9	406	59.1	820	53.5
Every day	46	5.4	201	29.3	247	16.1
Estimated total kilometers ever driven						
1600 or less	623	76.4	273	40.4	896	60.1
1601–8000	142	17.4	215	31.8	357	23.9
More than 8000	50	6.1	188	27.8	238	16.0
Drinking frequency in the past 12 months						
None or less than once per month	353	41.7	284	41.3	637	41.5
One to three times per month	342	40.4	290	42.2	632	41.2
Once per week or more	152	17.9	113	16.4	265	9.2
Use of tobacco in the past 12 months						
No	422	49.9	341	49.6	763	49.8
Yes	424	50.1	346	50.4	770	50.2
Use of drugs without a prescription in the past 12 months						
No	540	63.8	448	65.2	988	64.4
Yes	307	36.2	239	34.8	546	35.6
Driving after drinking any alcohol in the past 12 months						
No	87	10.3	201	29.3	288	18.8
Yes	760	89.7	486	70.7	1246	81.2
Stopped by the police during road check in the past 12 months						
No	128	15.3	284	41.5	412	27.1
Yes	710	84.7	400	58.5	1110	72.9

Table 1 (*Continued*)

Variables	G1 holders		G2 holders		Total	
	N	%	*N*	%	*N*	%
Have taken or currently taking a driver education course						
Yes	456	54.2	573	83.5	1029	67.3
No	386	45.8	113	16.5	499	32.7
Collision involvement as a driver in the past 12 months						
Yes	25	3.0	112	16.4	139	9.0
No	817	97.0	571	83.6	1388	91.0
Months of licensure						
1	58	7.0	91	13.3		
2	61	7.3	49	7.2		
3	75	9.0	53	7.8		
4	74	8.9	45	6.6		
5	74	8.9	42	6.2		
6	99	11.9	45	6.6		
7	77	9.2	47	6.9		
8	71	8.5	56	8.2		
9	64	7.7	49	7.2		
10	42	5.0	45	6.6		
11	39	4.7	37	5.4		
12	27	3.2	35	5.1		
13+	73	8.8	88	12.9		
Total	834	100.0	682	100.0		
Average months of licensure		6.8		7.1		

logistic models (Greenland, 1998). Initially, we selected a set of variables covering demographic, behavioural and perceived environmental variables and exposure factors which could be related to collision involvement. This set included all the variables included in Table 1 in addition to a variable representing school. Based on univariate logit analysis of the pooled data set, any variable whose univariate test had a *P*-value < 0.25 was included in the multivariate models (Hosmer and Lemeshow, 2000). Other variables were excluded from the logistic regression analyses in order to avoid synonymous variables and collinearity (Klepp and Perry, 1990). For example, tobacco use was not included in the models because tobacco was strongly correlated with drug use. The school variable was included in the logistic regression model in order to control for school effects. Because the sampling is based on seven schools, it is quite likely that a school as a cluster includes people who are more like one another (e.g., ethnically and socioeconomically). As a result, there may tend to be more diversity or heterogeneity between than within schools.

Multivariate logistic regression models were built based on license class since there were important differences in licensing conditions for G1 and G2 holders. Multivariate model building was limited to observations without missing values. After excluding observations without missing values, 773 (91.2%) of 847 subjects were included in the multivariate analysis for G1 holders and 631 (91.9%) of 686 subjects were included in the multivariate analysis for G2 holders.

Model fit was evaluated using the model Chi-square (χ^2) (Menard, 1995; Munro, 1997; Pampel, 2000). Adjusted odds ratios (OR) and 95% confidence intervals (CI) were calculated to assess the strength of the associations between taking a driver education course and collisions, after adjusting for other predictors.

3. Results

Table 2 shows the odds ratio and 95% confidence intervals of collision involvement for driver education and other predictors in the multivariate logistic regression models for G1 and G2 holders. As can be seen from Table 2, when the effects of other variables were adjusted for, the impact of taking a driver education course on collisions among G1 license drivers was significant. The odds ratio of collision involvement for driver education of 0.31 (95% CI: 0.12–0.83) revealed that G1 holders who reported taking driver education were much less likely to be involved in collisions than G1 holders who did not report driver education. Thus, taking a driver education course was associated with a significantly lower proportion of G1 drivers reporting collisions. While there appeared to be some elevation of collision risk associated with driver education among G2 drivers, this increase was not statistically significant.

Additionally, while there were no other significant predictors of collision involvement for G1 holders, there were three additional significant predictors of collision involvement

Table 2
Multivariate (conditional) logistic regression analyses of determinants of self-reported collision involvement for G1 and G2 drivers

Variables	OR (95% CI)	
	G1 drivers ($N = 847$)	G2 drivers ($N = 686$)
Driver education		
No	1.00	1.00
Yes	0.31 (0.12, 0.83)*	1.73 (0.83, 3.66)
Age (16–18 years)	1.11 (0.56, 2.20)	0.65 (0.39, 1.07)
Sex		
Female	1.00	1.00
Male	1.25 (0.49, 3.19)	0.52 (0.32, 0.84)**
School bus taking		
Never/rarely	1.00	1.00
Often/always	0.50 (0.15, 1.58)	0.84 (0.47, 1.48)
Transit taking		
No	1.00	1.00
Yes	0.18 (0.02, 1.21)	1.02 (0.44, 2.37)
Drug use		
No	1.00	1.00
Yes	2.45 (0.96, 6.43)	1.56 (0.95, 2.56)
Road check		
No	1.00	1.00
Yes	2.32 (0.88, 6.06)	1.58 (0.97, 2.56)
Months of licensure (1, 2, . . ., 12, 13+)	1.04 (0.91, 1.18)	1.12 (1.04, 1.21)***
Estimated total kilometers ever driven		
1600 or less	1.00	1.00
1601–8000	0.80 (0.25, 2.60)	2.06 (1.15, 3.68)**
More than 8000	2.38 (0.68, 8.27)	2.10 (1.13, 3.90)*
Drinking frequency		
None or less than once per month	1.00	1.00
1–3 times per month	0.77 (0.18, 3.32)	0.64 (0.32, 1.26)
Once per week or more	2.01 (0.68, 5.88)	0.80 (0.43, 1.48)
School	$\chi^2 = 1.071$ d.f. = 6 $P = 0.983$	$\chi^2 = 1.336$ d.f. = 6 $P = 0.970$
Observation cases	773 (91.2%)	631 (91.9%)
Missing cases	74 (8.7%)	55 (8.1%)
Initial −2 log likelihood	213.914	564.837
−2 log likelihood	184.186	509.480
Model square (χ^2)	29.728 ($P = 0.040$, d.f. = 18)	55.357 ($P = 0.000$, d.f. = 18)

* $P < .05$, Wald test.
** $P < .01$, Wald test.
*** $P < .001$, Wald test.

among G2 holders. The odds ratio for sex was 0.52 (95% CI: 0.32–0.84), with male G2 holders being less likely to be involved in collisions than female G2 holders. The odds ratio for months of licensure was 1.12 (95% CI: 1.04–1.21), indicating that the odds of collision increased with increasing months of licensure among G2 holders. The risk of collision involvement increased with increased kilometers driven. As can be seen in Table 2, when the group who reported driving 1600 km or less was used as the reference group, the odds ratios were 2.06 (95% CI: 1.15 and 3.68) for driving 1601–8000 km and 2.10 (95% CI: 1.13 and 3.90) for driving 8000 km and over.

4. Discussion

In interpreting the results of this study, several limitations should be noted. First, the results of this study cannot be assumed to be generalizable to the population of young drivers. The overall sample design was guided by the need to provide a dispersed, heterogeneous sample of students and the seven schools were chosen to ensure the inclusion of urban–rural and regional differences. Second, the data involve self-report, and thus, may be subject to self-report bias. For example, some individuals may not respond honestly to some of the questions, particularly where sensitive information is involved. However, survey data on youthful self-reports of a variety of behaviours, including alcohol and drug use, drinking driving and collisions, have been found to have acceptable levels of validity under conditions employed here (anonymity, no consequences associated with reporting; O'Malley et al., 1983; Smith-Donals and Klitzner, 1985; Stacy et al., 1985; Campanelli et al., 1987; Turner et al., 1992; Harrison et al., 1993). McKnight et al. (1982) compared self-reports of collisions with official records in a sample of older drivers and found that there was no selective bias in self-report associated with driver training. Third, while the response rate for these surveys (around 70%) is considered very good (Aday, 1996), if particular types of people were less likely to participate, this could bias the sample. For example, heavy drinkers, who may be more likely to drink and drive and to be involved in collisions (Macdonald and Mann, 1996), may be less likely to participate. Bias introduced by this factor has been shown to be conservative and to decrease the likelihood of detecting differences between groups (Mann et al., 2002). A fourth consideration is the possibility that the results observed here could be accounted for by factors other than those included in the analyses. Many factors potentially influence the risk of collisions among adolescent drivers, including demographic, environmental and behavioural (U.S. Department of Transportation, 1985; Health and Welfare Canada, 1988; Klepp and Perry, 1990; Macdonald and Mann, 1996). While an important innovation of this research in the context of assessing the effects of driver training was our ability to include many of these measures, such as driving experience and exposure, in our multivariate analyses, some measures were not available to us and thus cannot be entirely ruled out as potential explanations. Fifth, because this is a cross-sectional study, a causal interpretation of the results cannot be assumed. Keeping in mind these limitations, the results of this study are nevertheless of substantial interest.

Multivariate logistic regression analysis revealed that there was a reduced risk of collisions associated with driver education among drivers with a G1 license. Many investigators have evaluated the impact of taking a driver education course on collisions among young drivers, but the evidence has been controversial (Vernick et al., 1999). Our results suggest that driver education taken very early in the licensing process reduced the risk of collisions among beginning drivers, during the time that their license is subject to a larger number of restrictions.

A potential confounding factor in these analyses is the availability of reduced time with a G1 license as an incentive to take driver education. The G1 licensing period lasts a minimum of 12 months, but a G1 license holder can reduce that time to 8 months by completing an approved driver education course (Ontario Ministry of Transportation, 2001). Thus, the time at risk for collisions for G1 drivers with driver education may be potentially only two-thirds that of G1 drivers without driver education and a reduced rate of collisions by G1 drivers with driver education as a group may be due to this possible difference in exposure. Similarly, G2 drivers who have taken driver education may have less driving experience than those who have not taken driver education and thus be more inexperienced drivers and more likely to be involved in a collision. The confounding effects of driving exposure and experience are potential explanations of many previous analyses of the effects of driver education (Society for Adolescent Medicine, 1997; Vernick et al., 1999). However, we believe that our results are unlikely to be confounded by exposure and experience differences for two reasons. First, months with current drivers license was included as a factor in our analyses in order to control for its effect. Kilometers driven, another measure of driving experience was also included and would also control for differing experience. Second, we split G1 and G2 drivers at the median of numbers of months with current license for each group and compared drivers with and without driver education for each level of license. Among drivers holding a G1 license, a comparison of groups who had held a drivers license above or below the median number of months of licensure revealed no significant differences in the proportions with and without driver education ($\chi^2 = 0.09$, $P > 0.10$). Similarly, there were no significant differences between G2 drivers holding a license above and below the median period of current licensure in the proportions with and without driver education ($\chi^2 = 1.55$, $P > 0.10$). Thus, exposure and experience factors do not appear to account for the effects of driver education observed here.

Other significant predictors of self-reported collisions identified in the study were gender, months of licensure and kilometers driven for G2 holders. A significant sex difference in the risk of collisions for G2 drivers appeared when other factors were adjusted for, with female drivers being more likely to be involved in collisions than male drivers. While other studies have reported that young male drivers are more likely to be involved in collisions (e.g., Roberts, 1971), Kim et al. (1998) found that controlling for exposure reduced this difference. Our data suggest that when exposure, experience and other factors are controlled as well, the observed collision risk of the two genders may change even more. Months of licensure and the measure of kilometers driven reflect a driver's experience and exposure. The risk of collisions decreases as a driver has more driving experience (Chipman, 1982; Roberts, 1971; Motor Vehicle Branch Ministry of Attorney General, 1992), but increases as a driver has more driving exposure (Chipman, 1982). We observed that more months of licensure and driving more kilometers were associated with a higher risk of collisions, suggesting that these results reflect driving exposure in our sample.

The finding that driver education was associated with significant reductions in collision risk for G1 drivers, but not G2 drivers, is an important observation for efforts to understand and prevent collisions among young and new drivers. However, based on previous studies (e.g., Boase and Tasca, 1998), it does not seem advisable to encourage driver education with methods that will lead to increased driving exposure. Additional research to understand the factors that increase or reduce collision risks among young drivers and to assess the role of driver education in modifying that risk, is clearly necessary (Mayhew et al., 1998).

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