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Compliance With and Enforcement of Graduated Driver Licensing Restrictions

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Abstract

Introduction—Graduated Driver Licensing (GDL) is the most effective strategy to reduce the burden of young driver crashes, but the extent to which young intermediate (newly licensed) drivers comply with and police enforce important GDL passenger and night-time restrictions is largely unknown. Population-level rates of intermediate drivers' compliance were estimated as well as police enforcement among crash-involved drivers who were non-compliant.

Methods—New Jersey's statewide driver licensing and crash databases were individually linked. The quasi-induced exposure method's fundamental assumption—that non-responsible young intermediate drivers in clean (i.e., only one responsible driver) multivehicle crashes are reasonably representative of young intermediate drivers on the road—was borrowed. Incidence was then estimated among the 9,250 non-responsible intermediate drivers who were involved in clean multivehicle crashes from July 2010 through June 2012. The proportion of crash-involved non-compliant intermediate drivers who were issued a GDL citation, by crash responsibility, was calculated. Data were collected in 2013 and analyzed in 2015.

Results—Overall, 8.3% (95% CI=7.8%, 8.9%) of intermediate drivers' trips were non-compliant with New Jersey's passenger restriction and 3.1% (95% CI=2.8%, 3.5%) with its night-time restriction; compliance was significantly lower among those residing in low-income and urban areas, among male drivers, on weekends, and in summer months. The proportion of crash-involved non-compliant intermediate drivers who were issued a GDL citation was low (non-responsible drivers, 10.3%; responsible drivers, 19.0%).

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Conclusions—The vast majority of intermediate driver trips are in compliance with GDL restrictions. Outreach activities should consider targeting higher-risk situations and groups with higher non-compliance rates.

Introduction

Motor vehicle crashes are the leading cause of death and acquired disability among U.S. adolescents.¹ Graduated Driver Licensing (GDL) systems remain the cornerstone of public policy to reduce the burden of young driver crashes. Certain GDL provisions restrict newly licensed (“intermediate”) drivers from engaging in particular driving behaviors known to substantially increase their fatal crash risk.^{2,3} Carrying two peer passengers is associated with a twofold increase in young drivers’ risk of being killed in a crash versus driving alone,² and per-mile fatal crash rates for 16-year-old drivers have been found to be approximately three times higher at night-time.³ Evaluations of GDL passenger and night-time restrictions have found significant crash reduction.^{4,5} However, the effectiveness of these provisions depends largely on young drivers’ compliance with them, which is likely to be at least partly motivated by the extent of police enforcement (or perceived enforcement).

The level of young intermediate drivers’ compliance with GDL restrictions is largely unknown, partly due to limitations of epidemiologic methods currently employed. Consequently, no population-level estimates of compliance exist. Cross-sectional surveys primarily have provided only general estimates of driver non-compliance; estimates vary substantially between jurisdictions.⁶ Further, surveys are likely limited by nonresponse bias, lack of representativeness, and smaller sample sizes that preclude assessment of subgroup differences. Studies that directly observe behaviors among young drivers are unable to accurately measure “compliance” per se because intermediate drivers are not easily distinguished from fully licensed drivers; further, observed driving behaviors in limited settings may not typify behavior at other times and locations.^{7,8} Previous analyses of crash data either included at-fault drivers, likely leading to underestimates of compliance in the general young driver population, or were unable to isolate the full group of intermediate drivers for whom the restriction is applicable, instead relying on age as a proxy.^{9–11} Finally, naturalistic driving studies capturing real-time compliance via in-vehicle technology likely have the most internally valid estimates but are resource intensive and have limited generalizability owing to highly selective samples.^{12,13}

Even less is known about police enforcement of GDL passenger and night-time restrictions. The existing literature consists of several semi-structured interviews with law enforcement that suggest police do not feel empowered to enforce restrictions and a recent analysis that found low levels of GDL conviction among young intermediate drivers.^{6,14,15} To date, no study has assessed GDL enforcement specifically among non-compliant intermediate drivers.

In this study, population-level young intermediate driver compliance with GDL passenger and night-time restrictions in NJ were estimated using application of the quasi-induced exposure (QIE) method—a validated traffic safety method used to estimate driving exposure in the absence of more-detailed information (e.g., vehicle miles traveled). In addition,

compliance variation by relevant driver, vehicle, and environmental factors was examined. Finally, the extent to which police enforce GDL passenger and night-time restrictions among crash-involved non-compliant intermediate drivers was reported.

Methods

The GDL system in NJ is one of the most comprehensive in the U.S. Residents are eligible for an intermediate license at age 17 years and must hold this license at least 1 year. During this phase, drivers are limited to one passenger unless a parent/guardian is in the vehicle and are banned from driving between 11:01PM and 5:00AM. NJ is one of only a few U.S. states for which GDL passenger and night-time restrictions apply to all newly licensed drivers aged <21 years; in virtually all others, new drivers aged 18 years are not subject to these restrictions. With proper documentation, NJ intermediate drivers are eligible for exemption to the night-time restriction for employment or religious reasons. At age 18 years and following the intermediate period, drivers are eligible for a full, unrestricted license.

Data Source

Data from two administrative sources were previously linked: the NJ Motor Vehicle Commission's Licensing Database, which contains detailed information on each NJ driver's progression through the licensing process and the date and type of all traffic-related citations; and the NJ Department of Transportation's Crash Record Database, which contains data for all police-reported crashes. In total, 98% of crash-involved NJ drivers were linked to a licensing record; 94% of these matched on exact 15-digit driver license number. Finally, the date of acquisition of an intermediate license and license transactions that indicated transition to a full license were used to identify exact dates of the intermediate license phase. A detailed description is provided in Curry et al.¹⁶

The QIE method permits relative estimates of crash involvement adjusted for driving exposure.^{17,18} QIE's fundamental assumption is that non-responsible (i.e., not-at-fault) drivers in clean (i.e., one and only one responsible driver) two-vehicle crashes are "randomly selected" by responsible drivers from the population of road users at the time and space of the crash and thus are reasonably representative of the road user population. If the assumption is valid, then compliance with GDL restrictions among these non-responsible crash-involved intermediate drivers should also reasonably represent the estimated compliance among intermediate drivers on the road.

Appropriate application of the QIE method required that the authors:

1. validly determined crash responsibility; and
2. validated the fundamental assumption that non-responsible young NJ intermediate drivers in clean two-vehicle crashes are reasonably representative of young NJ intermediate drivers on the road.

This formative work was conducted in two previous studies.^{19,20} In the first, it was determined that crash responsibility was more validly determined using the presence of a crash-contributing driver action rather than traffic citations, used historically¹⁹; this finding

was supported by several other recent studies.^{21,22} Thus, in this study, a driver was determined to be responsible if they were noted to have committed one or more driver action that contributed to the crash. NJ's *Police Guide for Preparing Reports of Motor Vehicle Crashes* instructs the investigating officer to determine the most prominent proximate factors (at least one per crash and up to two per driver) that contributed to the crash, regardless of whether a citation was issued.²³ Possible factors include vehicle factors (e.g. brakes), environmental factors (e.g. road conditions), and 16 specific driver actions (e.g., inattention, unsafe speed). Any number of crash-involved drivers—including none—could be responsible. With respect to validating the fundamental assumption, it has been hypothesized that if not-at-fault drivers in clean two-vehicle crashes are indeed representative of the driving population, distributions of key variables among this group should be similar to distributions among later non-responsible drivers in clean three-or-more-vehicle crashes—a group whose randomness of crash involvement is likely greater.^{24,25} Thus, in the second previous study, existing validation methods were used to conclude that the representativeness assumption holds among the population of young NJ intermediate drivers.²⁰ Given the similarities between non-responsible drivers in two-vehicle and three-or-more-vehicle crashes and to optimize sample size, this study included non-responsible intermediate drivers from all clean crashes involving two or more passenger vehicles.

Study Sample and Measures

All NJ intermediate drivers aged 17–20 years involved in a police-reported crash from July 1, 2010 through June 30, 2012 were identified. Crash responsibility for each driver was determined as described and clean crashes identified (Figure 1). Non-compliance with NJ's night-time restriction was defined as involvement in a crash reported to occur from 11:01PM through 4:59AM. The presence of a parent/guardian could not be confirmed, so non-compliance with NJ's passenger restriction was conservatively defined as the presence of more than one passenger without at least one passenger aged ≥ 35 years.

Police enforcement of a GDL restriction was defined by the issuance of a citation for a GDL violation as noted on either:

1. the crash report; or
2. by record of a GDL violation occurring the same date as the crash in the licensing database, which was populated directly from the NJ Administration of the Courts database.

Enforcement of passenger restrictions was based on violations citing NJ Statutes Annotated (N.J.S.A.) 39:3–13.8b and night-time restriction enforcement on violations citing N.J.S.A. 39:3–13.8c. Both also included a commonly cited general statute that outlines intermediate driver restrictions (N.J.S.A. 39:3–13.4), and thus the outcome measure was more generally defined as “issued citation for a GDL violation.” Intermediate NJ drivers may not plea bargain any point carrying offense.

Exact age, gender, and ZIP code were obtained from the licensing record. Crash-specific variables were obtained or derived from the crash report. Each driver's residence address at the time of the crash was used to define ZIP code-level indicators for SES and population

density. The 2011 American Community Survey was used to categorize ZIP codes into quintiles of median household income and the 2010 Census Gazetteer Files to categorize ZIP codes into quintiles of people per square mile.

Statistical Analysis

The prevalence of non-compliance was estimated as I_i/N , where i is the restriction of interest, N is the total number of non-responsible intermediate drivers involved in clean multivehicle crashes, and I_i is the number of these non-responsible intermediate drivers who were not in compliance with restriction i at the time of their crash. I_i was assumed to follow a binomial distribution; the corresponding 95% CI was estimated using exact procedures. The non-compliance ratio for two driver subgroups or conditions was assumed to follow a normal distribution if sample size permitted. The rate of GDL citation issuance (i.e., enforcement) among non-complying intermediate drivers was calculated both for non-responsible drivers as well as those responsible and compared using chi-square tests. Explicit accounting for the same driver contributing to multiple crashes was not attempted, as only 5% of drivers were involved in more than one crash over the study period. Data were collected in 2013 and analyzed in 2015. All analyses were conducted using SAS, version 9.3. This study was approved by The Children's Hospital of Philadelphia's IRB.

Results

A total of 32,203 intermediate drivers aged 17–20 years were involved in 30,594 clean multivehicle crashes during the 2-year study period; 9,250 (29%) were deemed non-responsible (Figure 1). Characteristics of these drivers—and for comparison those responsible for their crashes—and their crashes are shown in Table 1. Approximately half were aged 17 years and female, and most were driving alone.

The estimated incidence of non-compliance among non-responsible crash-involved intermediate drivers was 8.3% (95% CI=7.8%, 8.9%) for NJ's GDL passenger restriction and 3.1% (95% CI=2.8%, 3.5%) for NJ's GDL nighttime restriction; 0.53% (95% CI=0.39%, 0.70%) were not in compliance with either restriction. Non-compliance rates were further estimated for driver subgroups and by relevant vehicle and environmental factors (Table 2). Compared with 17-year-olds, non-compliance with the passenger restriction was 34% higher among 18-year-old drivers but not those aged 19 or 20 years; for the night restriction, estimated rates of non-compliance among those aged 19 and 20 years were more than three times higher than for 17-year-olds. Non-compliance with the passenger restriction was also significantly higher among teens residing in areas with the highest and lowest population density, during summer months, and on interstate/highway roads, but no significant differences were found by gender. Unlike the passenger restriction, non-compliance with the night restriction was 35% higher for male drivers. Compared with drivers residing in the highest-income areas, the estimated likelihood of non-compliance among drivers residing in the lowest-income areas was 1.77 times higher (95% CI=1.40, 2.24) for the passenger restriction and 2.58 times higher (95% CI=1.73, 3.83) for the night restriction.

There were 767 non-responsible young intermediate drivers determined not to be in compliance with NJ's passenger restrictions. Of these drivers, 10.3% were issued a citation for a GDL violation. On the other hand, 19.0% of the 1,753 responsible drivers who were not in compliance were issued a GDL citation ($p<0.01$). Overall enforcement rates were lower for night-time restrictions but with a similar twofold increase among responsible drivers (non-responsible, 4.2% of 286 non-complying drivers; responsible, 10.0% of 783 non-complying drivers; $p<0.01$). Finally, enforcement rates were generally highest among the youngest drivers; among non-responsible intermediate drivers who were non-compliant with NJ's passenger restriction, the proportion of 17-year-olds issued a citation was approximately four times that of 18- and 20-year-olds and more than 6 times that of 19-year-olds (Figure 2).

Discussion

The effectiveness of GDL night-time and passenger restrictions hinge largely on teens' compliance with them. Despite that, surprisingly little is known about compliance in the general population of young novice drivers. This study offers an alternative method by which to estimate and monitor population-level rates of non-compliance with GDL restrictions among newly licensed drivers. Findings indicate that the vast majority of intermediate driver trips in NJ are in fact in compliance with passenger and night-time restrictions; however, there is variation in compliance among driver subgroups, and in particular higher non-compliance rates among those residing in low-income and urban areas, among male drivers, on weekends, and in summer months.

The majority of previous studies estimating compliance with GDL restrictions have done so using self-report surveys. These studies have provided mostly high-level per-driver estimates, which have varied widely by jurisdiction and for several reasons may overestimate the true extent of non-compliance.^{6,26} For example, a survey conducted in 2012 found that approximately 45% of NJ intermediate drivers reported driving with more than one passenger other than a family member.²⁷ Conversely, the QIE and naturalistic methods both estimate trip-level instead of driver-level compliance. Indeed, the findings of this study are very similar to those from naturalistic studies, which have estimated that newly licensed drivers carry two or more passengers (a rough estimate of non-compliance) in 8%–9% of trips.^{12,13} The current method is complementary in that it is substantially less resource intensive, more generalizable, and can address critical population-level research questions.

Although the proportion of overall young novice driver trips that are non-compliant trips appears to be relatively low (<10%), that is not to suggest there isn't room and need for improvement. Given the 8.5% passenger restriction non-compliance rate found, data suggesting that young novice drivers take an average of two to three trips per day,^{28,29} and a monthly average of more than 170,000 young intermediate drivers in NJ,³⁰ an estimated 30,000–40,000 intermediate driver trips taken each day in NJ are not in compliance with passenger restrictions. Further, 25% of all fatal crashes involving a young intermediate driver that occurred in NJ in 2010–2014 were during restricted hours (AEC, unpublished observations, 2016).

Very little is known about the enforcement of GDL laws. In general, enforcement of GDL provisions is challenging given that—in virtually all U.S. states—the only way to identify an intermediate driver is to conduct a traffic stop and inspect the driver's license. Officers have reported that this greatly compromises their ability to detect intermediate teen drivers and thus properly enforce GDL restrictions.^{14,35} A notable exception is NJ, which implemented a first-in-the-U.S. provision in 2010 requiring intermediate drivers to place a decal on their car indicating their license status; this was associated with a short-term increase in the GDL citation rate that did not persist over time.³⁶ Evaluations of laws prohibiting drivers' hand-held cell phone use suggest that stronger enforcement may increase compliance.³⁷ However, the findings of this study indicate that—although officers cite drivers more when they are responsible for their crash—overall GDL citation among non-complying young drivers involved in crashes remains low. This supports previous findings both of leniency in enforcing traffic safety laws and teens' perceptions of low enforcement.^{15,27,38}

Low rates of police enforcement suggest that parents may be a better target for ensuring teens comply with restrictions. Indeed, research has emphasized an important role for parents in establishing rules for and monitoring teens' compliance.³¹ However, the effect of parent-directed interventions aimed to increase compliance has been modest.^{7,32} Results from this study highlight several potential areas for future outreach, such as awareness campaigns targeting higher-risk times (weekends, summer) and affordable access to education about GDL for lower-income drivers, who have been found to have lower rates of participation in formal driver education and increased rates of risky driving behaviors and crashes.^{33,34,39}

Limitations

The primary strength of this study is its utilization of the QIE method, which allows for the first examination of population-based compliance with GDL restrictions. However, a notable limitation is that the overall compliance rate will reflect compliance in environments and conditions under which intermediate drivers experience multivehicle crashes and toward groups with relatively more presence on the road; that bias is somewhat reduced when analyses are stratified,¹⁸ as done here. In addition, the proportion of trips from 11:01AM through 4:59AM that were work-related and thus exempt could not be accounted for. For the passenger restriction, the conservative approach used here of assuming passengers aged 35 years or older were parents/guardians would be expected to lead to underestimates of non-compliance. With respect to enforcement, rates among non-complying young drivers were limited to crash situations; police behavior in issuing citations may be different in non-crash situations, although these data would be difficult to obtain as it would require documentation of situations in which young drivers were noted to be non-compliant but the police did not take any action. Given that NJ is a highly urbanized state, has the highest age of licensure, and is one of only a handful of states in which GDL applies to novice drivers aged 18–20 years, these findings may not be readily generalized to other jurisdictions; notably, however, non-compliance estimated in two other states (VA, NC) via naturalistic driving methods was remarkably similar.^{12,13} Finally, being able to identify young intermediate drivers relied on access to and linkage of high-quality driver licensing data, which may not be readily available in other jurisdictions.

Conclusions

This study is the first to assess population-based rates of compliance with these provisions and examine how rates vary among driver subgroups and under different conditions. Findings indicate that although the vast majority of intermediate driver trips are in compliance with passenger and night-time restrictions, non-compliance rates are higher for certain driver subgroups and under certain conditions. Future efforts to enhance teen compliance should consider incorporating opportunities for targeted messaging about higher-risk situations and toward higher-risk groups. Overall, less than a quarter of crash-involved drivers were issued GDL citations and citations were more likely to be issued to the youngest drivers; additional research on enforcement is needed.

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Dr. Curry conceptualized and designed the study, coordinated and supervised data management and analysis, drafted the manuscript, interpreted the data, and approved the final manuscript as submitted. Ms. Pfeiffer assisted with the design of the study, conducted data management and analysis, interpreted the data, reviewed and critically revised the manuscript, and approved the final manuscript as submitted. Dr. Elliott assisted with the design of the study, interpreted the data, reviewed and critically revised the manuscript, and approved the final manuscript as submitted.

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Figure 1.
Flowchart depicting selection of study population. Grey boxes indicate drivers who were excluded from the study.

Figure 2. Proportion of crash-involved non-compliant young NJ intermediate drivers that were issued a GDL citation, by crash responsibility and age, July 2010–June 2012. GDL, Graduated Driver Licensing; NJ, New Jersey

Table 1

Characteristics of Young New Jersey Intermediate Drivers Involved in Clean Multi-Vehicle Crashes, by Crash Responsibility

Factor	Non-responsible		Responsible	
	N	Column %	N	Column %
Overall	9,250	100	22,953	100
Age (at crash)				
17	4,475	48.4	11,826	51.5
18	2,501	27.0	6,193	27.0
19	1,295	14.0	2,977	13.0
20	979	10.6	1,957	8.5
Gender				
Female	4,864	52.6	11,152	48.6
Male	4,386	47.4	11,801	51.4
ZIP-code level population density, quintile				
1 (408.6)	657	7.1	1,696	7.4
2 (408.7–1223.6)	1,869	20.2	4,552	19.8
3 (1223.7–2615.8)	2,255	24.4	5,727	25.0
4 (2615.9–4876.8)	2,350	25.4	5,688	24.8
5 (4876.9)	2,111	22.8	4,983	21.7
Missing	8	0.1	307	1.3
ZIP code-level median household income, quintile				
1 (\$57,226)	1,815	19.6	4,182	18.2
2 (\$57,227–\$72,857)	1,961	21.2	4,663	20.3
3 (\$72,858–\$87,222)	1,848	20.0	4,597	20.0
4 (\$87,223–\$105,888)	2,028	21.9	5,109	22.3
5 (\$105,889)	1,590	17.2	4,095	17.8
Missing	8	0.1	307	1.3
Roadway type				
Interstate or state highway	2,589	28.0	6,403	27.9
Other road (e.g. state, county)	6,659	72.0	16,549	72.1
Day of week				
Saturday and Sunday	1,898	20.5	4,999	21.8
Monday through Friday	7,352	79.5	17,954	78.2
Season				
Spring (Mar–May)	2,390	25.8	5,781	25.2
Summer (Jun–Aug)	2,134	23.1	5,749	25.0
Fall (Sep–Nov)	2,577	27.9	6,162	26.8
Winter (Dec–Feb)	2,149	23.2	5,261	22.9
Environmental conditions				
Clear	7,453	80.6	18,334	79.9
Poor	1,779	19.2	4,554	19.8

Factor	Non-responsible		Responsible	
	N	Column %	N	Column %
Missing	18	0.2	65	0.3

Table 2
Ratio of Non-Compliance With GDL Restrictions Among Intermediate Drivers (n=9,250), by Relevant Characteristics^a

Factor	Passenger restriction ^b			Night restriction ^c		
	% of drivers who were non-compliant	Non-compliance ratio	95% CI	% of drivers who were non-compliant	Non-compliance ratio	95% CI
Age (at crash)						
17	7.5	ref		1.7	ref	
18	10.0	1.34	(1.15, 1.57) ***	3.4	2.01	(1.48, 2.72) ***
19	8.6	1.15	(0.94, 1.41)	5.7	3.34	(2.43, 4.57) ***
20	7.4	0.99	(0.78, 1.27)	5.3	3.14	(2.22, 4.44) ***
Gender						
Female	8.4	ref		2.7	ref	
Male	8.2	0.98	(0.86, 1.13)	3.6	1.35	(1.07, 1.69) *
ZIP-code level population density, quintile						
1 (408.6)	10.0	1.40	(1.06, 1.84) *	2.1	0.89	(0.50, 1.59)
2 (408.7–1223.6)	7.3	1.03	(0.82, 1.28)	1.9	0.80	(0.53, 1.22)
3 (1223.7–2615.8)	7.1	ref		2.4	ref	
4 (2615.9–4876.8)	8.5	1.19	(0.98, 1.46)	3.0	1.25	(0.88, 1.77)
5 (4876.9)	9.9	1.39	(1.14, 1.69) **	5.4	2.24	(1.63, 3.08) ***
ZIP code-level median household income, quintile						
1 (\$57,226)	10.7	1.77	(1.40, 2.24) ***	5.2	2.58	(1.73, 3.83) ***
2 (\$57,227–\$72,857)	8.0	1.33	(1.04, 1.70) *	3.4	1.70	(1.12, 2.58) *
3 (\$72,858–\$87,222)	8.6	1.43	(1.12, 1.82) **	2.9	1.45	(0.94, 2.24)
4 (\$87,223–\$105,888)	8.0	1.33	(1.04, 1.69) *	2.0	0.98	(0.62, 1.55)
5 (\$105,889)	6.0	ref		2.0	ref	
Roadway type						
Interstate or state highway	9.3	1.16	(1.01, 1.35) *	3.8	1.36	(1.07, 1.73) *

Factor	Passenger restriction ^d			Night restriction ^c		
	% of drivers who were non-compliant	Non-compliance ratio	95% CI	% of drivers who were non-compliant	Non-compliance ratio	95% CI
Other road (e.g. state, county)	8.0	ref		2.8	ref	
Day of week						
Saturday and Sunday	9.0	1.11	(0.95, 1.31)	7.6	3.93	(3.13, 4.92) ***
Monday through Friday	8.1	ref		1.9	ref	
Season						
Spring (Mar–May)	8.6	1.21	(0.99, 1.48)	3.0	1.06	(0.76, 1.49)
Summer (Jun–Aug)	9.6	1.35	(1.10, 1.65) **	3.7	1.30	(0.94, 1.81)
Fall (Sep–Nov)	7.9	1.11	(0.90, 1.35)	2.9	1.01	(0.72, 1.41)
Winter (Dec–Feb)	7.1	ref		2.9	ref	
Environmental condition						
Clear	8.6	ref		3.2	ref	
Poor	6.9	0.80	(0.67, 0.97) *	2.9	0.93	(0.69, 1.25)

Note: Boldface indicates statistical significance (* $p<0.05$; ** $p<0.01$; *** $p<0.001$).

^aLimited to non-responsive drivers in clean multi-vehicle crashes.

^bFor each factor, compliance with the passenger restriction was unknown for 0.09% to 0.57% of drivers; these drivers were excluded from analyses.

^cFor each factor, compliance with the night restriction was unknown for 0.19% to 1.90% of drivers; these drivers were excluded from analyses.

GDL, Graduated Driver Licensing