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The effect of the learner license Graduated Driver Licensing components on teen drivers' crashes

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ABSTRACT

Background: Most studies evaluating the effectiveness of Graduated Driver Licensing (GDL) have focused on the overall system. Studies examining individual components have rarely accounted for the confounding of multiple, simultaneously implemented components. The purpose of this paper is to quantify the effects of a required learner license duration and required hours of supervised driving on teen driver fatal crashes.

Methods: States that introduced a single GDL component independent of any other during the period 1990–2009 were identified. Monthly and quarterly fatal crash rates per 100,000 population of 16- and 17-year-old drivers were analyzed using single-state time series analysis, adjusting for adult crash rates and gasoline prices. Using the parameter estimates from each state's time series model, the pooled effect of each GDL component on 16- and 17-year-old drivers' fatal crashes was estimated using a random effects meta-analytic model to combine findings across states.

Results: In three states, a six-month minimum learner license duration was associated with a significant decline in combined 16- and 17-year-old drivers' fatal crash rates. The pooled effect of the minimum learner license duration across all states in the sample was associated with a significant change in combined 16- and 17-year-old driver fatal crash rates of −.07 (95% Confidence Interval [CI] −.11, −.03). Following the introduction of 30 h of required supervised driving in one state, novice drivers' fatal crash rates increased 35%. The pooled effect across all states in the study sample of having a supervised driving hour requirement was not significantly different from zero (.04, 95% CI −.15, .22).

Conclusion: These findings suggest that a learner license duration of at least six-months may be necessary to achieve a significant decline in teen drivers' fatal crash rates. Evidence of the effect of required hours of supervised driving on teen drivers' fatal crash rates was mixed.

1. Introduction

Motor vehicle crashes are the leading cause of death and a major contributor to nonfatal injury of teens in the United States (National Highway Traffic Safety Administration, 2010b). To address this public health threat, Graduated Driver Licensing (GDL) laws have been enacted by all fifty states and the District of Columbia (Williams and Shults, 2010). GDL was introduced in the United States beginning in the mid-1990s, replacing laws that allowed quick and easy access to full-privilege licenses. GDL laws vary in their requirements, but commonly include two levels that impose restrictions on teens' driving (Foss and Goodwin, 2003). The first is a learner license that allows teens to gain driving experience under the supervision of a fully-licensed driver (typically a parent or parent designate over age 21). The second is an intermediate license, which allows teens who have gained some initial experience driving with a learner license to drive independently but with restrictions that limit their exposure to the highest risk driving conditions: driving at night (Williams and Shabanova, 2003) and driving with young passengers (Chen et al., 2000).

There is little question that GDL reduces 16- and 17-year-old driver crashes (Masten et al., 2011; Shope, 2007); however, the elements responsible for the greatest reductions in crashes and the mechanism by which these reductions are achieved are not well understood. Evaluations of individual components of GDL have rarely accounted for the confounding effect of multiple GDL components being implemented simultaneously, and have assumed independent implementation of each component, which does not reflect the reality of how the majority of these laws were introduced. Further, most evaluations used a pre- and post-GDL study design that is unable to distinguish whether a decline in crashes was

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directly attributable to GDL, or the result of a preexisting downward trend (Elliot and Shope, 2003; Sivak and Schoettle, 2010).

Currently in the U.S., learner license requirements are the most widely implemented of all GDL components, existing individually or side-by-side with other components in all fifty states and the District of Columbia. However, evidence of the effectiveness of the details of the learner license requirements is not well established. For example, the optimal number of months a learner license should be held has not been determined. Studies in Kentucky, Connecticut, and Nova Scotia indicated substantial crash reductions for 16-year-old drivers when a learner license period was newly mandated or an existing period was extended (Agent et al., 2001; Mayhew et al., 2003; Ulmer et al., 2001). While these findings indicated an extension of the learner license period reduced crashes, none of these studies used licensure data, so it is unclear whether a delay in the age of independent driving, or improvements in driving ability due to an extension in supervised driving beyond the required minimum were responsible for the crash reductions. Furthermore, little is known about the optimal number of months a learner license should be held for the best safety benefit. In all three states above, the learner license was mandated to be six months; however, there is no evidence to suggest whether or not a six-month period of supervised driving is adequate (Foss, 2007). For example, for the states discussed above, it is unknown whether a doubling of the learner license period (to twelve months) would have resulted in the same or a larger crash reduction.

Similarly, the safety effect of a required number of supervised driving hours on teen drivers is also poorly understood. The small body of research examining the subject is inconclusive. A study of Swedish teens found an average of 120 h of supervised driving was associated with a significant reduction in crash involvement during independent licensure, compared to those who had approximately 50 h of supervised driving practice (Gregersen et al., 2000, 2003; Sagberg and Gregersen, 2005). Teen drivers in the northeastern U.S. who completed a period of supervised driving, however, were no different in their time-to-first-crash from those who did not have supervised driving experience (McCartt et al., 2003). Similarly, French teens who received professional driving instruction with an extensive period of supervised driving (equivalent to approximately 3000 miles) had the same crash likelihood as teens who only received professional driving instruction (Page, 2004). Due to the small number of studies, it is not possible to determine whether or not 120 h is the optimal number of supervised driving hours.

The purpose of this paper is to quantify the effect of two required GDL components of the learner license on 16- and 17-year-old drivers' fatal crash rates: the length of the learner license (months) and the number of supervised driving hours.

1.1. Research hypotheses

This study tested the following hypotheses:

1. The introduction of a learner license required minimum holding period as part of GDL will be followed by a reduction in 16- and 17-year-old drivers' fatal crash rates.
2. The introduction of a minimum number of required supervised driving hours as part of GDL will be followed by a decline in 16- and 17-year-old drivers' fatal crash rates.

2. Method

2.1. Inclusion criteria

To test these hypotheses, states that introduced a learner license holding period, or required hours of supervised driving *independent of other GDL components* during the period 1990–2007, were identified (Tables 1 and 2). The evaluation period spanned 1990–2009, however, because at least two years of data post-implementation were required to estimate the effect of a component, the sample was limited to states introducing GDL components prior to December 31st 2007. States were also excluded from the sample if they introduced multiple GDL components simultaneously with the component of interest, or had a learner license age below 15.

2.2. Data and measures

Monthly counts of fatal crashes involving at least one teen driver (aged 16 or 17 years) in cars, trucks/pickups, vans/minivans, and sport utility vehicles were obtained for the contiguous period 1990–2009 from the Fatality Analysis Reporting System (FARS) for the states being analyzed (National Highway Traffic Safety Administration, 2010a). Ideally, data from all injury crashes (not just fatal crashes) occurring in each candidate state would also be included; however, only a limited number of states make their injury crash data available to researchers (National Highway Traffic Safety Administration, 2011), so such an approach could not be taken for this study. Furthermore, injuries are not recorded consistently across states or sometimes even across police agencies within a state. Fatal crash rates would ideally be based on the number of licensed teen drivers, however, licensure data reported by the Federal Highway Administration underreport the actual number of licensed teens, and licensure data are difficult to obtain from individual states (Insurance Institute for Highway Safety, 2006). Miles driven by each teen would also be ideal, but are difficult to measure and are unavailable. Therefore, crash rates were based on the number of teens in the overall population.

Annual population estimates by state and year of age were obtained from the U.S. Census Bureau (Bureau of the Census US Department of Commerce, 1999, 2010). Monthly values were interpolated using cubic spline curves, which are the smoothest curve that exactly fits a set of data points (Bartels et al., 1998). The combined monthly fatal crash involvement rates of 16- and 17-year-old drivers per 100,000 population were calculated using monthly fatal crash counts and monthly population estimates. Data for drivers younger than 16 years were excluded because only a few states allow unsupervised driving by 15 year olds (Insurance Institute for Highway Safety, 2012).

Several states in the sample had relatively small populations, increasing the probability of a floor effect, where crash rates cannot take on a value lower than zero. To compensate for this effect, states with a 16- to 17-year-old population below 85,000 (Maine, Nebraska, New Hampshire, Rhode Island, and Utah) were modeled using quarterly data. Quarterly fatal crash involvement rates were calculated using the monthly crash counts and population estimates.

2.3. Covariates

2.3.1. Comparison population

The monthly fatal crash rate for drivers age 25–54 was used as a covariate, representing crashes for the typical adult driving population. Applying the identical method used to estimate 16- and 17-year-old fatal crash rates, monthly fatal crash rates of 25- to 54-year-old drivers per 100,000 population were calculated using monthly fatal crash counts and monthly population estimates. The purpose of the comparison population was to adjust for variability in the teen driver crash rates due to extraneous factors affecting drivers of all ages and to test the effect of GDL against a comparison population of persons unaffected by GDL. Although time series analyses control for pre-existing secular trends in crash rates, the inclusion of the crash rates of another age group as a historical