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Original article

Can Adolescent Drivers' Motor Vehicle Crash Risk Be Reduced by Pre-Licensure Intervention?

Jessica H. Mirman, Ph.D. [a,*], Allison E. Curry, Ph.D. [b,c], Michael R. Elliott, Ph.D. [d], Leann Long, Ph.D. [e], and Melissa R. Pfeiffer, M.S. [b]

[a] *Department of Psychology, The University of Alabama, Birmingham, Alabama*
[b] *Center for Injury Research and Prevention, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania*
[c] *Perelman School of Medicine, The University of Pennsylvania, Philadelphia, Pennsylvania*
[d] *Department of Biostatistics, University of Michigan, Arbor, Michigan*
[e] *Department of Biostatistics, The University of Alabama, Birmingham, Alabama*

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A B S T R A C T

Purpose: Although motor vehicle crashes are the leading cause of death for adolescents, there is a scarcity of research addressing adolescents' lack of pre-licensure practical driving experience, which is theorized to increase their post-licensure crash risk.
Methods: Utilizing police-reported crashes and survey data from a randomized and quasi-randomized trial (n = 458 adolescents, 16 or 17 years of age at enrollment), the impact of a parent-directed supervised practice driving intervention and a comprehensive on-road driving assessment (ODA) with feedback was evaluated on adolescent drivers' motor vehicle crashes involvement.
Results: Compared with the control condition, a nonsignificant 20% relative reduction in risk was observed for the parent-directed intervention: adjusted hazard ratio = .80 (95% confidence interval [CI] .44, 1.43); the unadjusted absolute risk reduction was 1.1% (95% CI –4.4, 7.1). Exposure to the ODA resulted in an 53% relative reduction of risk: adjusted hazard ratio = .47 (95% CI .24, .91); the unadjusted absolute risk reduction was 5.4% (95% CI –.3, 10.7).
Conclusions: Comprehensive ODA might be protective for adolescents; however, additional research is needed.

IMPLICATIONS AND CONTRIBUTION

Identifying interventions to reduce adolescent drivers' risk for motor vehicle crashes is critical for adolescent health and for public safety. In this study, preliminary evidence suggests that comprehensive on-road driver assessment in variable conditions and feedback administered prior to licensure may reduce crash risk.

Motor vehicle crashes (MVCs) are the leading cause of death and disability among adolescents in the United States [1]. Adolescents' MVC risk is due to multiple interactive factors [2] (e.g., personality, maturation) but largely influenced by practical inexperience with the driving task [3,4]. MVC involvement is highest during the transition from permit holder to licensed driver and then reduces as adolescent drivers gain experience [5,6]. The most successful interventions are graduated driver licensing (GDL) policies. GDL policies phase adolescents into licensure by providing an opportunity to build practical experience while restricting adolescents from higher risk driving scenarios (e.g., driving with peers). GDL is a successful "one-size-fits-all" intervention [7]. Individual-level interventions targeting inexperience directly are needed to complement universal policies.

Learner period of graduated driver licensing

GDL programs typically contain provisions requiring a minimum amount of supervised practice driving during a "learner's permit period," which is intended to serve as protected time

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* Address correspondence to: Jessica H. Mirman, Ph.D., Department of Psychology, University of Alabama at Birmingham, Campbell Hall 231, 1530 3rd Avenue South, Birmingham, AL 35294-1170.
E-mail address: jhmirman@uab.edu (J.H. Mirman).

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for adolescents to gain practical skill under the supervision of a qualified adult, prior to independent licensure. It is common for parents to serve as their adolescents' practice supervisor [8], but studies have shown that parents have difficulty providing an appropriately varied and challenging practice experience [9–12]. Since MVC rates are highest when adolescents transition from supervised learners to independent license holders and because parents are responsible for most adolescents' practice [6,13,14], it follows that learner-period interventions are needed. Yet, there are few effective programs. The majority target parents' knowledge of GDL, passively provide informational resources, and aim to increase the quantity of practice, without attention to a broader range of potential intervention targets (e.g., quality of supervised practice) [13,15,16]. Interventions that have demonstrated initial success on precursor behaviors (e.g., increased parent engagement, driving skills) were interactive (e.g., used active learning principles) and were more comprehensive in focus (i.e., targeted multiple psychological or behavioral factors) [16–18]. However, long-term effectiveness has been largely unevaluated.

Current study

We evaluated the long-term effectiveness of a web-based intervention, the TeenDrivingPlan (TDP), administered during the learner period of GDL on adolescents' involvement in police-reported MVCs for up to 4 years post-enrollment using a randomized-controlled trial design. A detailed description of the TDP can be found elsewhere [17,19,20]. Briefly, the TDP was designed to improve the quality and quantity of practice driving. The TDP had three main components: (1) a practice tutorial library that consisted of short animated videos on how to practice specific environment-based goals (e.g., lane management on highways) and how to create a positive learning environment; (2) an interactive practice planner that families could use to plan drives ahead of time (e.g., pick a date and time, practice activity); and (3) a logging and rating tool. The logging and rating tool was the most used component of the TDP followed by the tutorial library; the planner was infrequently used [21]. TDP use was assessed with user-specific log-in credentials. The TDP increased parent engagement, social support, and practice diversity, and decreased the likelihood that adolescents would fail a comprehensive on-road driving assessment (ODA); no effect was observed on the quantity of practice [17,19].

Because the ODA was not administered to every participant, the trial design presents a unique opportunity to determine if the ODA is associated with crash involvement. This is important because driver licensing evaluations in the U.S. last on average only about 20 minutes and are generally undemanding of drivers [22]. Therefore, there are direct GDL policy implications for identifying if a comprehensive ODA with feedback could be protective against crashes. As such, the primary objectives of the current analysis were to determine if the TDP and ODA influenced adolescent drivers' involvement in police-reported MVCs. Secondary objectives were to evaluate if there was a difference in the amount of diversity and quantity of supervised driving practice between those participants who took the ODA and those who did not, and to determine if individual differences in these two practice variables were associated with adolescents' MVC involvement.

The TDP was designed to improve parent-supervised practice explicitly. However, it is also possible that the ODA affected parents' supervision by causing parents to "teach to the test." In other words, the knowledge that their adolescent was going to participate in the ODA could have prompted parents to increase the quantity and diversity of supervised practice in preparation.

Hypotheses. We hypothesized that (1) the TDP and ODA would reduce MVC involvement, (2) greater practice diversity would be associated with reduced MVC involvement, and (3) the ODA would increase both practice diversity and practice quantity. We did not make specific hypotheses about practice quantity and MVCs. Prior research has indicated weak support for practice quantity as a protective factor associated with future crashes, with the caveat that there have been methodological problems with most of the studies on this topic [23,24]. We theorized that increasing diversity of practice (i.e., exposure to a greater variety of driving environments and conditions) could enhance the degree of correspondence between the pre-license supervised practice and the real-world task demands associated with independent driving, resulting in adolescent drivers who are more prepared to drive independently in a wider variety of settings and circumstances.

Methods

Description of the trial design

A stratified (ODA + survey vs. survey only) randomized (3:2) controlled trial design was used to determine how assignment to the TDP compared with a usual practice condition on the proportion of adolescent participants involved in motor vehicle crashes and the time to these events. As the primary foci of the initial trial were to evaluate the effect of the TDP on adolescents' pre-license driving skill and to evaluate the relationship between supervised practice and driving skill, performance on the ODA served as the key outcome measure. Due to scheduling logistics, enrollment into the ODA stratum was prioritized based on the projected number of ODA time slots available, which varied weekly. When potential participants contacted the study team they were enrolled into the ODA stratum if slots were available and, if no slots were available, were enrolled into the survey-only stratum. Slot availability was determined by the rehabilitation hospital that conducted the ODA. ODA stratum enrollment began in December 2011 and concluded in July 2012, and survey only enrollment began in January 2012 and ended in August 2012. Study procedures for the original trial concluded in January 2013. Therefore, TDP assignment was random and ODA assignment was quasi-random.

Description of the on-road driving assessment

The ODA was administered by certified driving rehabilitation specialists in a dual control vehicle at 12 (±3) and 24 (±3) weeks after enrollment, serving as safety and primary outcome assessments for the initial trial, respectively. Evaluators were blinded to TDP assignment status. The ODA was 30.6 km (19.0 mi) long and consisted of seven sequential modules in two sets: set 1: parking lot, intermediate roads, suburban commercial district, and residential neighborhood, and set 2: urban commercial district, highway, and rural roads. The 12-week assessment consisted of the set 1 modules only. Inter-rater reliability for the two evaluators who conducted the ODA was strong: $\kappa = .85$ (95% confidence interval [CI] .84–.87] [25]. The ODA can discriminate between novice adolescent drivers and experienced adults [25,26], and dimensions of supervised practice are associated with better