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

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Abstract

Purpose—Although motor vehicle crashes (MVC) 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 driver assessment (ODA) with feedback was evaluated on adolescent drivers' MVC involvement.

Results—Compared to the control condition, a non-significant 20% relative reduction in risk was observed for the parent-directed intervention: aHR=0.80(95%CI: 0.44,1.43); 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: aHR=0.47(95% CI: 0.24,0.91); the unadjusted absolute risk reduction was 5.4%(95% CI: −0.3%,10.7%).

Conclusions—Comprehensive ODA might be protective for adolescents; however, additional research is needed.

Keywords

Motor vehicle crashes; Graduated Driver Licensing; Teen drivers; Adolescence; Expertise

Motor vehicle crashes (MVCs) are the leading cause of death and disability to 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

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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 policies (GDL). 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 GDL

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 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 four 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 US 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 ODA

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 miles) long and consisted of 7 sequential modules in 2 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. Interrater reliability for the two evaluators who conducted the ODA was strong: $\kappa = 0.85$ [95% CI, 0.84–0.87].[25] The ODA can discriminate between novice adolescent drivers and experienced adults,[25,26] and dimensions of supervised practice are associated with better ODA test performance at 24 weeks (fewer errors, less likely to fail).[19,26] Administrative procedures and scoring criteria are described elsewhere.[25,26] At the conclusion of the 24-week ODA, and after scores were recorded, evaluators provided performance-related feedback and answered questions from the parents and adolescents. The content of these discussions was neither dictated nor documented by the study team. Providing feedback to the participants was deemed important for ethical reasons.

Eligibility Criteria

To be eligible for the initial trial, adolescent participants were required to: be 16 or 17 years of age at the time of enrollment; hold a learner's permit with no more than 5 hours of behind-the-wheel practice at the time of enrollment; be fluent in written and spoken English; have an internet connection in the home; have one available vehicle at their primary residence; and have a parent or guardian at least 21 years of age to serve as the primary practice supervisor. Adolescents who were pregnant, anticipated needing a handicapped placard or license in order to drive, or who previously received driver education were ineligible to participate. Participants were recruited from the general community in the Philadelphia metro-area, which includes urban, suburban, and rural areas. The study procedures were approved by the IRB's of the Children's Hospital of Philadelphia and the University of Alabama at Birmingham.

Measures

Police-Reported Crashes—Crash records from December 2011 through December 2015 were requested from the Pennsylvania Department of Transportation (DOT). Reportable crashes in Pennsylvania are those that involve a death or injury and/or damage to any vehicle such that it must be towed from the scene. TDP trial data were individually joined with crash data provided by the DOT via learner permit numbers, which are the same as driver license numbers. The quality of the join was assessed by checking sociodemographic variables on the crash report against those provided at enrollment.

Surveys—A sociodemographic survey administered at enrollment was used to assess participants' gender, date of birth, race, ethnicity, education, date of permit, and hours of prior behind-the-wheel practice. Four additional surveys were administered electronically at 6-week intervals for 24 weeks that collected data on a variety of social and behavioral variables; methodological details available elsewhere.[19,27] For the current analysis, we utilized: (1) self-reported practice in the prior week in hours/minutes assessed at weeks 6, 12, 18, and 24. Parents and adolescents reported the number of hours of supervised practice completed in the past week and (2) self-reported practice diversity assessed only at week 24. Parents and adolescents used a six-point modified frequency scale: 1, "none"; 2, "less than 1 hour"; 3, "1–2 hours"; 4, "3–5 hours"; 5, "6–10 hours"; and 6, "more than 10 hours" to report how much supervised driving practice the adolescent completed in each of the following environments during the learner period: (1) empty parking lots; (2) residential neighborhoods; (3) one or two lane intermediate roads; (4) rural roads; (5) commercial roads (e.g., around shops and businesses); and (6) highways. Practice diversity was defined as the number of environments in which parent-adolescent dyads reported practicing for at least 1–2 hours. Responses were averaged for parents and adolescents.

Main Analytic Approach

For the effect of TDP, an intent-to-treat analytic approach was used, meaning that the randomization (enrollment) drives treatment delineation rather than treatment compliance. Time from enrollment to first crash was used as the primary outcome. For those participants without reported crashes, their event time was censored at December 31, 2015. Whether the proportion of participants having a crash differs by intervention group was assessed with a chi-square test. Cumulative incidence plots were used to visualize the time-to-crash outcome by treatment group and ODA assignment. Given the treatment and ODA assignment structure, all statistical models included both treatment group and ODA group. In order to jointly model effects of treatment and ODA assignment, Cox proportional hazards models were fit, and effect modification of both ODA assignment and gender were assessed separately through statistical interactions. Sensitivity analyses using time from intervention cessation (24 weeks) to crash were also performed. The analytic data set was de-identified prior to analysis. The level of statistical significance was set to 0.05. All analyses were conducted in SAS 9.4 (SAS Institute, Inc., Cary, NC) and R 3.3.1. (R Core Team, 2015).

Participants

The analytic sample consisted of 458 adolescents; this was 89% of the original study sample (Figure 1). Attrition was 5% in the survey only group and 18% in the ODA group; however, attrition was not selective to sociodemographic characteristics ($p>.05$ for all comparisons). Although the data for all 458 participants were obtained from the Pennsylvania DOT, one participant had crash data contradicting the age and gender from demographics obtained at enrollment; this case was excluded. Demographic characteristics of participants in the intervention and control groups did not differ, but compared to the ODA group, adolescent participants in the non-ODA group were more likely to be black, were slightly older, and parents engaged in less frequent internet use at work (Table 1).

Results

Of the 457 participants, 46 (10.1%) were involved as a driver in a reportable crash. In the non-ODA group 12.2% of participants crashed compared with 6.7% of participants in the ODA group (p=0.059), making the absolute unadjusted risk reduction 5.4% (95% CI:−0.3%, 10.7%). Therefore, the estimated number needed to treat (i.e., the inverse of the absolute risk reduction) is: 1 out of 19 participants would be prevented from experiencing a crash if they were administered the ODA. In comparison, 10.7% of control participants crashed compared with 9.6% of participants in the TDP group, making the absolute risk reduction 1.1%(95% CI: −4.4%,7.1%). Therefore, we estimate that 1 out of 89 adolescents would be prevented from crashing if they received the TDP.

Accounting for ODA group, the hazard ratio for TDP was 0.86(95% CI: 0.48,1.54). Based on testing statistical interactions, there was no evidence that ODA (p=0.50) or gender (p=0.20) modified the effect of the TDP. Accounting for the TDP group, the hazard ratio for ODA was 0.53(95% CI:0.27,1.02). Adjusting for potential confounders (race, age at enrollment, and parent work internet use) did not change the point estimate for the effect of the ODA: 0.53(95% CI: 0.26,1.02). Given the emerging evidence that ODA may reduce crash risk, we performed an exploratory analysis examining whether gender modifies the effect of ODA assignment; it did not (p=0.49). Adjusting for TDP group and stratifying by gender, the following unadjusted hazard ratios for males and females were obtained: HR_{males}=0.39(95% CI: 0.15,1.06) and $HR_{females}$=0.66(95% CI: 0.27,1.62). Comparisons of the overall proportion of adolescents who crashed versus those who did not showed no significant differences related to the parent and teen characteristics in Table 1 (see online supplement). Figure 2 depicts the cumulative proportion of crash-involved participants by group.

A Cox proportional hazards model was used to examine the independent effects of the TDP and ODA jointly with quantity and diversity of practice driving on adolescents' crash risk. Wilcoxon rank-sum tests were used to assess for group-level differences in the practice variables by TDP and ODA assignment. Effect modification was assessed by creating multiplicative interaction terms (e.g., ODA*Diversity). For the Cox model, multiple imputation using chained equations was applied to account for those participants missing either practice diversity or practice quantity.[29–31]

As shown in Table 2, the ODA was associated with increased practice diversity (p=0.021) and the average amount of practice quantity across the 4 assessment points (p=0.004), while the TDP increased diversity (p=0.018) and slightly decreased practice quantity (p=0.019). Results of the multiple Cox proportional hazards regression model of crash risk accounting for practice quantity and practice diversity appear in Table 3. Adjusting for all other predictors in the model, the overall estimate of the effect of ODA was: HR=0.47(95% CI: 0.24,0.91). Practice quantity was not associated with crashes: $HR_{quantity}$=1.00(95% CI: 0.71,1.41), but greater practice diversity was: $HR_{diversity}$=1.45(95% CI:1.02,2.06). There were no statistical interactions between ODA and practice diversity nor ODA and practice quantity (all comparisons p>.10).

To examine whether ODA assignment influenced practice quantity over time, a hierarchical approach to analyzing practice quantity across the 4 waves was used. Log-transformation of minutes of practice per week was necessary for statistical model validity, so the individual parameters from the linear mixed effects model are not straightforward to interpret on the original minutes per week scale. In light of that nuance, we have expressed the effect size as a relative percent change (that is, [exp(β) −1]*100%) between each of our comparison groups (ODA vs. non-ODA and Wave 4 vs. Wave 1). We found that participants experienced approximately a 43% increase in practice quantity by wave 4 compared to wave 1, holding ODA assignment and treatment group constant ($p<0.0001$). In addition, the ODA was associated with a 17% increase in minutes practiced per week over those not assigned to ODA, holding all other variables constant (at any given time, and across treatment groups) $p=0.004$, but that difference did not change over time ($p=0.44$); (see the online supplement for the graphical depiction).

Discussion

We explored the potential for a comprehensive on-road assessment with feedback and a web-based parent supervised driving program to improve practice behaviors during the learner period of GDL and to reduce adolescents' motor vehicle crashes during the initial years of independent licensure. In our sample, the ODA increased practice quantity and diversity and reduced crash risk by an estimated 53%. The TDP reduced practice quantity, although this effect was quite small, and increased practice diversity. We did not observe strong evidence that the TDP reduced crashes. This pattern of results could be due to the salience of the ODA in comparison to the TDP (i.e., an on-road assessment in live traffic vs. a software application), the ODA's timing in relation to the outcome of interest (i.e., exposure to the TDP was earliest in the beginning portion of the learner's permit period in contrast to the ODA, which was last administered at the very end of the permit period), and/or that the initial positive effects of the TDP were largest for the psychological variables and weaker for the behavioral variables. Finally, the ODA directly targeted teens whereas the TDP primarily was designed for parents.

Further research on the potential effectiveness of the ODA as well as discerning the mechanisms between ODA and crash reduction is needed. In contrast to parents and driver educators who emphasize verbal, instructional didactics, and maintaining safety margins,[12,32] the ODA evaluators did not provide instruction; they created an opportunity to observe drivers' performance in a variable and challenging traffic environment. This might have created a platform for *spontaneous* strategy discovery. Improved performance on higher-order problem solving tasks can result from explicit instruction about optimal strategies or through spontaneous strategy discovery, and occur abruptly in a phase shift, as opposed to gradually over time.[33–37] Consistent with prior research on this topic (see Williams, 2007) our study did not provide strong evidence that practice quantity is protective.[23] This counterintuitive, but consistent, finding could be further evidence that learning-to-drive safely may not be best characterized by *only* gradual learning processes, the dominant framework that is currently used to describe learning-to-drive safely.[38,39] There is a scarcity of research on theoretical models of learning-to-drive safely and the results of this study highlight that much more research is needed on this topic.

We observed an interesting pattern of associations among the practice variables, crash risk, and the ODA. Although the ODA was protective against crashes and reduced crash risk, practice diversity was positively associated with future crashes, after adjusting for any ODA and TDP effects, which was contrary to our hypothesis. There may be a critical difference between self-selected and induced practice diversity. *Self-selected* practice diversity, in-part, might serve as an early proxy variable for future exposure to the driving environment. The positive association between exposure and crash risk is well documented.[40] Adolescents with a stronger interest in - or practical need for - diverse driving may be more likely to practice in diverse environments when they have their permits and then go on to become high exposure drivers later, which increases their opportunity to be involved in a motor vehicle crash. Therefore, it may not be the diversity of practice per se, but rather other unmeasured psychosocial or practical factors that are accounting for some of the positive association between self-selected practice diversity and future crash risk.

It is also possible that experimentally *inducing* adolescents to experience a more diverse driving environment during the learner period (i.e., exposing them to a more diverse environment than what they would have chosen on their own) could have sensitized them to their strengths and weaknesses, which could have influenced their post-license behaviors (e.g., avoidance of challenging environments that exceed their developing skill), as well as directly increased their driving skills and strategies, accounting for some of the positive effects of the ODA. We did not, however, directly assess these variables in the current study.

Limitations

The study had important strengths such as the use of the statewide crash database, which served to minimize recall bias and selective reporting bias. However, the study did have several limitations: sample homogeneity (e.g., race, education), lack of statistical power, potential sample selection bias at enrollment, and lack of true randomization of ODA assignment. As ODA assignment was only quasi-random, we cannot rule out the presence of unmeasured confounders associated both with enrollment in the ODA stratum and with crashes; however, there is not strong empirical or theoretical guidance that suggests that exposure would be different in these groups or what factors, other than the ODA, could account for the magnitude of the effect observed. Finally, because countries vary in their policies and programs used to transition adolescents into licensure, we cannot be certain how the ODA might fit into non-US systems.

Conclusions

Most road test examinations that serve as gateways for the intermediate period of GDL are less comprehensive than the ODA and do not entail a detailed feedback process with parents and adolescents. This might be a missed opportunity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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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.

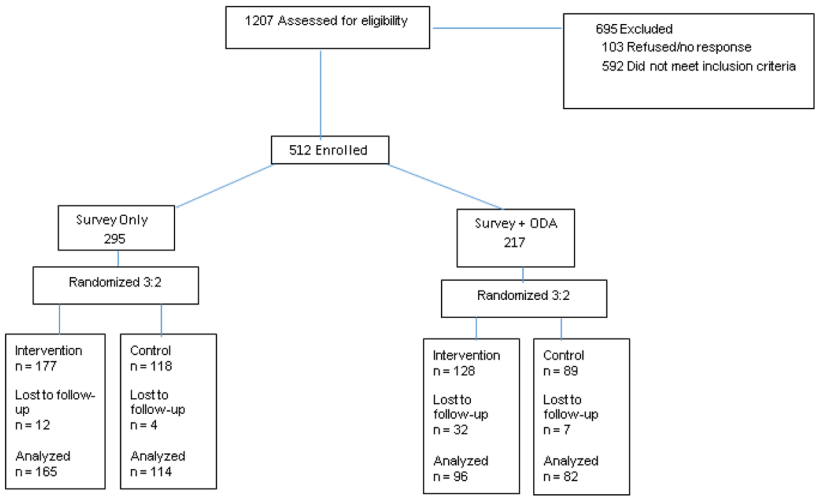

Figure 1.
Enrollment diagram for the original trial

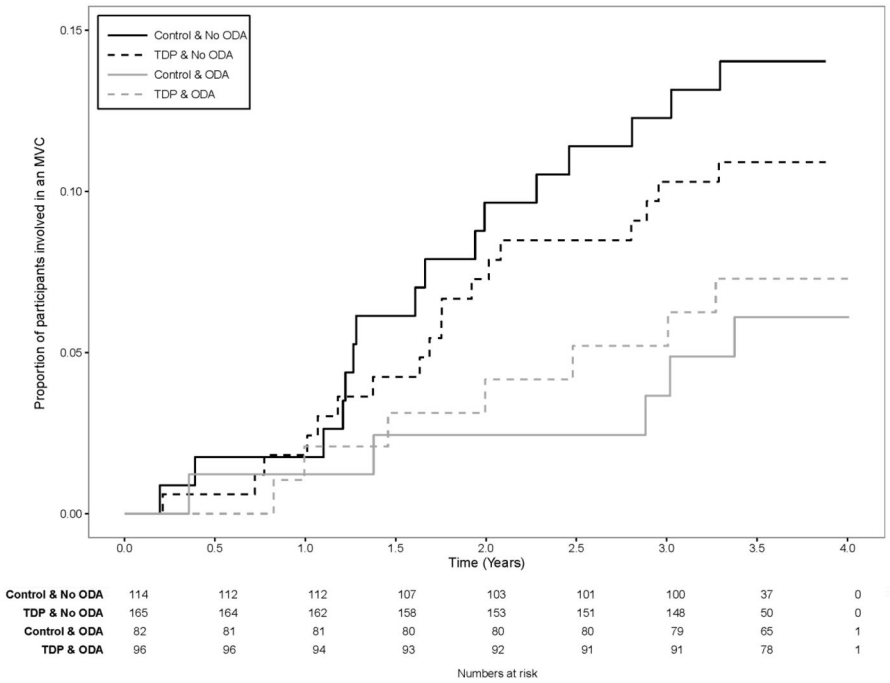

Figure 2.
Cumulative Incidence Plot

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Table 1

Characteristics of the Study Sample

	Overall Sample		Non-ODA		ODA	
Teen Characteristics	**Non-ODA (n=279)**	**ODA (n=178)**	**TDP Group (n=165)**	**Control (n=114)**	**TDP Group (n=96)**	**Control (n=82)**
Any crash, No. (%)	34 (12.2)	12 (6.7)	18 (10.9)	16 (14.0)	7 (7.3)	5 (6.1)
0 Crash	245 (87.8)	166 (93.3)	147 (89.1)	98 (86.0)	89 (92.7)	77 (93.9)
1 Crash	32 (11.5)	11 (6.2)	17 (10.3)	15 (13.2)	6 (6.3)	5 (6.1)
2 Crashes	2 (0.7)	1 (0.6)	1 (0.6)	1 (0.9)	1 (1.0)	0 (0)
Age at enrollment, y, Median (IQR) *	16.3 (16.1, 16.7))	16.2 (16.0, 16.5)	16.3 (16.1, 16.6)	16.3 (16.1, 16.9)	16.1 (16.0, 16.4)	16.2 (16.1, 16.6)
Behind-the-wheel practice hours at enrollment, Median (IQR)	2.0 (0.3, 3.0)	1.5 (0.5, 3.0)	1.0 (0, 3.0)	2.0 (0.5, 3.5)	1.8 (0.5, 3.0)	1.5 (0.5, 3.0)
Gender, No. (%)						
Male	134 (48.0)	77 (43.3)	87 (52.7)	47 (41.2)	41 (42.7)	36 (43.9)
Female	145 (52.0)	101 (56.7)	78 (47.3)	67 (58.8)	55 (57.3)	46 (56.1)
Race *						
Black or African American	41 (14.7)	9 (5.1)	22 (13.3)	19 (16.7)	5 (5.2)	4 (4.9)
White	221 (79.2)	159 (89.3)	133 (80.6)	88 (77.2)	88 (91.7)	71 (86.6)
Other/multiple race	17 (6.1)	9 (5.1)	10 (6.1)	7 (6.1)	3 (3.1)	6 (7.3)
Refused	0 (0)	1 (0.6)	0 (0)	0 (0)	0 (0)	1 (1.2)
Hispanic						
Non-Hispanic	270 (96.8)	170 (95.5)	158 (95.8)	112 (98.2)	93 (96.9)	77 (93.9)
Hispanic	7 (2.5)	6 (3.4)	5 (3.0)	2 (1.8)	2 (2.1)	4 (4.9)
Unsure/refused	2 (0.7)	2 (1.1)	2 (1.2)	0 (0)	1 (1.0)	1 (1.2)
Parent characteristics						
Relation to Teen						
Mother	218 (78.1)	136 (76.4)	130 (78.8)	88 (77.2)	72 (75.0)	64 (78.0)
Father	59 (21.2)	42 (23.6)	35 (21.2)	24 (21.1)	24 (25.0)	18 (22.0)
Grandparent	2 (0.7)	0 (0)	0 (0)	2 (1.8)	0 (0)	0 (0)
Previous experience teaching a teen to drive						
Yes	124 (44.4)	74 (41.6)	78 (47.3)	46 (40.4)	41 (42.7)	33 (40.2)
No	155 (55.6)	98 (55.1)	87 (52.7)	68 (59.6)	52 (54.2)	46 (56.1)
Missing	0 (0)	6 (3.4)	0 (0)	0 (0)	3 (3.1)	3 (3.7)

	Overall Sample		Non-ODA		ODA	
Parent characteristics con't	**Non-ODA (n=279)**	**ODA (n=178)**	**TDP Group (n=165)**	**Control (n=114)**	**TDP Group (n=96)**	**Control (n=82)**
Marital Status						
Single	44 (15.8)	15 (8.4)	27 (16.4)	17 (14.9)	8 (8.3)	7 (8.5)
Living with partner	3 (1.1)	1 (0.6)	2 (1.2)	1 (0.9)	0 (0)	1 (1.2)
Married	231 (82.8)	159 (89.3)	136 (82.4)	95 (83.3)	88 (91.7)	71 (86.6)
Refused	1 (0.4)	1 (0.6)	0 (0)	1 (0.9)	0 (0)	1 (1.2)
Missing	0 (0)	2 (1.1)	0 (0)	0 (0)	0 (0)	2 (2.4)
Education						
Some college or less	73 (26.2)	46 (25.8)	46 (27.9)	27 (23.7)	28 (29.2)	18 (22.0)
College graduate	116 (41.6)	75 (42.1)	69 (41.8)	47 (41.2)	42 (43.8)	33 (40.2)
Graduate degree	90 (32.3)	56 (31.5)	50 (30.3)	40 (35.1)	26 (27.1)	30 (36.6)
Refused	0 (0)	1 (0.6)	0 (0)	0 (0)	0 (0)	1 (1.2)
Internet/email home use						
Several times a day	207 (74.2)	136 (76.4)	123 (74.5)	84 (73.7)	75 (78.1)	61 (74.4)
About once a day	44 (15.8)	31 (17.4)	26 (15.8)	18 (15.8)	14 (14.6)	17 (20.7)
3–5 days a week	15 (5.4)	8 (4.5)	10 (6.1)	5 (4.4)	4 (4.2)	4 (4.9)
1–2 days a week or fewer	12 (4.3)	3 (1.7)	6 (3.6)	6 (5.3)	3 (3.1)	0 (0)
Missing	1 (0.4)	0 (0)	0 (0)	1 (0.9)	0 (0)	0 (0)
Internet/email work use *						
Several times a day	163 (58.4)	127 (71.3)	96 (58.2)	67 (58.8)	70 (72.9)	57 (69.5)
About once a day	23 (8.2)	7 (3.9)	14 (8.5)	9 (7.9)	3 (3.1)	4 (4.9)
3–5 days a week	5 (1.8)	4 (2.2)	4 (2.4)	1 (0.9)	1 (1.0)	3 (3.7)
1–2 days a week or fewer	86 (30.8)	36 (20.2)	49 (29.7)	37 (32.5)	20 (20.8)	16 (19.5)
Missing	2 (0.7)	4 (2.2)	2 (1.2)	0 (0)	2 (2.1)	2 (2.4)

Note: To compare the ODA and Non-ODA groups, we used Wilcoxon ranked sum tests for continuous variables and chi-square or Fisher's exact tests for categorical variables.

* Indicates p<.01. No other ODA vs. Non-ODA comparisons were significant.

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Table 2

Supervised Practice Variables (N=457)

	Non-ODA (n=279)	ODA (n=178)	*p*-value	TDP Group (n=261)	Control (n=196)	*p*-value*
Practice Diversity, Median (IQR)	5.0 (4.0, 6.0)	5.5 (4.5, 6.0)	0.021	5.0 (4.5, 6.0)	5.0 (4.0, 6.0)	0.018
Observed n,	n=254	n=171		n=237	n=188	
Practice Quantity (Hours/Week), Median (IQR)	1.9 (1.3, 2.7)	2.3 (1.6, 3.2)	0.004	2.0 (1.4, 2.7)	2.2 (1.5, 3.0)	0.019
Observed n,	n=244	n=167		n=231	n=180	

Note. The Wilcoxon rank-sum test used for each comparison.

Table 3

Adjusted Hazard Ratio (aHR) Estimates of Adolescents' Crash Risk in a Multiple Cox Proportional Hazards Model (N=457)

Variable	aHR (95% CI)	p-value
TDP	0.796 (0.442, 1.433)	0.447
ODA	0.470 (0.241, 0.914)	0.026
Practice Quantity	1.022 (0.866, 1.208)	0.793
Practice Diversity	1.449 (1.022, 2.055)	0.038

Note: Parameter estimates are adjusted for all other terms in the model: Intervention assignment, ODA assignment, Practice Quantity, and Practice Diversity.