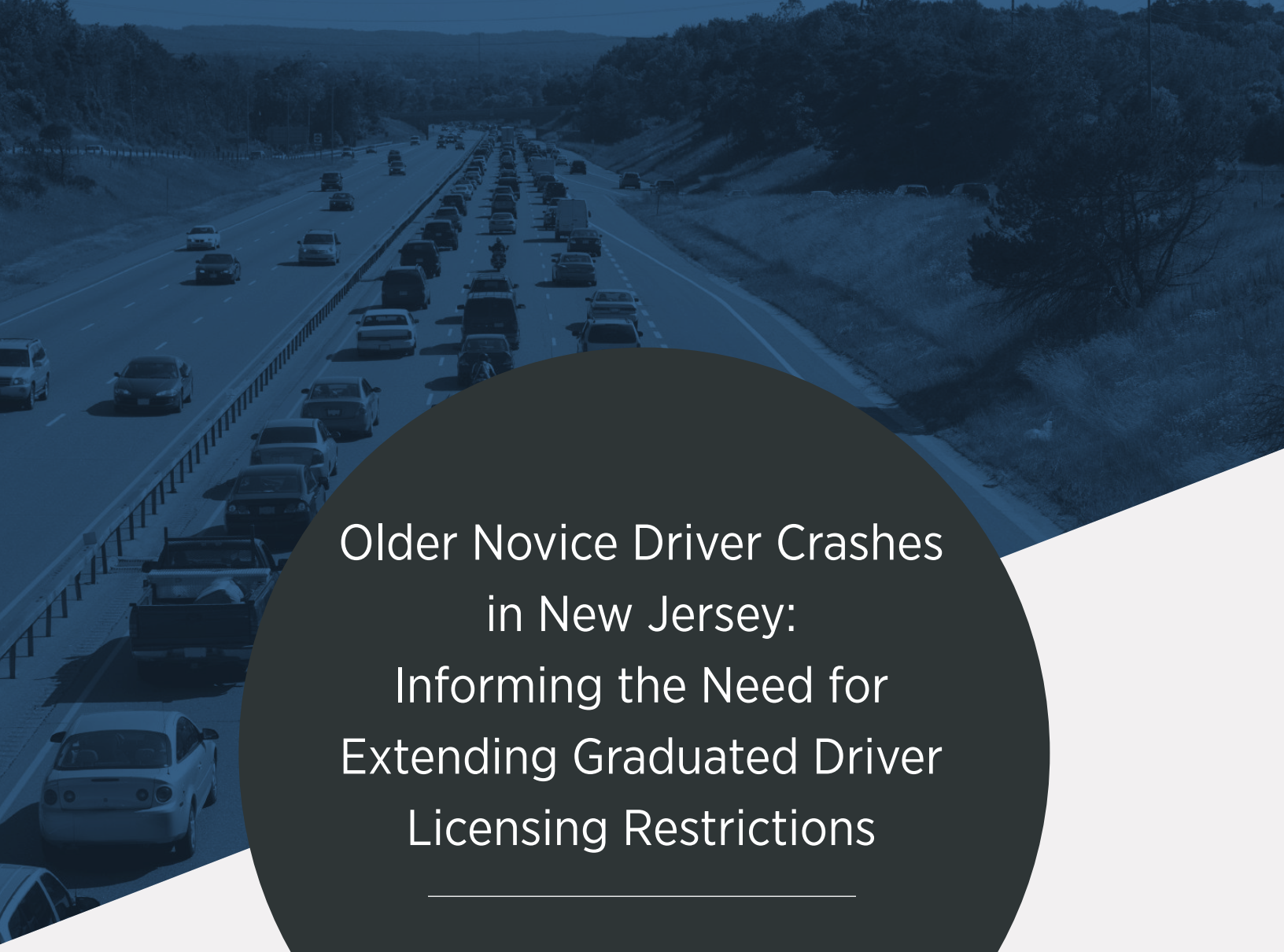

Older Novice Driver Crashes in New Jersey: Informing the Need for Extending Graduated Driver Licensing Restrictions

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Title

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Foreword

The research described in this report builds upon a body of work by the AAA Foundation for Traffic Safety that examines issues related to the licensing of new drivers. Although studies clearly show that new drivers of all ages have elevated crash rates, Graduated Driver Licensing systems in most U.S. states only apply to new drivers younger than 18. This report presents the results of a study that investigates whether there is epidemiologic evidence to support extending two key components of Graduated Driver Licensing systems for young novice drivers—restrictions on carrying multiple passengers and on driving late at night—to new drivers licensed at the age of 18 years or older.

This report should be a useful reference for researchers and practitioners who are involved with the training or licensing of new drivers.

C. Y. David Yang, Ph.D.

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About the Sponsor

AAA Foundation for Traffic Safety
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Founded in 1947, the AAA Foundation for Traffic Safety is a not-for-profit, publicly supported charitable research and education organization dedicated to saving lives by preventing traffic crashes and reducing injuries when crashes occur. Funding for this report was provided by voluntary contributions from AAA/CAA and their affiliated motor clubs, individual members, AAA-affiliated insurance companies and other organizations or sources.

Executive Summary

In contrast to most other countries with Graduated Driver Licensing (GDL) systems, only a few U.S. jurisdictions currently extend GDL restrictions to drivers licensed at age 18 or older. However, several recent studies have found that a substantial proportion of drivers are getting licensed at older ages, and further, that later licensure occurs disproportionately among low-income and minority drivers. A current topic of discussion in the traffic safety community is whether standard GDL policies that are applied in the U.S. for younger novice drivers should be applied to older novices not presently covered by them. One step in evaluating this issue is to determine whether there is epidemiologic evidence to support—from a crash reduction perspective—adoption of extended-age GDL policies, and in particular passenger and nighttime restrictions. However, the current body of literature that directly addresses whether GDL restrictions might reduce the burden of crashes if applied to older novices is very limited. This study examines how overall, injury, nighttime, and passenger crashes over the initial four years of licensure differ for novice drivers licensed at different ages.

Using the New Jersey Traffic Safety Outcomes (NJ-TSO) Program database, the research team constructed an analytic database of New Jersey drivers who obtained their initial intermediate driver's license from January 2006 through December 2014 and had at least one month of follow-up from the date of licensure to study end or death (n=1,034,835). Novice drivers were grouped based on age at licensure: (1) age 17 (subject to full GDL restrictions); (2) age 18–20 (subject to full GDL restrictions in New Jersey but not in the vast majority of other U.S. states); (3) age 21–24 (not subject to nighttime or passenger restrictions in U.S. states); and (4) age 25 or older (not subject to nighttime or passenger restrictions in U.S. states). Monthly rates were estimated for overall crashes (per 10,000 licensed drivers) as well as: injury crashes, late night crashes (11:01 p.m.–4:59 a.m.), early night crashes (9 p.m.–11 p.m.), and multiple-passenger crashes (two or more passengers present). Average monthly rates were calculated for specific relevant time periods since licensure (0–3 months, 4–6 months, 7–12 months, 13–18 months, 19–24 months, 25–36 months, and 37–48 months) and were compared via estimation of rate ratios and 95% confidence intervals using Poisson regression models. Rate ratios, adjusted for sex, were estimated to compare rates: (1) between novice driver groups with the same time since licensure; (2) over the first 48 months of licensure within each novice driver group; and (3) between same-aged 21-year-old drivers with varying lengths of licensure.

Main findings for overall, nighttime, and multiple-passenger crashes were as follows:

Although the initial three-month crash rates of novice New Jersey drivers age 21 and older were higher than rates of same-aged experienced drivers, they were substantially lower than initial three-month rates for 17- to 20-year-old novice drivers, who were subject to full GDL policies upon licensure in New Jersey. This was particularly true for novice drivers aged 25 and older, whose average crash rates over the first three months of licensure were more than 50% lower than for those licensed at age 17. Moreover, novice drivers aged 21 and older experienced much less steep crash reductions over the first year of licensure than younger novice drivers.

Nighttime crash rates among the groups licensed at ages 21 to 24 and at ages 25 and older were stable over the first year of licensure. For novice drivers licensed before age 21, early night crash rates during the 9 p.m.–11 p.m. period declined rapidly over the course of licensure—significantly more rapidly than overall crashes did—while changes in rates of late night crashes were much smaller.

First-year multiple-passenger crash rates were highest for drivers licensed at ages 18 to 20. Novice driver groups experienced varying amounts of reduction in multiple-passenger crashes over time. Among drivers licensed at age 17, the rate of multiple-passenger crashes was 35% lower at 7 – 12 months post-licensure compared with the first three months post - licensure. Drivers licensed at ages 21 and older experienced similar reductions to drivers licensed at ages 18-20, with 17% to 23% lower rates over the same time period.

In summary, findings support New Jersey's current GDL policies for 17- to 20-year-old novice drivers and the potential for added benefits from beginning the restrictions at 9 p.m. There is a lack of compelling evidence for extending GDL policies currently applied to younger novices to drivers licensed at ages 21 – 24. The lower initial crash rates for these drivers compared with younger novice drivers and the lack of steep reductions in their crashes over time call into question the potential for GDL provisions to significantly reduce the crash rates of these drivers. There is no evidence to indicate a need for additional GDL policies for New Jersey novices aged 25 years and older.

Introduction

Most countries with Graduated Driver Licensing (GDL) systems are applicable to either a subset of or all drivers who first get licensed at age 18 or older (e.g., Australia, Canada, New Zealand). On the other hand, only six U.S. states (Connecticut, Indiana, Maine, Maryland, Minnesota, and New Jersey) and the District of Columbia currently extend any GDL restrictions to these drivers. All of these states' systems involve a learner period for either some or all novices, and the District of Columbia requires all drivers who initiate the licensure process before age 18 to complete the full intermediate period—that is, there is no automatic graduation to an unrestricted license at age 18. Currently, only New Jersey and Indiana apply a comprehensive set of GDL provisions—including an extended learner's permit period and restrictions on driving at night and on carrying passengers—to all newly licensed drivers younger than age 21. Given that GDL was originally designed to primarily target the issue of driver inexperience—and not young age specifically—there is some discussion in the traffic safety community as to whether standard GDL policies that are applied in the U.S. for younger novice drivers should be extended to newly licensed drivers aged 18 and older.

This discussion is timely, as recent studies have indicated that many drivers are getting licensed at older ages, and further that the characteristics of those who do get licensed at older ages are different than those licensed earlier in ways that may affect crash risk. National surveys conducted by the Centers for Disease Control and Prevention and the AAA Foundation for Traffic Safety as well as an analysis of New Jersey's statewide licensing database all indicate that a substantial proportion of new drivers—approximately 1 in 3—now get licensed at age 18 or later (Tefft et al., 2013; Curry et al., 2015a; Shults et al., 2016), patterns which have largely emerged in the wake of the U.S.'s recent recession (Shults and Williams, 2013). Further, all three studies reported that later licensure occurs disproportionately more frequently among low-income and minority teens. These findings have raised concern that teens in lower-income households in the U.S. are licensed without the benefits of GDL.

Central to this discussion is an understanding of the extent to which U.S. GDL systems—if applied to older novice drivers—might reduce the burden of crashes among these drivers. Ideally, this should include examination of how crash rates of older novice drivers compare with younger novice drivers, how crash rates of older novice drivers change over time, and how crash rates of older novice drivers compare with same-aged drivers with more driving experience. However, the current body of literature that directly addresses these questions is limited to a handful of studies (McCartt et al. 2009; Chapman et al. 2014; Curry et al. 2015b; Vlakveld, 2004); this limitation is due in part to the difficulty of accessing the administrative data needed to construct a driver's licensing history. These studies include a study of self-reported crashes in Europe, a study of older novices of various ages in California and previous work funded by the AAA Foundation for Traffic Safety focused on 17- to 20-year old novices in New Jersey. Collectively, these studies found high initial crash rates that declined over the first year of driving for newly licensed drivers; rates of reduction varied based on drivers' age at licensure. This suggests that the first year of unsupervised driving is a learning period for all novices, although much less is known about crash trajectories of novice drivers aged 21 and older. A more detailed review of the

current international evidence for extending GDL restrictions to older novice drivers can be found in Curry et al. (2017).

The goal of this study is to evaluate whether there is epidemiologic evidence to support—from a crash-reduction perspective—adoption of passenger and nighttime restrictions for newly-licensed drivers aged 18 years and older. This longitudinal study examined how overall, injury, nighttime, and passenger crashes differ for novice drivers licensed at different ages over the initial few years of licensure. It is important to note that New Jersey is already unique among states in that the minimum age for independent driving is 17, and all novice drivers under age 21 are covered by full GDL policies (e.g., learner period, nighttime restrictions, multiple-passenger restriction). Given that 18- to 20-year-old novice drivers in New Jersey are already covered under New Jersey's GDL system, this study is unique in its ability to address the existing benefit of current restrictions among these drivers. Examination of novice drivers age 21 and older will address whether there could be a benefit from implementing these restrictions among these drivers.

Methods

New Jersey GDL System

The New Jersey GDL system, which was implemented in 2001, requires all new drivers to progress through three licensing phases. A brief description of these three phases is provided below.

(1) *Learner's permit.* Available at a minimum age of 16 (or 17 for those with no formal driver training), with a six-month minimum holding period for drivers younger than 21 during which the new driver must be accompanied by an adult supervising driver. Those who initiate the licensing process at age 21 or older have a three-month holding period.

(2) *Probationary (intermediate) license.* Available at a minimum age of 17 with a one-year minimum holding period and the following restrictions: (a) one-passenger limit unless a parent/guardian is in the vehicle; (b) ban on driving from 11:01 p.m. through 4:59 a.m.; and (c) requirement to display a reflectorized decal on front and back license plates. Those who initiate the licensing process at age 21 or older technically also have a minimum one-year intermediate period but are not subject to these three restrictions. Intermediate drivers of all ages, however, are also banned from using any interactive wireless communication devices (more experienced drivers are prohibited only from using hand-held devices).

(3) *Basic (full) license.* Available at a minimum age of 18 following completion of phases (1) and (2). Drivers must visit a New Jersey Motor Vehicle Commission location to obtain a full license.

Full details regarding New Jersey's GDL policy are available from the State of New Jersey Motor Vehicle Commission (www.state.nj.us/mvc).

Data Source and Study Population

The data source for this study is the New Jersey Traffic Safety Outcomes (NJ-TSO) Program database, a unique database that contains linked data from two administrative sources—the New Jersey Motor Vehicle Commission's Licensing Database and the New Jersey Department of Transportation's Crash Database. Details on the linkage and data management processes are available in our previous AAA Foundation-sponsored study (Curry et al, 2015a; Curry et al., 2015b). Briefly, these two databases were linked via a five-step hierarchical deterministic linkage, and in total 98% of crash-involved New Jersey drivers matched to a unique licensing record. Thus, the resulting database includes for virtually every New Jersey driver (n≈10 million): (1) a rich description of their progression through the licensing process through December 2014; and (2) detailed, in-depth data for all police-reported crashes occurring in New Jersey from January 2006 through December 2014.

Using the NJ-TSO database, the research team constructed an analytic database of New Jersey drivers who obtained their initial intermediate driver's license from January 2006 through December 2014. As described above, all new New Jersey drivers (i.e., those that have never held a license in any jurisdiction) are required to obtain a one-year intermediate license. (Note that drivers ages 18 years and older who have a full license issued by another jurisdiction and then move to New Jersey are issued a full license.) To further ensure that only true first-time drivers were included in the study (and not those that migrated from another jurisdiction), the study population was limited to only intermediate drivers who also obtained a learner's permit in New Jersey (n=1,120,030). In addition, drivers whose dates of intermediate license were listed to be the same day or prior to the date of their learner's permits (n=2,445, 0.2%) or were 24 months or more after their permit dates (n=73,257, 6.5%) were excluded. Finally, 9,493 (0.9%) drivers with less than one month of follow-up from their date of licensure to the end of the study period (or death, whichever came first) were also excluded. The final analytic database for this study included a fixed cohort[1] of 1,034,835 novice drivers who obtained intermediate licenses in New Jersey during the nine-year study period. Exact age at licensure and sex were ascertained from the licensing record, and each driver's age at each crash was derived from exact dates on the licensing and crash reports.

Given that the intent of this report is to provide foundational knowledge to inform potential extension of GDL to older novice drivers, licensing age cohorts—which will hereafter be referred to as "novice driver groups"—were defined as follows:

(1) *Licensed at age 17*. The majority of U.S. GDL systems cover this age group.

(2) *Licensed at age 18 to 20*. This group is subject to full GDL restrictions in New Jersey but not in other U.S. states with the exception of Indiana.

[1] An epidemiologic cohort is defined as a *fixed cohort* if no individuals enter the population after the start of follow-up. In this study, membership is fixed at time of licensure.

(3) *Licensed at age 21 to 24*. This group is not covered by U.S. GDL systems but is covered under GDL in some international jurisdictions.

(4) *Licensed at age 25 or older*. This group is not covered by U.S. GDL systems but is covered under GDL in some international jurisdictions.

The study's selection procedure and novice driver groups are summarized in Figure 1.

Main Outcome Measures

The primary outcome in this study is the monthly rate of crashes per 10,000 drivers. The analysis focused on the initial 48 months of licensure. Monthly overall crash rates for each age cohort were calculated for each month after intermediate licensure using: 1) the number of drivers with a valid driver's license (denominator) and 2) the number of police-reported crashes that occurred among those drivers with a valid driver's license (numerator). This type of ecological analysis make it possible to account for changes in the underlying pool of licensed drivers eligible to crash during any given month. If a driver crashed more than once in a given month (a rare occurrence), both crashes were included in the numerator. Notably, out-of-state emigrations that might have occurred prior to license expiration were not reliably recorded in the New Jersey licensing database and thus could not be taken into account.

In addition to all police-reported (overall) crashes, monthly crash rates for several specific types of crashes were also examined. *Injury crashes* were defined as crashes that involved at least one person whose physical condition was recorded on the crash report as a "moderate injury," "incapacitated," or "killed." *Late night crashes* were defined as crashes that occurred from 11:01 p.m. through 4:59 a.m., the restricted period in New Jersey. To investigate a time period that is currently not covered by New Jersey's GDL program but considered the optimal start time in existing literature (McCartt et al., 2010; Mayhew et al, 2014), *early night crashes* (9 p.m.–11 p.m.) were also examined. *Multiple-passenger crashes* were defined as crashes in which the driver was carrying two or more passengers of any age. This measure was selected because it closely resembles the current passenger limit in New Jersey. Passengers of all ages were considered (i.e., not only young passengers) because there is not yet evidence to support any specific passenger age threshold for older novice drivers, and an overly-complex restriction may decrease feasibility, acceptance, and compliance. Crashes involving any passengers irrespective of number (i.e., one or more passengers) were also examined.

Statistical Analysis

Descriptive analyses quantified the number of New Jersey residents licensed within each age group and the number and proportion of licensed drivers in each age group who crashed during the study period. Average monthly rates were calculated for specific relevant time periods (0–3 months; 4–6 months; 7–12 months; 13–18 months; 19–24 months; 25–36 months; and 37–48 months after licensure). Rates were compared via estimation of rate ratios and 95% confidence intervals using Poisson regression models. Rate ratios were adjusted for sex, given that it is a well-established crash risk factor, and were estimated to compare rates for several important groups:

(1) *Between novice driver groups with the same time since licensure.* For example, nighttime crash rates of older novice drivers (e.g., drivers licensed at age 21 – 24) and the youngest novice drivers (drivers licensed at 17 years old) were compared over the first three months of licensure. These comparisons will provide insight into the question: *Do older novice drivers experience the initial heightened nighttime crash risk that the youngest novices are known to experience?*

(2) *The first 48 months of licensure within each novice driver group.* For example, the nighttime crash rates for older novice drivers were compared in the initial months of driving through four years after licensure. These comparisons will provide insight into the questions: *How does crash risk change over the first four years of licensure for older novice drivers? Does driving at night appear to be a particularly strong crash risk factor in the initial licensure period for older novice drivers?*

(3) *Same-aged drivers with varying lengths of licensure.* In order to address this, average crash rates of the following groups were compared:
   a. Drivers licensed at age 21 over their first year of licensure.
   b. Drivers licensed at age 18 over their fourth year of licensure.
   c. Drivers licensed at age 17 over their fifth year of licensure.

For analyses of specific crash types, only crashes of the specific type under study were considered to be a "crash event." For example, for analyses of nighttime crashes, the monthly rate used a denominator of the number of licensed drivers that month and a numerator of the number of nighttime crashes among those licensed drivers that month.

Results

Description of New Jersey Novice Drivers

A total of 1,034,835 drivers were included in the study and were followed from a minimum of 0.1 years to a maximum of 9.0 years (median=4.6 years). As shown in Figure 2, slightly over two-thirds of New Jersey novice drivers (68.3%) were licensed at age 17. An additional 16.3% were licensed from the ages of 18 to 20 and were also subject to full GDL nighttime and passenger restrictions. Finally, 5.0% and 10.4% were licensed at age 21 to 24 and age 25 or older, respectively.

To provide a more complete description of the state's older novice driver population, we estimated the proportion of licensed drivers of each age who were in their first year of intermediate licensure. To do this, the proportion of all licensed drivers of a specified age on July 1, 2014 who held an intermediate driver's license was calculated using the full NJ-TSO database (see Figure 3). Over one-quarter of all 18-year-old New Jersey drivers were in their first year of licensure, while 4% of all 21-year-old drivers were. Novice drivers constitute just a small proportion of all licensed drivers for each age beyond age 21.

Overall Crashes

Figure 4 depicts three-month average overall crash rates for each novice driver group, while Table 1 provides a closer look at how crash rates compare: (a) between novice driver groups with the same amount of time since licensure; and (b) over the first 48 months of licensure within each novice driver group. Table 2 provides further insight on crash rates of same-aged drivers who were licensed at various ages (i.e., with varying years since licensure). Several findings are evident:

(1) *Youngest novice drivers had the highest initial crash rates.* As shown in Table 1a and Figure 4, crash rates in the first three months post-licensure are highest for those licensed at age 17 at 193.1 per 10,000 drivers, followed by those licensed at age 18 to 20 at 169.7 per 10,000 drivers (compared with 17-year-old licensees, adjRR: 0.88; 95% CI: 0.86, 0.90). Initial crash rates for novices licensed at age 25 and older are more than 50% lower than for those licensed at age 17 (adjRR: 0.48; 95% CI:0.46, 0.50).

(2) *Crash rates for 17-year-old novice drivers converge with 18- to 20-year old novice drivers within the first 6 months of licensure.* As shown in Table 1a and Figure 4, crash rates for those licensed at age 17 converge with rates for those licensed at age 18 to 20 approximately 6 months after licensure. (Note: in-depth comparison of crash rates among novice 17- to 20-year-old drivers by age at licensure was covered in a previous report [Curry et al., 2015a]). The oldest novice drivers—those licensed at age 25 and older—had consistently lower crash rates than the younger novice driver groups.

(3) *Crash rates decrease more rapidly for younger novice drivers than older novice drivers.* Compared with initial three-month rates, rates at 19 – 24 months of licensure were 50% lower for drivers licensed at age 17 and 32% lower for drivers licensed at age 18 to 20 (Table 1b). Reductions in crash rates over the same time period were smaller for older novices: overall crash rates were 22% lower among those licensed at age 21 to 24 and 17% lower among those licensed at age 25 and older.

(4) *Older novice drivers have higher crash rates than same-aged experienced drivers.* As shown in Table 2, first-year average crash rates of drivers licensed at age 21 are 43% higher than same-aged drivers who were licensed at age 18 and 87% higher than those licensed at age 17.

(5) *The long-term crash rate trajectory of drivers licensed at 17 years old is markedly better than those licensed at 18 to 20 years old.* It is evident in Table 1b that *within* each driver group, crash rates improve and stabilize after approximately 3 years of licensure. However, differences *between* driver groups licensed at different ages are sustained well into licensure. For example, by 24 months post-licensure, drivers licensed at age 17 have crash rates well below those licensed at age 18 to 20. These differences persist through 37–48 months post-licensure, during which time drivers licensed at age 18 to 20 continue to experience 24% higher crash rates than those licensed at age 17 (Table 1a).

Injury Crashes

Although crashes involving a moderate- or greater -severity injury made up only 5% of all police-reported crashes, temporal patterns of injury crash rates over the first 24 months of

licensure between and within novice groups were similar to those of overall crashes (Table 3, Figure 5).

Nighttime Crashes

Depending on the novice driver group and licensure month, late and early night crashes each account for approximately 5% – 10% of total crashes. Main findings are summarized below:

(1) *Nighttime crash rates among drivers licensed at age 21–24 and age 25 and older were relatively stable over the first year of licensure.* This was observed both for late night crashes (Tables 4b and 5b) and early night crashes (Figures 6 and 7).

(2) *Late night crash rates are higher among drivers licensed at age 18–20 and 21-24 than among the youngest novice drivers.* This is clearly depicted in Figure 6 and Table 4a. As further seen in Table 2, 21-year-old novices also have substantially higher rates than same-aged drivers who were licensed at age 17.

(3) *Trends for drivers licensed under age 21 differ during the two nighttime periods.* Crash rates during the 9 p.m.–11 p.m. period—when the majority of nighttime crashes occurred (Appendix A)—were highest for the two youngest novice driver groups, and declined rapidly over the course of licensure for these groups (Figure 7). On the other hand, changes in nighttime crashes that occurred after 11 p.m. were much smaller (Figure 6).

Appendix B and C depict how, for each novice driver group, the change in late and early night crash rates over the first four years of licensure compares to that of overall crashes (note adjusted rate ratios can also be found in part (b) of the respective tables). In general, the rate of change for nighttime crashes is not significantly different than that of overall crashes for drivers licensed at age 21 or older. For drivers licensed before age 21, late night crashes decline at a slower rate than overall crashes, while early night crashes decline at a faster rate.

Multiple-passenger crashes

Multiple-passenger crashes accounted for 10% – 12% of overall crashes, varying somewhat by novice driver group and time since licensure.

(1) *First-year multiple-passenger crash rates are highest for drivers licensed at age 18 to 20.* Over the first year of licensure, those licensed at 18 to 20 years old generally had the highest multiple-passenger crash rates, while rates among those licensed at age 17 and at age 21 to 24 were similar (Table 6a, Figure 8).

(2) *Novice driver groups experience varying amounts of reduction in multiple-passenger crashes.* All novice driver groups experience crash reduction over time. Among drivers licensed at age 17, the rate of multiple-passenger crashes was 35% lower at 7–12 months post-licensure compared with the first three months post -licensure (Table 6b).

Those licensed at age 21 or older experienced similar reductions to drivers licensed at age 18-20, with 17% to 23% lower rates over the same time period. For drivers licensed at age 21 or older, first-year reductions were slightly larger for crashes involving multiple passengers than for crashes involving one or more passengers (Table 7 and Figure 9).

(3) *Multiple-passenger crash rates are substantially higher for novice 21-year-old drivers compared with same-aged experienced drivers.* Average rates among 21-year-old novice drivers in their first year of licensure were 93% higher than the rate among same-aged drivers who were licensed at age 18 and 4.1 times the rate among those licensed at age 17 (Table 2).

(4) *Differences in multiple-passenger crash rates between drivers licensed at age 17 and drivers licensed at older ages were sustained well into licensure.* Compared with those licensed at age 17, the average multiple-passenger crash rate in the 37 – 48 months of licensure was 85% higher for those licensed at age 18 to 20 and more than double for those licensed at age 21 to 24 (Table 6a).

Appendix D and E depict how, for each novice driver group, the change in rates of multiple-passenger crashes and crashes involving any passengers over the first four years of licensure compare to that of overall crashes (adjusted rate ratios can also be found in part (b) of the respective tables). In general, the rate of decrease in crashes involving passengers is generally faster than for overall crashes for drivers licensed before age 21, while the difference is less pronounced for drivers licensed at age 21 or older.

Discussion

As U.S. states continue to struggle with decisions about whether to strengthen existing GDL provisions or extend current requirements to cover older novice driver populations (GHSA, 2011), it is critical for the research community to provide the foundational knowledge necessary for such decisions to be grounded in rigorous scientific evidence. By examining overall, injury, nighttime, and passenger crash rate trajectories of novice driver groups licensed at different ages over their first four years of licensure, this study aimed to continue to build that foundational knowledge.

The central question addressed in this study is whether there is evidence to suggest that GDL policies in place for younger drivers might lead to crash reduction among older novice drivers if such policies were extended to these groups. Thus, the following section first discusses whether the findings with respect to New Jersey novice drivers licensed at age 21 and older—who currently constitute 15% of New Jersey's novice driver population—suggest the need for GDL coverage for this population. Also discussed are the implications of the study's findings for drivers licensed before they turn 21. Although such drivers are already completely covered by New Jersey's GDL program, this study provides some important insights related to GDL and these drivers' crash trajectories.

GDL for Novice Drivers Aged 21 and Older

Although the initial three-month crash rates of novice New Jersey drivers age 21 or older are higher than rates of same-aged experienced drivers, they are substantially lower than initial three-month rates for 17- to 20-year-old novice drivers, who are licensed under GDL policies. This is particularly true for novice drivers aged 25 and older, whose average crash rates over the first three months of licensure were more than 50% lower than for those licensed at age 17. Moreover, older novice drivers experience much less steep crash reductions over the first year of licensure than younger novices. This smaller reduction among older drivers is in line with findings from a previous study in California (Chapman et al., 2014). In particular, the absence of the sharp reduction in crashes that has been clearly demonstrated among drivers licensed at 16 or 17 years old in New Jersey, North Carolina, and California suggests that—unlike younger novice drivers—lack of driving experience does not translate into extremely high initial crash rates upon licensure for new drivers ages 21 or older (Curry et al., 2015b; Foss et al., 2011; Chapman et al., 2014).

Comparisons of nighttime crash rates by novice driver age are more difficult to interpret, and observed differences between older and young novice drivers are likely in part explained by important differences in several interrelated factors such as driving exposure and alcohol involvement. However, crash rates for both late night (11:01 p.m.–4:59 a.m.) and early night (9 p.m.–11 p.m.) crashes were relatively stable for novice drivers aged 21 and older over the first year of licensure, suggesting that inexperience is not likely a primary underlying causative factor.

Multiple-passenger crash rates for 21- to 24-year-old novice drivers tell a somewhat different story. Initial three-month crash rates for these drivers are not significantly different than for younger novices, and their risk of being involved in a crash while carrying multiple passengers is over three and a half times that of same-aged drivers who obtained their licenses when they were first eligible at age 17. Previous research on the association of passengers on crash risk of drivers in their 20s has been mixed (Williams et al., 2007). However, to the knowledge of the research team, this is the first study to examine crash rates involving passengers of *novice* drivers beyond the teenage years. Given how little research has been done in this area, more in-depth investigations should be conducted, including identification of specific driver-passenger age and/or sex combinations that may be particularly risky or protective as well as potential mechanisms by which passengers affect crash risk. Importantly, observation of the age distribution of passengers (Appendix F) indicates that a passenger restriction only restricting young passengers would likely be less consequential for older novices in New Jersey not covered by GDL.

In summary, given the lower absolute overall crash rates and much milder reductions over time, the authors believe there is *no evidence* to suggest that additional GDL policies are needed in New Jersey for novice drivers 25 and older and *a lack of compelling evidence* that such policies are needed for novice drivers aged 21 to 24. (Note: as discussed below, New Jersey already has a required three-month learner permit for all novice drivers ages 21 and older.)

GDL for Novice Drivers under Age 21

As mentioned previously, New Jersey is one of only two U.S. states in which full GDL policies apply to 18- to 20-year-old novice drivers (the other is Indiana). A previous AAA Foundation-sponsored study examined crash rates of young novice drivers in more narrowly-defined licensing age cohorts (Curry et al., 2015b). That report concluded that although first-month post-licensure crash rates of drivers licensed at age 18, 19, or 20 were lower than those licensed immediately after eligibility (e.g., at 17 years 0 months), these drivers still experienced 25% – 35% reductions in crash rates over the first year of licensure—which indirectly speaks to the benefit of GDL policies for these drivers. The findings of this report reiterate and extend previous findings by showing that, compared with drivers licensed at age 21 or older, 18- to 20-year-old drivers have relatively high initial crash rates and steeper reductions over time.

The findings of this study also have specific implications on nighttime restrictions for these drivers. The substantially higher late night crash rates among 18-to 20-year-old novice drivers than among 17-year-old novice drivers is not surprising given the recent findings that the former group has higher nighttime driving exposure rates (Curry et al., 2016). However, the relatively flat late night crash rate trajectory *within* 17-year-old and 18- to 20-year-old novice driver groups over the first year of licensure—which differs significantly from the sharp reduction in overall crashes—is quite notable. This trend is also starkly different than the rapid decline observed over time for crashes occurring from 9 p.m. through 11 p.m. This two-hour time period—which accounts for 8% of all crashes and 60% of all nighttime crashes among New Jersey novice drivers under age 21 in their first year of licensure (Appendix A)—is not currently covered by New Jersey's GDL provision, despite empirical evidence supporting a 9 p.m. or 10 p.m. starting time for nighttime restrictions (Trempel, 2009; McCartt et al., 2010; Masten et al., 2013; Mayhew et al., 2014). These findings speak both to the likelihood of benefits of the current nighttime restriction in New Jersey and the potential of added benefits from beginning those restrictions at 9 p.m. for all novice drivers under age 21.

Licensing Cohorts: Differences in Long-Term Crash Rate Trajectories

An additional study finding deserves discussion. Similar to the previous AAA Foundation-sponsored study (Curry et al., 2015b), findings of this study suggest that the long-term crash rates of drivers licensed at age 17 are lower than those licensed at older ages. Specifically, while crash rates *within* each licensing cohort begin to stabilize after just a few years of licensure, significant differences *between* cohorts continue to exist even after four years of licensure. Specifically, crash rates of drivers licensed at 17 years old were substantially lower than those licensed at 18 to 20 years old, even after both groups had been driving for four years. The authors suspect these findings do not indicate that early learners are inherently better drivers, but instead support findings from several growing bodies of literature showing that: (1) the makeup of licensing cohorts may differ in several important ways that may be related to crash risk (Tefft et al., 2013; Curry et al., 2015a; Shults et al., 2016; Harper et al., 2015); and (2) there may be differentiable groups of high- and low-risk young drivers (Guo et al., 2013; Carney et al., 2010). The authors plan to continue work to characterize licensing cohorts and risk groups and to determine the extent

to which within- versus between-group differences explain variation in long-term crash risk.

Other Considerations

This study was not able to account for driving exposure—a very important factor that influences crash rates and that likely differs both between novice driver groups and within a group over time. Initial nighttime driving exposure among New Jersey drivers licensed at age 21 or older would be expected to be higher than among those licensed before age 21 given that the latter group is prohibited from driving during this period whereas the former is not. Thus, per-mile overall crash rates of older novices may be even lower compared with rates of younger novices than were the per-driver rates observed in this study. With respect to how exposure changes over the course of licensure, data from the National Household Travel Survey indicate that annual mileage among 18-year-old drivers is markedly higher than 17-year-old drivers (NHTS). Year-to-year changes in mileage after age 18 are less variable, but there also may be meaningful changes in type of driving (when, where) that also are not accounted for in these analyses (Janke, 1991). However, few studies have assessed rates of driving exposure specifically among novice drivers licensed at various ages. A recent study conducted in New Jersey did report lower rates of compliance with New Jersey's passenger restriction among 18-year-old novice drivers than 17-year-old novice drivers (Curry et al., 2016). It is important to keep this limitation in mind when interpreting the implication of study findings. Several novel methodologies now being employed to estimate driving exposure may help provide increased specificity on how driving exposure changes over time for and differs among various groups of novice drivers (Curry et al. 2016; Klauer et al, 2011).

A specific strength of the study was its ability to isolate true novice drivers given that all new drivers are required to obtain an intermediate driver's license in New Jersey, while drivers age 18 and older who were previously licensed in another jurisdiction are issued an unrestricted (full) license. However, the study was not able to account for a driver's migration out of New Jersey because the New Jersey licensing database does not clearly indicate when drivers move out of state (license expiration occurs after 4 years). This would lead to underestimates of the true crash rates that would become larger over time (as members of the fixed cohorts migrate out of New Jersey).

As mentioned previously, New Jersey's GDL program is unique among states. It already has a three-month learner period for novices aged 21 or older, so this study can only address the potential need for GDL requirements over and above that requirement. However, the effect of a learner period on these drivers has not been studied and—given differences such as possible lack of a parent to supervise their practice driving—cannot be assumed to be similar to that found for younger novice drivers.

Few prior studies directly and rigorously examined whether GDL provisions benefit 18- to 20-year-old novice drivers (Curry et al., 2017). This lack of research is notable given six jurisdictions apply some GDL restrictions for this age group and presumably possess the data needed to evaluate the effects of these restrictions. It is critical that the traffic safety community recognizes legislative changes such as this as opportunities to advance public

health by analyzing results of these "natural experiments." To yield their potential benefit, such studies should be planned well in advance of the legislation's effective date. The future ability of the research community to continue to shape and inform GDL policy efforts rests squarely on two key factors: (1) the ongoing support and collaboration of state governmental entities, and (2) the initial collection of traffic data in a manner that optimizes its value for both administrative and research purposes.

Conclusion

Key findings from this study are:

(1) Results support New Jersey's current GDL policies for 17- to 20-year-old novice drivers and the potential for added benefits from beginning the restrictions at 9 p.m.
(2) There is a lack of compelling evidence for additional policies for drivers licensed at age 21–24. The lower initial crash rates for these drivers compared with younger novice drivers and the lack of steep reductions in their crashes over time calls into question the potential beneficial impact that GDL provisions would have on crashes.
(3) There is no evidence to indicate a need for additional GDL policies for New Jersey novices aged 25 years and older.

Future work is needed to further characterize licensing cohorts and risk groups and to determine the extent to which differences within versus between cohorts may explain variation in long-term crash risk.

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Tables and Figures

Figure 1. Flowchart depicting selection of licensing age cohorts (i.e., novice driver groups). *Gray boxes indicate individuals who were excluded from analyses.*

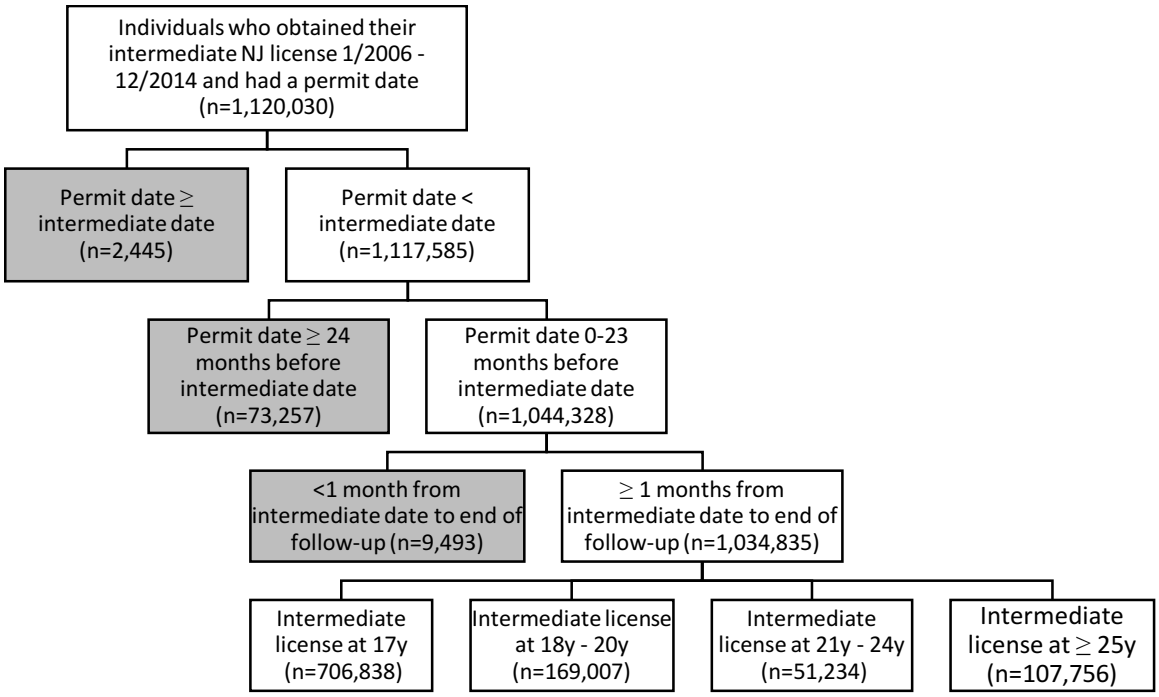
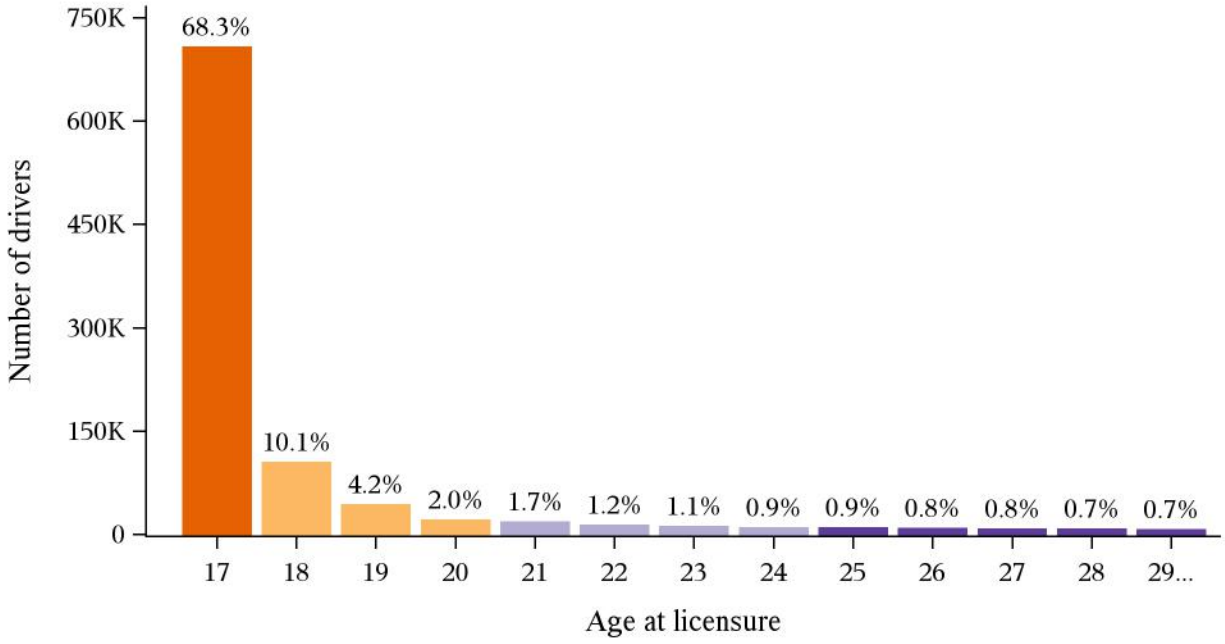
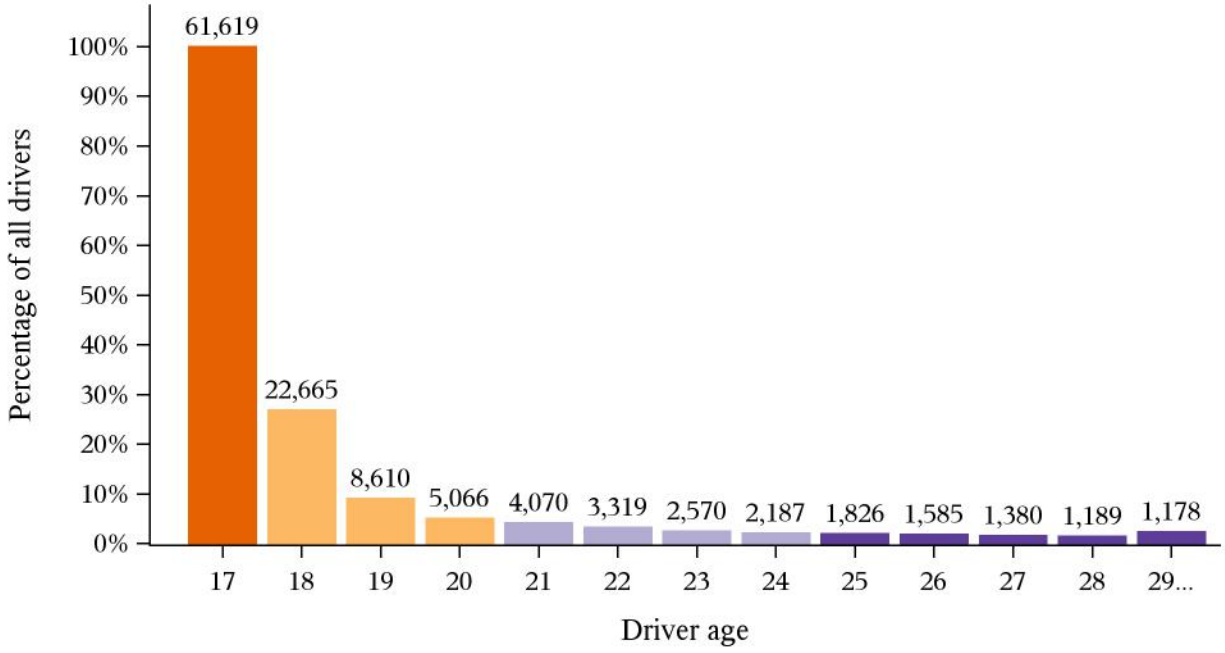


Figure 2. Number and percentage of all novice drivers who were licensed at specified ages, New Jersey, 2006-2014.



Notes: Bars indicate the number of novice drivers who were licensed at each specified age. Percent labels above bars indicate the percentage of all novice drivers in New Jersey who were licensed at the specified age. For example, there were 104,763 drivers who were licensed at age 18 in New Jersey between 2006 and 2014, representing 10.1% of all novice drivers in the state over the study period. 6.6% of all novice drivers were age 30 years and older (data not shown).

Figure 3. Number and percentage of all licensed drivers on July 1, 2014 who were licensed < 1 year, by age, New Jersey.



Notes: For each specified age, the bars indicate the percentage of all licensed drivers on 7/1/14 who were licensed less than one year. The numbers above the bars indicate the number of drivers who were licensed less than one year. For example, on 7/1/14 there were 22,665 18-year-old drivers who had been licensed less than one year, representing 27% of all 18-year-old licensed drivers in the state.

Table 1. Sex-adjusted rate ratios (adjRR) and 95% confidence intervals (CI) for overall crashes, by age at intermediate licensure, New Jersey, 2006-2014.

Months after intermediate licensure	17y		18y to 20y		21y to 24y		25y and older	
	adjRR	95% CI	adjRR	95% CI	adjRR	95% CI	adjRR	95% CI
(a) Comparison of rates between novice driver groups with the same time since licensure.								
1-3	1.00	-	0.88	(0.86, 0.90)	0.69	(0.66, 0.72)	0.48	(0.46, 0.50)
4-6	1.00	-	0.97	(0.95, 1.00)	0.83	(0.79, 0.87)	0.58	(0.56, 0.61)
7-12	1.00	-	0.97	(0.95, 0.99)	0.88	(0.85, 0.91)	0.62	(0.60, 0.63)
13-18	1.00	-	1.04	(1.02, 1.06)	0.95	(0.91, 0.99)	0.71	(0.69, 0.73)
19-24	1.00	-	1.20	(1.17, 1.23)	1.08	(1.03, 1.13)	0.80	(0.77, 0.83)
25-36	1.00	-	1.19	(1.16, 1.21)	1.05	(1.02, 1.09)	0.85	(0.83, 0.88)
37-48	1.00	-	1.24	(1.22, 1.27)	1.10	(1.05, 1.14)	0.90	(0.87, 0.92)
(b) Comparison of rates over first 48 months of licensure within each novice driver group.								
1-3	1.00	-	1.00	-	1.00	-	1.00	-
4-6	0.83	(0.82, 0.84)	0.92	(0.89, 0.95)	1.00	(0.94, 1.06)	1.01	(0.96, 1.06)
7-12	0.72	(0.71, 0.73)	0.80	(0.78, 0.82)	0.92	(0.87, 0.97)	0.93	(0.89, 0.97)
13-18	0.60	(0.59, 0.61)	0.72	(0.69, 0.74)	0.83	(0.78, 0.88)	0.89	(0.85, 0.93)
19-24	0.50	(0.49, 0.50)	0.68	(0.66, 0.70)	0.78	(0.73, 0.83)	0.83	(0.79, 0.87)
25-36	0.44	(0.44, 0.45)	0.60	(0.59, 0.62)	0.68	(0.64, 0.72)	0.79	(0.76, 0.83)
37-48	0.39	(0.39, 0.40)	0.56	(0.54, 0.58)	0.63	(0.59, 0.67)	0.74	(0.71, 0.78)

Figure 4. Three-month average rates of overall crashes per 10,000 drivers, by age at licensure, New Jersey, 2006-2014.

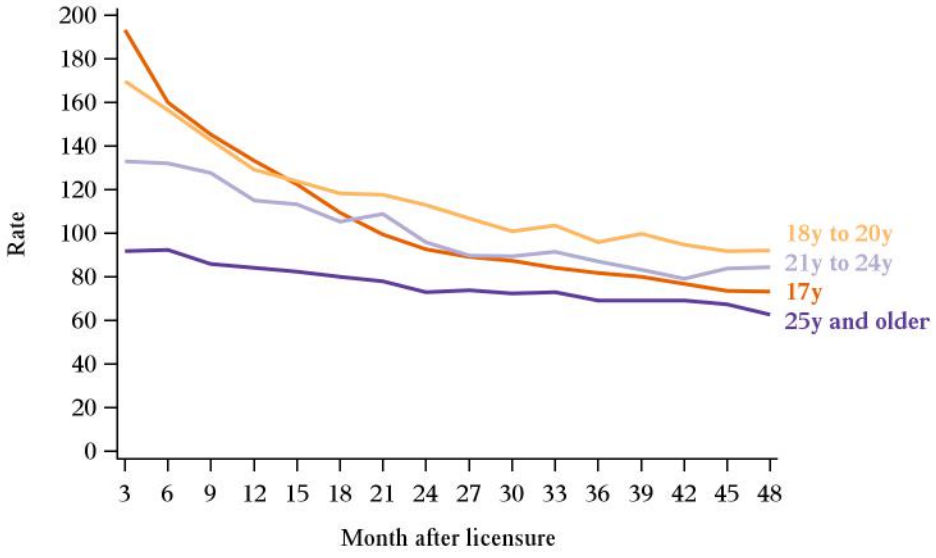


Table 2. Twelve-month average crash rates and sex-adjusted rate ratios and 95% confidence intervals comparing same-aged drivers with varying lengths of licensure, New Jersey, 2006-2014.*

	Crash rates per 10,000 drivers			Sex-adjusted rate ratios and 95% confidence intervals	
Crash type	Licensed at age 21, 1st year of licensure	Licensed at age 18, 4th year of licensure	Licensed at age 17, 5th year of licensure	21y vs 18y	21y vs 17y
Overall	134.8	94.6	72.3	1.43 (1.37, 1.50)	1.87 (1.80, 1.95)
Injury	6.9	4.8	3.5	1.45 (1.18, 1.76)	1.98 (1.66, 2.36)
Late night	13.8	9.9	6.9	1.41 (1.23, 1.63)	2.03 (1.79, 2.30)
Early night	9.5	6.1	4.6	1.58 (1.33, 1.88)	2.05 (1.77, 2.39)
Multiple passenger	16.4	8.5	4.0	1.93 (1.68, 2.21)	4.12 (3.66, 4.64)
≥ 1 passenger	47.4	26.0	16.0	1.82 (1.68, 1.97)	2.98 (2.78, 3.19)

* Average crash rates were compared for: (1) drivers who were licensed at 21 years old over their first year of licensure: (2) drivers who were licensed at age 18 over their fourth year of licensure; and (3) drivers who were licensed at age 17 over their fifth year of licensure. Drivers in each group were 21 years old at the beginning of the comparison year.

Table 3. Sex-adjusted rate ratios (adjRR) and 95% confidence intervals (CI) for crashes involving a moderate or greater severity injury, by age at intermediate licensure, New Jersey, 2006-2014.

Months after intermediate licensure	17y		18y to 20y		21y to 24y		25y and older	
	adjRR	95% CI	adjRR	95% CI	adjRR	95% CI	adjRR	95% CI
(a) Comparison of rates between novice driver groups with the same time since licensure.								
1-3	1.00	-	0.83	(0.75, 0.92)	0.57	(0.46, 0.71)	0.30	(0.25, 0.37)
4-6	1.00	-	0.97	(0.87, 1.08)	0.73	(0.59, 0.90)	0.49	(0.41, 0.59)
7-12	1.00	-	1.01	(0.93, 1.10)	0.80	(0.68, 0.95)	0.51	(0.44, 0.59)
13-18	1.00	-	1.05	(0.95, 1.16)	0.85	(0.71, 1.03)	0.60	(0.52, 0.71)
19-24	1.00	-	1.15	(1.04, 1.28)	1.04	(0.85, 1.27)	0.61	(0.51, 0.72)
25-36	1.00	-	1.11	(1.01, 1.21)	0.99	(0.84, 1.17)	0.62	(0.54, 0.72)
37-48	1.00	-	1.32	(1.20, 1.46)	0.77	(0.61, 0.96)	0.73	(0.62, 0.85)
(b) Comparison of rates over first 48 months of licensure within each novice driver group.								
1-3	1.00	-	1.00	-	1.00	-	1.00	-
4-6	0.79	(0.74, 0.84)	0.93	(0.81, 1.06)	1.01	(0.75, 1.35)	1.28	(0.98, 1.67)
7-12	0.67	(0.63, 0.70)	0.82	(0.72, 0.92)	0.93	(0.72, 1.21)	1.11	(0.87, 1.42)
13-18	0.55	(0.52, 0.59)	0.70	(0.62, 0.80)	0.82	(0.62, 1.08)	1.09	(0.85, 1.39)
19-24	0.48	(0.45, 0.51)	0.67	(0.58, 0.76)	0.87	(0.66, 1.15)	0.96	(0.74, 1.24)
25-36	0.41	(0.39, 0.44)	0.55	(0.49, 0.62)	0.71	(0.54, 0.92)	0.84	(0.66, 1.06)
37-48	0.35	(0.33, 0.37)	0.56	(0.49, 0.64)	0.47	(0.34, 0.63)	0.83	(0.65, 1.06)

Figure 5. Three-month average rates of crashes involving a moderate or greater severity injury per 10,000 drivers, by age at licensure, New Jersey, 2006-2014.

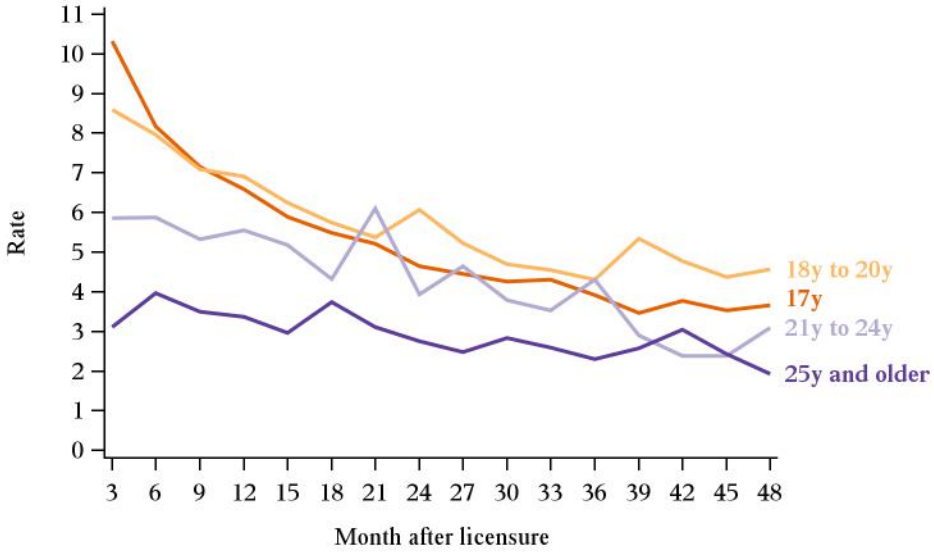


Table 4. Sex-adjusted rate ratios (adjRR) and 95% confidence intervals (CI) for late night crashes (11:01 p.m.–4:59 a.m.), by age at intermediate licensure, New Jersey, 2006-2014.

Months after intermediate licensure	17y		18y to 20y		21y to 24y		25y and older	
	adjRR	95% CI	adjRR	95% CI	adjRR	95% CI	adjRR	95% CI
(a) Comparison of rates between novice driver groups with the same time since licensure.								
1-3	1.00	-	1.61	(1.47, 1.77)	1.40	(1.20, 1.65)	0.70	(0.60, 0.82)
4-6	1.00	-	1.75	(1.59, 1.93)	1.76	(1.50, 2.06)	0.94	(0.81, 1.09)
7-12	1.00	-	1.75	(1.63, 1.88)	1.86	(1.66, 2.09)	0.94	(0.84, 1.05)
13-18	1.00	-	1.44	(1.34, 1.55)	1.51	(1.33, 1.71)	0.79	(0.70, 0.89)
19-24	1.00	-	1.45	(1.34, 1.57)	1.42	(1.24, 1.64)	0.70	(0.62, 0.80)
25-36	1.00	-	1.43	(1.34, 1.52)	1.17	(1.04, 1.32)	0.68	(0.62, 0.76)
37-48	1.00	-	1.60	(1.49, 1.71)	1.14	(0.99, 1.32)	0.77	(0.69, 0.87)
(b) Comparison of rates over first 48 months of licensure within each novice driver group.								
1-3	1.00	-	1.00	-	1.00	-	1.00	-
4-6	0.88	(0.82, 0.94)	0.95	(0.85, 1.07)	1.09	(0.88, 1.36)	1.17	(0.95, 1.44)
7-12	0.85	(0.80, 0.91)	0.93	(0.84, 1.02)	1.13	(0.94, 1.36)	1.14	(0.95, 1.38)
13-18	0.96	(0.91, 1.02)	0.86	(0.78, 0.95)	1.04	(0.86, 1.27)	1.09	(0.90, 1.32)
19-24	0.96	(0.90, 1.02)	0.86	(0.78, 0.96)	0.98	(0.80, 1.20)	0.98	(0.80, 1.19)
25-36	0.89	(0.84, 0.95)	0.79	(0.72, 0.87)	0.75	(0.62, 0.91)	0.89	(0.74, 1.07)
37-48	0.79	(0.75, 0.84)	0.78	(0.71, 0.86)	0.65	(0.53, 0.80)	0.90	(0.75, 1.09)

Figure 6. Three-month average rates of late night crashes (11:01 p.m.–4:59 a.m.) per 10,000 drivers, by age at licensure, New Jersey, 2006-2014.

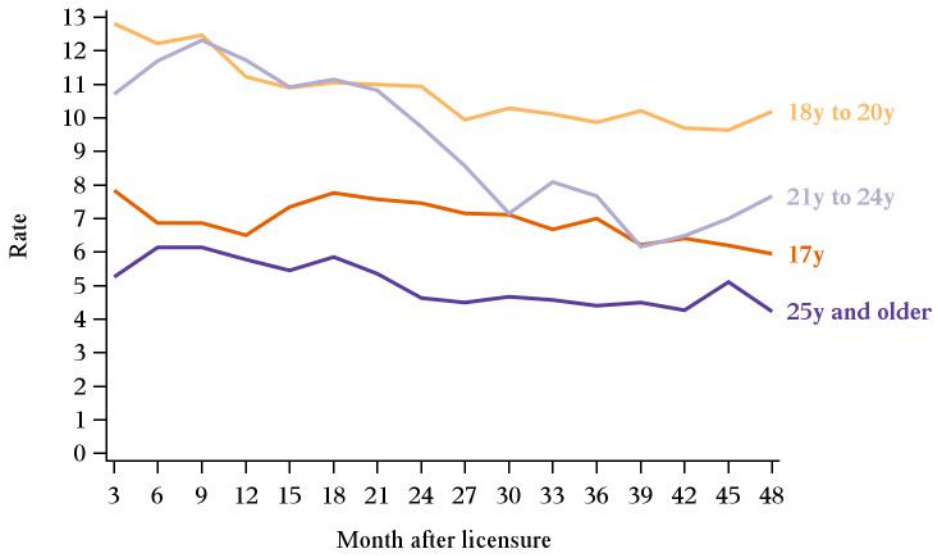


Table 5. Sex-adjusted rate ratios (adjRR) and 95% confidence intervals (CI) for early night crashes (9 p.m.–11 p.m.), by age at intermediate licensure, New Jersey, 2006-2014.

Months after intermediate licensure	17y		18y to 20y		21y to 24y		25y and older	
	adjRR	95% CI	adjRR	95% CI	adjRR	95% CI	adjRR	95% CI
(a) Comparison of rates between novice driver groups with the same time since licensure.								
1-3	1.00	-	0.86	(0.80, 0.93)	0.58	(0.49, 0.68)	0.31	(0.26, 0.36)
4-6	1.00	-	0.98	(0.90, 1.08)	0.71	(0.59, 0.85)	0.38	(0.33, 0.45)
7-12	1.00	-	1.00	(0.93, 1.07)	0.86	(0.75, 0.98)	0.52	(0.46, 0.59)
13-18	1.00	-	1.10	(1.02, 1.19)	0.87	(0.75, 1.01)	0.56	(0.49, 0.64)
19-24	1.00	-	1.25	(1.15, 1.36)	0.87	(0.73, 1.04)	0.68	(0.59, 0.78)
25-36	1.00	-	1.20	(1.11, 1.28)	0.88	(0.76, 1.02)	0.66	(0.59, 0.74)
37-48	1.00	-	1.17	(1.08, 1.28)	1.03	(0.87, 1.21)	0.67	(0.58, 0.76)
(b) Comparison of rates over first 48 months of licensure within each novice driver group.								
1-3	1.00	-	1.00	-	1.00	-	1.00	-
4-6	0.72	(0.69, 0.76)	0.82	(0.74, 0.92)	0.88	(0.70, 1.12)	0.91	(0.73, 1.14)
7-12	0.59	(0.56, 0.61)	0.68	(0.62, 0.75)	0.87	(0.71, 1.07)	1.01	(0.83, 1.22)
13-18	0.49	(0.46, 0.51)	0.62	(0.56, 0.69)	0.73	(0.59, 0.91)	0.90	(0.74, 1.10)
19-24	0.41	(0.39, 0.43)	0.59	(0.54, 0.66)	0.62	(0.49, 0.78)	0.91	(0.75, 1.12)
25-36	0.34	(0.33, 0.36)	0.48	(0.43, 0.52)	0.52	(0.42, 0.65)	0.75	(0.62, 0.91)
37-48	0.30	(0.29, 0.31)	0.41	(0.37, 0.45)	0.54	(0.43, 0.67)	0.67	(0.55, 0.82)

Figure 7. Three-month average rates of early night crashes (9 p.m.–11 p.m.) per 10,000 drivers, by age at licensure, New Jersey, 2006-2014.

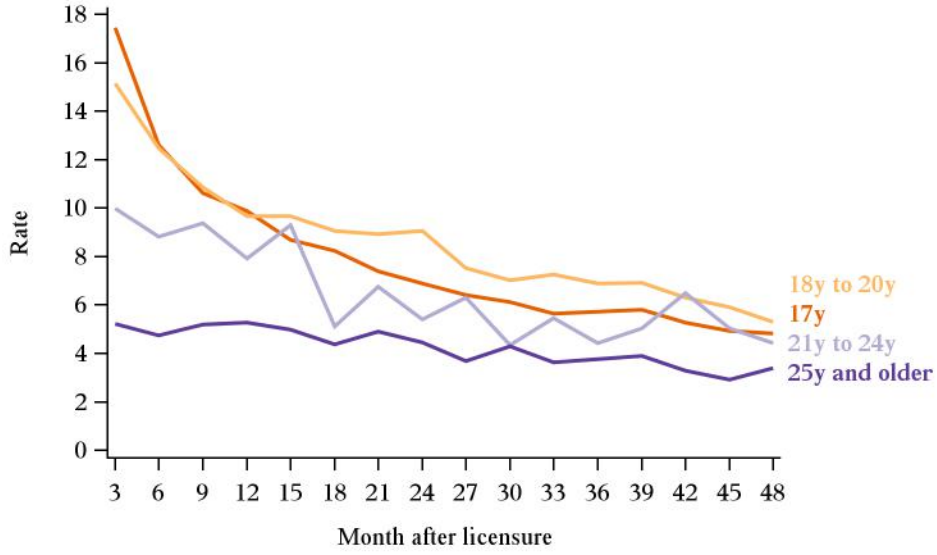


Table 6. Sex-adjusted rate ratios (adjRR) and 95% confidence intervals (CI) for multiple-passenger crashes, by age at intermediate licensure, New Jersey, 2006-2014.

Months after intermediate licensure	17y		18y to 20y		21y to 24y		25y and older	
	adjRR	95% CI	adjRR	95% CI	adjRR	95% CI	adjRR	95% CI
(a) Comparison of rates between novice driver groups with the same time since licensure.								
1-3	1.00	-	1.03	(0.96, 1.11)	0.90	(0.79, 1.02)	0.65	(0.59, 0.72)
4-6	1.00	-	1.23	(1.14, 1.32)	1.00	(0.87, 1.14)	0.72	(0.64, 0.81)
7-12	1.00	-	1.22	(1.15, 1.30)	1.08	(0.97, 1.20)	0.84	(0.77, 0.91)
13-18	1.00	-	1.10	(1.03, 1.17)	0.99	(0.87, 1.11)	0.76	(0.70, 0.84)
19-24	1.00	-	1.41	(1.31, 1.52)	1.34	(1.17, 1.53)	1.02	(0.92, 1.13)
25-36	1.00	-	1.53	(1.43, 1.63)	1.50	(1.34, 1.67)	1.27	(1.17, 1.38)
37-48	1.00	-	1.85	(1.72, 1.99)	2.10	(1.86, 2.37)	1.64	(1.49, 1.80)
(b) Comparison of rates over first 48 months of licensure within each novice driver group.								
1-3	1.00	-	1.00	-	1.00	-	1.00	-
4-6	0.78	(0.74, 0.82)	0.92	(0.85, 1.01)	0.87	(0.73, 1.04)	0.86	(0.75, 1.00)
7-12	0.65	(0.62, 0.68)	0.77	(0.71, 0.83)	0.78	(0.66, 0.91)	0.83	(0.73, 0.94)
13-18	0.62	(0.59, 0.65)	0.66	(0.60, 0.71)	0.68	(0.57, 0.80)	0.72	(0.63, 0.83)
19-24	0.44	(0.42, 0.46)	0.60	(0.55, 0.65)	0.65	(0.55, 0.78)	0.69	(0.60, 0.79)
25-36	0.33	(0.32, 0.35)	0.49	(0.45, 0.53)	0.55	(0.47, 0.65)	0.64	(0.57, 0.73)
37-48	0.25	(0.24, 0.26)	0.44	(0.40, 0.48)	0.58	(0.49, 0.69)	0.63	(0.55, 0.72)

Figure 8. Three-month average rates of multiple-passenger crashes per 10,000 drivers, by age at licensure, New Jersey, 2006-2014.

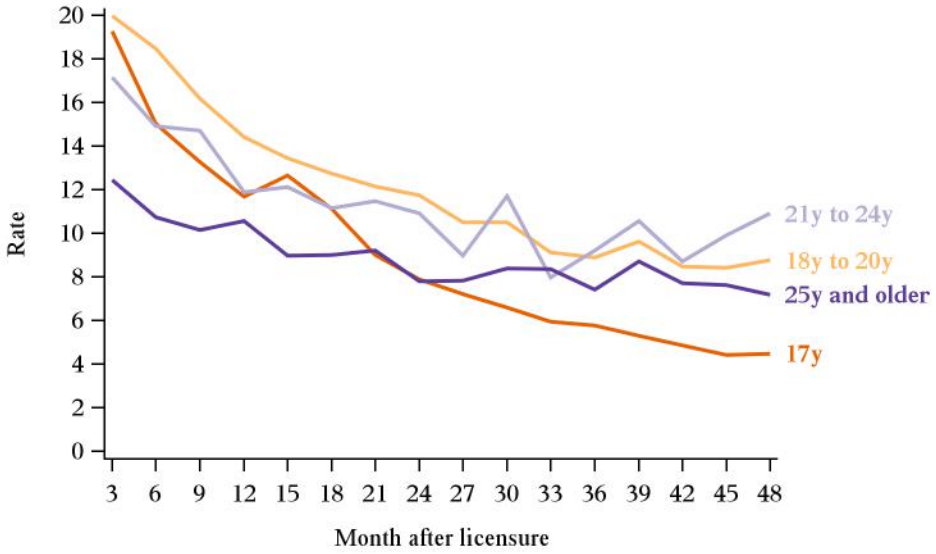
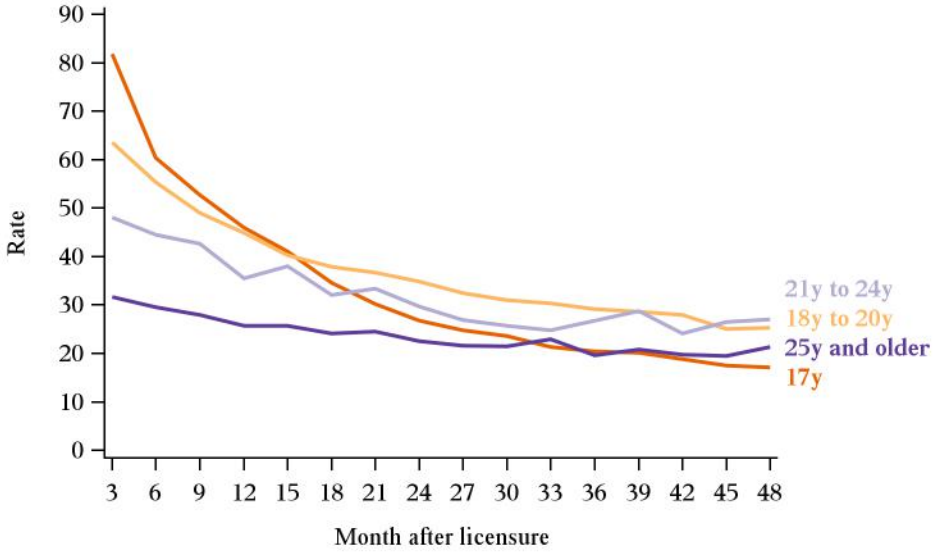


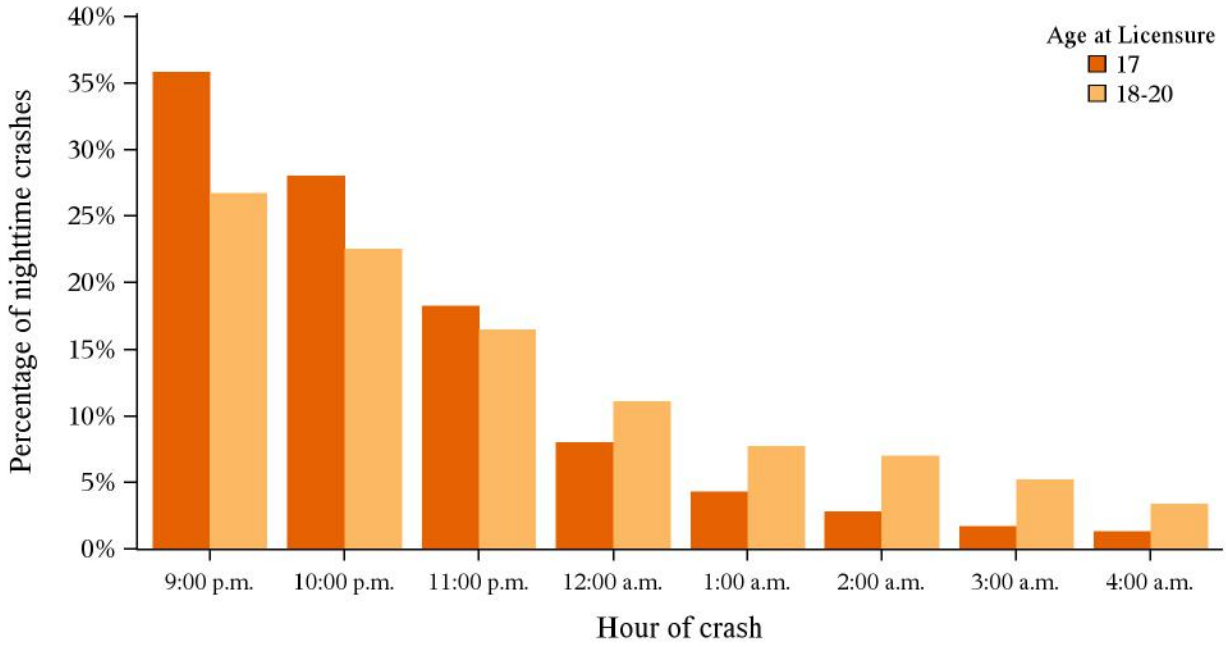
Table 7. Sex-adjusted rate ratios (adjRR) and 95% confidence intervals (CI) for ≥ 1 passenger crashes, by age at intermediate licensure, New Jersey, 2006-2014.

Months after intermediate licensure	17y		18y to 20y		21y to 24y		25y and older	
	adjRR	95% CI	adjRR	95% CI	adjRR	95% CI	adjRR	95% CI
(a) Comparison of rates between novice driver groups with the same time since licensure.								
1-3	1.00	-	0.78	(0.75, 0.81)	0.59	(0.55, 0.63)	0.39	(0.36, 0.41)
4-6	1.00	-	0.92	(0.88, 0.95)	0.74	(0.68, 0.80)	0.49	(0.46, 0.53)
7-12	1.00	-	0.95	(0.92, 0.98)	0.80	(0.75, 0.85)	0.55	(0.52, 0.58)
13-18	1.00	-	1.03	(0.99, 1.07)	0.93	(0.87, 1.00)	0.66	(0.63, 0.70)
19-24	1.00	-	1.25	(1.20, 1.31)	1.12	(1.03, 1.21)	0.83	(0.78, 0.89)
25-36	1.00	-	1.36	(1.32, 1.41)	1.16	(1.08, 1.24)	0.96	(0.91, 1.01)
37-48	1.00	-	1.45	(1.40, 1.52)	1.45	(1.35, 1.56)	1.11	(1.05, 1.17)
(b) Comparison of rates over first 48 months of licensure within each novice driver group.								
1-3	1.00	-	1.00	-	1.00	-	1.00	-
4-6	0.74	(0.72, 0.75)	0.87	(0.83, 0.92)	0.92	(0.83, 1.03)	0.93	(0.85, 1.02)
7-12	0.60	(0.59, 0.62)	0.74	(0.71, 0.77)	0.81	(0.74, 0.89)	0.85	(0.78, 0.92)
13-18	0.46	(0.45, 0.47)	0.62	(0.59, 0.65)	0.73	(0.66, 0.81)	0.79	(0.72, 0.85)
19-24	0.35	(0.34, 0.36)	0.56	(0.53, 0.59)	0.66	(0.59, 0.73)	0.74	(0.68, 0.81)
25-36	0.28	(0.27, 0.28)	0.49	(0.46, 0.51)	0.54	(0.49, 0.60)	0.68	(0.63, 0.73)
37-48	0.23	(0.22, 0.23)	0.42	(0.40, 0.44)	0.55	(0.50, 0.61)	0.64	(0.59, 0.70)

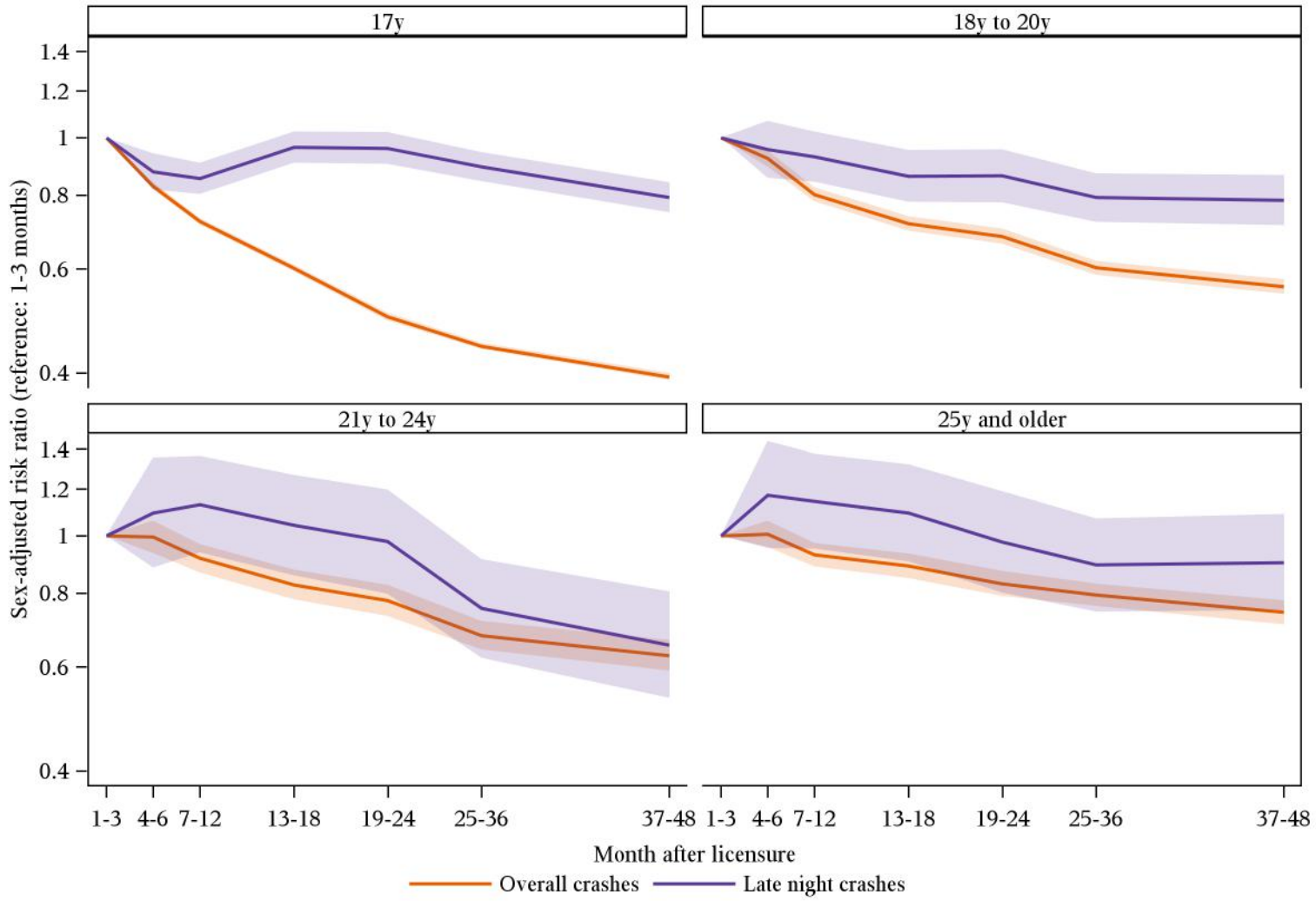
Figure 9. Three-month average rates of ≥ 1 passenger crashes per 10,000 drivers, by age at licensure, New Jersey, 2006-2014.



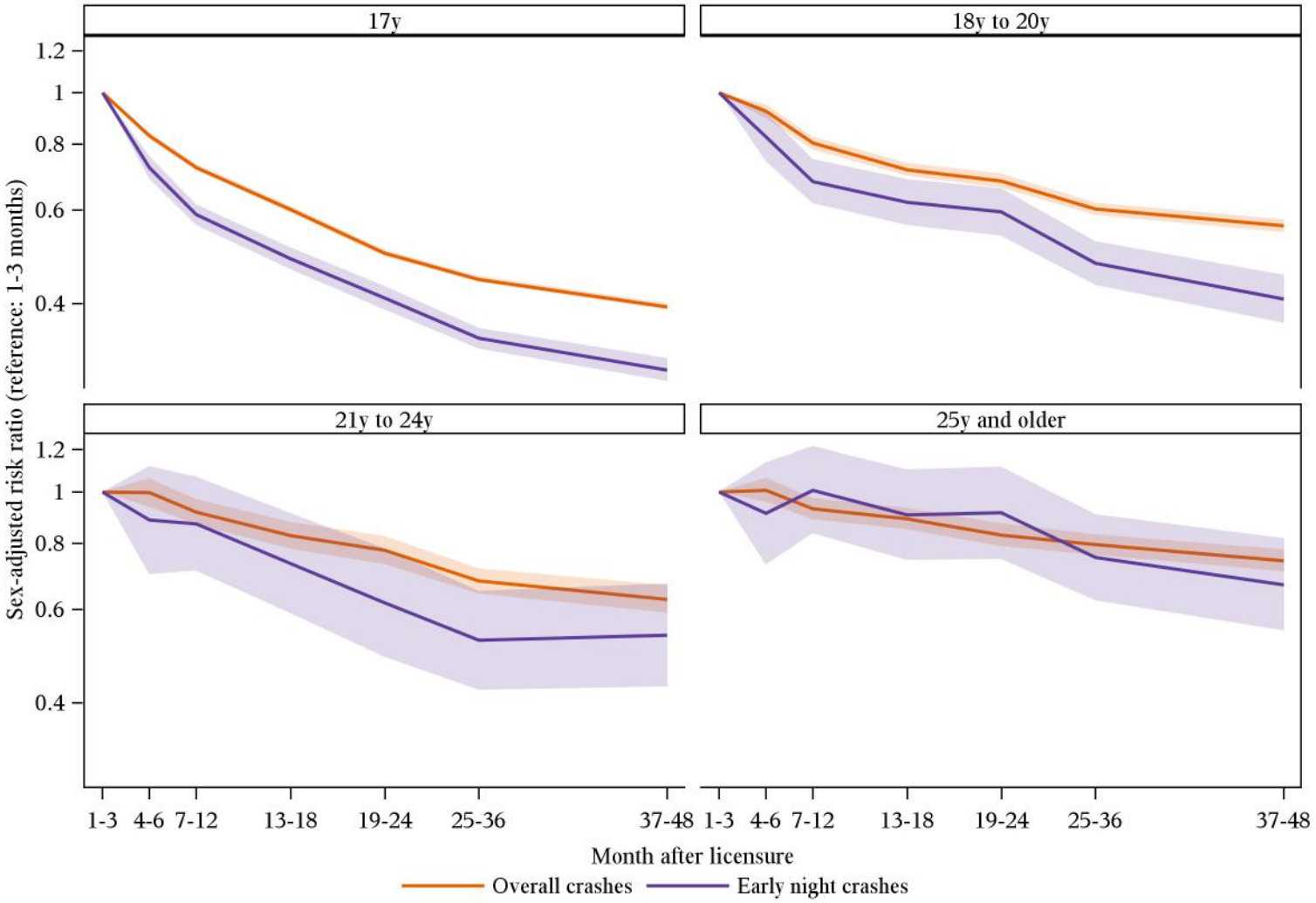
Appendix A. Proportion of all nighttime crashes (9 p.m.–4:59 a.m.) among drivers in their first year of licensure that occurred within each hour, by age at licensure, New Jersey, 2006-2014.



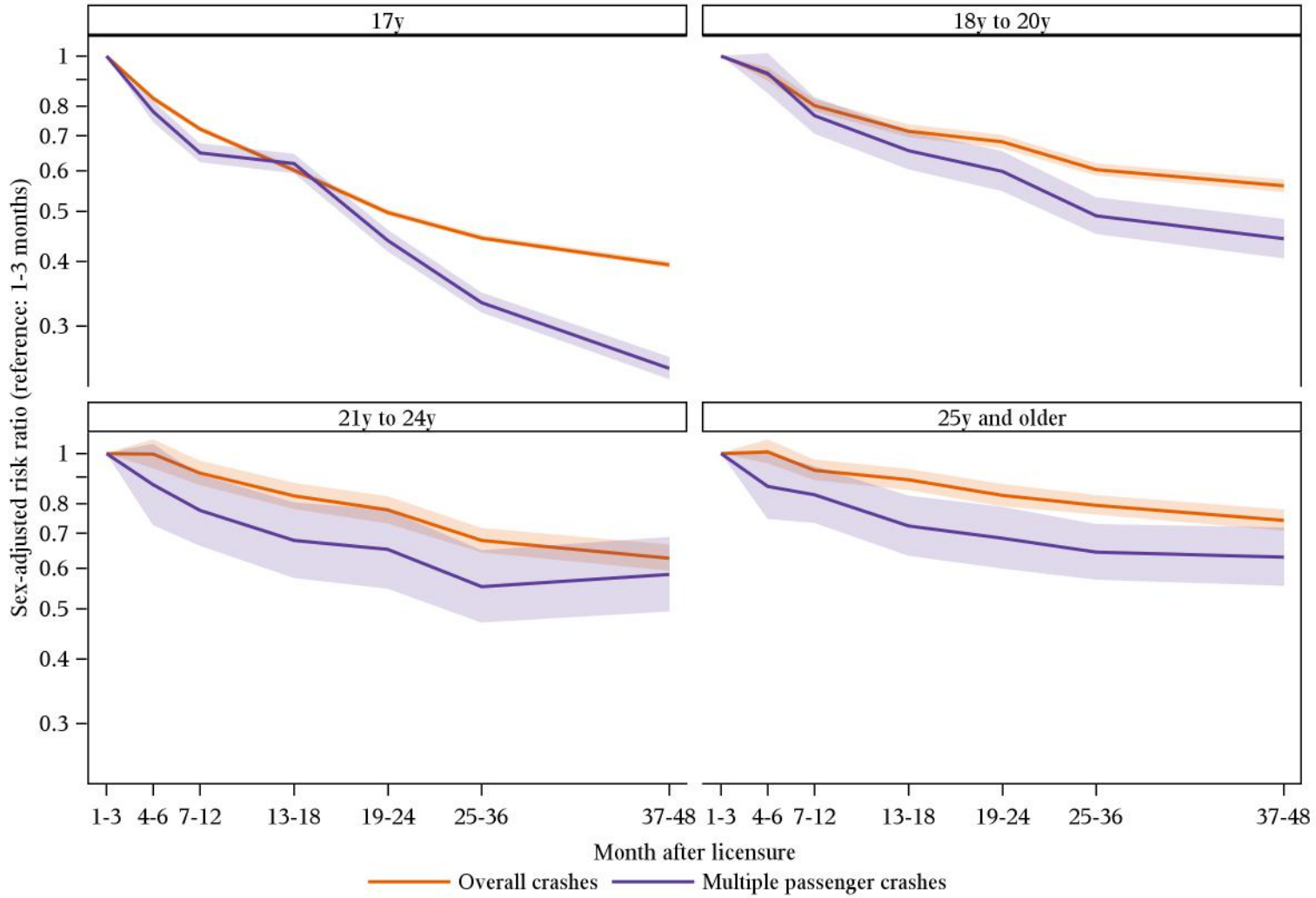
Appendix B. Comparison of sex-adjusted risk ratios (lines) and 95% confidence intervals (bands) for overall crashes and late night crashes (11:01 pm.–4:59 a.m.), over the first four years of licensure, by age at licensure, New Jersey, 2006-2014.



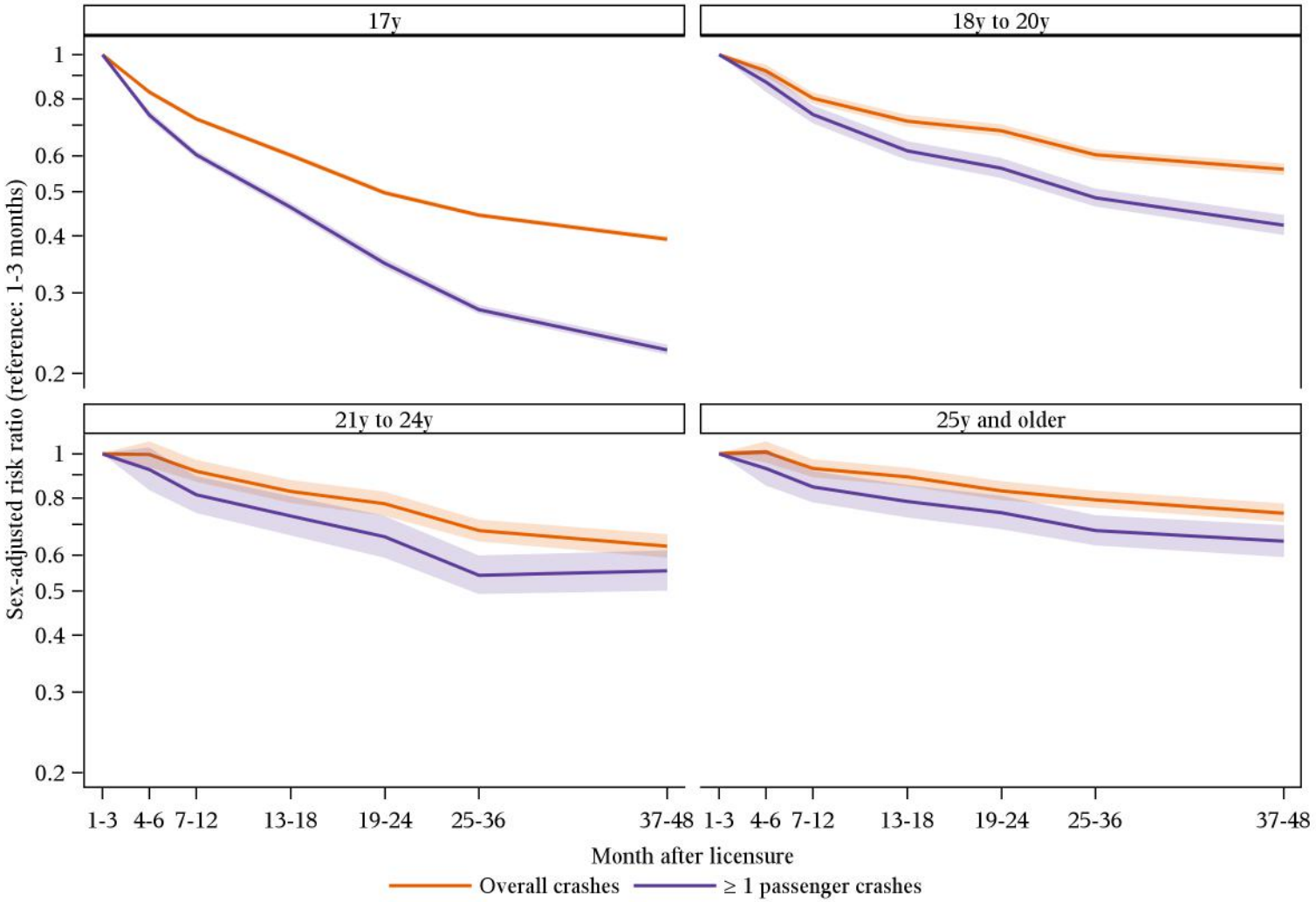
Appendix C. Comparison of sex-adjusted risk ratios (lines) and 95% confidence intervals (bands) for overall crashes and early night crashes (9 p.m.–11 p.m.), over the first four years of licensure, by age at licensure, New Jersey, 2006-2014.



Appendix D. Comparison of sex-adjusted risk ratios (lines) and 95% confidence intervals (bands) for overall crashes and multiple-passenger crashes, over the first four years of licensure, by age at licensure, New Jersey, 2006-2014.



Appendix E. Comparison of sex-adjusted risk ratios (lines) and 95% confidence intervals (bands) for overall crashes and ≥ 1 passenger crashes, over the first four years of licensure, by age at licensure, New Jersey, 2006-2014.



Appendix F. Age distribution of passengers of drivers in their first year of licensure who were involved in multiple-passenger crashes, by age at licensure, New Jersey, 2006-2014.