# Transitions in Riding With an Alcohol/Drug-Impaired Driver From Adolescence to Emerging Adulthood in the United States

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**ABSTRACT. Objective:** The purpose of this study was to examine changes and predictors of changes in riding with an alcohol/drug-impaired driver (RWI) from 10th grade through the first post–high school year. **Method:** Transition models were used to estimate the association of four waves (W1–W4) of RWI with W4 environmental-status variables and time-varying covariates in the NEXT Generation Health Study, a nationally representative cohort of U.S. 10th graders ($N$ = 2,785). **Results:** Overall, 33% (weighted) of adolescents reported RWI in the past 12 months in W1, and slightly declined in W2 (24%), W3 (27%), and W4 (26%). Across time, transition models with generalized estimating equations showed that RWI was more likely among those who previously reported RWI (ORs from 3.62 to 3.66, $p < .001$), substance use (ORs from 1.81 to 1.82, $p < .001$), and heavy episodic drinking (ORs from 1.85 to 1.86, $p < .001$). Those living on college campuses were somewhat more likely to engage in RWI (OR = 1.38, $.05 < p < .10$) than those living at home. The effects of parental monitoring knowledge and peer alcohol/substance use on RWI were suppressed when individual substance use and heavy episodic drinking were taken into consideration. **Conclusions:** Substance use and heavy episodic drinking in previous waves and the history of RWI were persistent factors of RWI in a dynamic pattern. The setting in which emerging adults live during their first post–high school year could affect their engagement in RWI. The findings suggest that harm-reduction strategies should focus on the identification of early RWI coupled with reduction of substance use and heavy episodic drinking. (*J. Stud. Alcohol Drugs, 77,* 77–85, 2016)

FATAL CRASHES BECAUSE OF ALCOHOL-impaired driving in the United States increased from 2011 (9,865) to 2013 (10,076) in drivers of all ages. In 2012, 4,283 young drivers were in fatal crashes and of the 1,875 young drivers killed, 28% were known to have been drinking at the time of the crash (National Highway Traffic Safety Administration [NHTSA], 2014a). Sixteen percent of those killed were known to be passengers riding with an alcohol-impaired driver (NHTSA, 2014b). Although fatal crashes among young drivers have declined by 20% from 2003 to 2012 (NHTSA, 2014a), public health and safety concerns remain warranted.

Although a large body of existing research has focused on alcohol/drug-impaired young drivers, there is a paucity of research on individual and social factors associated with riding with alcohol/drug-impaired drivers (RWI; O'Malley & Johnston, 2007). Moreover, recent studies show that driving while alcohol/drug-impaired (DWI) is more likely among adolescents previously exposed to RWI (Evans-Whipp et al., 2013; Li et al., 2014c). Therefore, identifying factors that contribute to RWI is a necessary prerequisite for the identification of unique intervention opportunities and their timing.

Recent studies show cross-sectional association of RWI with heavy drinking and illegal drug use (Li et al., 2013), and they also show prospective association of RWI with drinking, but not with illegal drug use (Li et al., 2014b) among adolescents. These findings suggest that relationships between heavy drinking and illegal drug use and RWI may be variable during the mutable and malleable developmental stages of mid-to-late adolescence.

Individual characteristics and social factors (e.g., peer and parental influence) may play important roles from a risk or protective perspective, particularly when teens are faced with considering RWI in a peer/friend group context. Perceived peer risk behavior is a well-known risk factor increasing teenagers' risky behavior (Simons-Morton & Farhat, 2010), including risky driving (Scott-Parker et al., 2009; Simons-Morton et al., 2011). However, few studies have used longitudinal designs to examine associations between perceived peer alcohol and other drug use and RWI.

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Parental monitoring is an aspect of authoritative parenting that is frequently found to be associated with adolescent behavior (Steinberg et al., 1994). When it comes to substance use (Bohnert et al., 2012; DiClemente et al., 2001), risky driving (Simons-Morton et al., 2011), and RWI (10th–11th grades) (Li et al., 2014b), parental monitoring knowledge has been identified as a protective factor against adolescent risk behavior. However, the association of parental monitoring knowledge with RWI during the dynamic developmental stages of mid-to-late adolescence and into early adulthood is still unclear.

Overall, because of the salient health risk that RWI poses throughout adolescence and emerging adulthood, there is an important need to bring greater clarity to its contributing and predictive factors. A longitudinal study design enables examination of the dynamic risk and protective factors, thus providing important implications for intervention content and timing. The purpose of this study was to longitudinally identify individual (e.g., drinking alcohol, other drug use) and social (e.g., perceived peer alcohol and substance use) risk and protective factors (e.g., parental monitoring knowledge) of RWI among a recent U.S. cohort that has transitioned from high school through the first post–high school year.

## Method

### *Sampling*

Data used were from Waves 1 to 4 (W1–W4) of the NEXT Generation Health Study, a longitudinal, nationally representative study with a probability cohort starting with 10th-grade students (2009–2010 school year). Sampling strategy is reported elsewhere (Li et al., 2014a, 2014b). Of the 3,796 students invited to participate, 2,525 consented and completed the W1 survey (baseline). The response rate was 67% in W1. In W1, 260 participants did not complete the survey because the school district joined the study at W2 due to a delay in district-level approvals. Therefore, a total of 2,785 (2,525 + 260) participants eventually completed the survey in all four waves; and 91% [(2,785 – 260) / 2,785], 88%, 86%, and 78% of the total 2,785 participants completed the survey from W1 to W4, respectively. Most participants who were lost to follow-up could not be located. African American participants were oversampled to provide accurate population estimates. Parental consent or students' consent was obtained in all waves. The study protocol was reviewed and approved by the Institutional Review Board of the Eunice Kennedy Shriver National Institute of Child Health and Human Development.

### *Measures*

*Riding with alcohol/drug-impaired drivers.* RWI was measured using one question derived from the Youth Risk Behavior Survey (YRBS) questionnaire (Centers for Disease Control and Prevention, 2010). RWI was measured in all waves by asking participants how many times, during the last 12 months (YRBS asks RWI in the past 30 days), they rode in a vehicle driven by someone who had been drinking alcohol or using illegal drugs (with five response options: 1 = *0 times* to 5 = *six or more times*). The RWI score was coded as a dichotomous variable: one or more times versus never.

*Parental monitoring knowledge.* Adolescents reported their perceptions of their father's and (on separate items) their mother's monitoring knowledge about their activities, including who their friends were, how they spent their money, what they did with their free time, where they were after school, and where they went at night (with four response options: 1 = *don't have/see father or mother/guardian,* 2 = *he/she doesn't know anything,* 3 = *he/she knows a little,* and 4 = *he/she knows a lot*). The Cronbach's alpha for adolescent responses to mother- and father-related questions were .83 and .95 for W1, .88 and .96 for W2, and .90 and .97 for W3, respectively.

*Alcohol drinking.* Alcohol drinking was measured using one question derived from the Health Behavior in School-aged Children questionnaire (Currie et al., 2004), "On how many occasions (if any) have you drunk alcohol in last 30 days?" (with seven response options: 1 = *never* to 7 = *40 times or more*). Because of a severe floor effect and non-normal distribution of the data (the same reason for the dichotomous variables below), scores were dichotomized to at least once versus none.

*Heavy episodic drinking.* Teens were asked, "Over the last 30 days, how many times (if any) have you had four (for females)/five (for males) or more drinks in a row on an occasion?" (with six response options: 1 = *none* to 6 = *10 or more times*). Scores were dichotomized to at least once versus none. This question was adapted from the Monitoring the Future national survey (Johnston et al., 2010).

*Substance use.* Substance use was measured by asking participants 10 questions derived from the Monitoring the Future national survey (Johnston, et al., 2010) on how often they ever used drugs (e.g., marijuana, medication to get high) in the last 12 months for all waves (with seven response options: 1 = *never* to 7 = *40 times or more*). A dichotomous variable was used to indicate if participants had used any of those drugs at least once versus none.

*Peer alcohol and substance use.* A single variable, peer alcohol and substance use, was measured by averaging five items derived from the National Longitudinal Study of Adolescent Health (Harris et al., 2009) in all waves by asking participants how often they thought their five closest friends drank alcohol, got drunk, smoked cigarettes, smoked/used marijuana, and took other drugs (with five response options: 1 = *never* to 5 = *almost always*). Cronbach's alphas for peer alcohol and substance use were .85 for W1, .85 for W2, and .87 for W3.

*Driving licensure.* Driving licensure was generated based on students' reporting if they had a license allowing independent, unsupervised driving (with/without temporary restriction on late night driving, teen passengers) at W1, W2, W3, and/or W4. They were then dichotomized into reported versus did not report having an independent driver's license at each wave.

*Environmental status variables at Wave 4.* Three environmental status variables were assessed: current residence, school status, and work status. Residence included three categories: parent/guardian's home, own place (rented room, apartment), and on campus (school dormitory or residence hall, fraternity/sorority house). School status consisted of three categories: not in school, technical/community college, and university or college. Work status included three categories: not working, working part time (≤30 hours), and working full time (≥30 hours).

*Potential confounders.* Because having an independent driving license might presumably affect riding, we considered controlling for this potential confounder with a dichotomous variable (having an independent driving license vs. not). In addition, a co-occurring risk factor, such as being a risky rider, may potentially increase his or her RWI, so we considered controlling for seat belt use (never wearing seat belt while riding at W1 vs. rarely, sometimes, most of the time, or always).

*Demographic variables.* Participants reported age, gender, race/ethnicity, family socioeconomic status, and urbanicity (urban/rural). Family socioeconomic status was estimated using the Family Affluence Scale (Currie et al., 2004). Students were categorized as low, moderate, and high affluence (Spriggs et al., 2007). One parent reported the education level of both parents, and this was categorized based on the highest level of education of either parent.

### *Statistical analyses*

Of the 2,785 participants, 126 participants still in high school at W4 or self-reported other residences (living in barracks as part of the armed services, hospitalized for a sustained duration of time, living with family members other than their parents, and/or homeless) were excluded from the analysis because each group had too few to analyze. They could not be combined because these environments represented qualitatively different life circumstances. The dichotomized RWI variable represented the outcome of interest. Of the 2,659 participants included in the analyses, 2,406 completed the survey at W1, 2,327 at W2, 2,297 at W3, and 2,051 at W4. In addition, 2,391 (missing rate = 10%) participants reported RWI at W1, 2,306 (missing rate = 13%) at W2, 2,278 (missing rate = 14%) at W3, and 2,028 (missing rate = 24%) at W4.

Multivariate imputation by chained equations (MICE) based on the assumption of missing at random (Little & Rubin, 2002; van Buuren & Groothuis-Oudshoorn, 2011) was used to impute missing outcome and independent variables resulting from both subject and item nonresponse values. The algorithm recursively imputed each missing variable by estimating its distribution conditional on other variables. Fifty multiply-imputed data sets were generated using the IVEware software package (Raghunathan et al., 2002).

Transition models (Diggle et al., 2002), which trace the longitudinal sequence of an outcome variable over time and represent the distribution of its current value as a function of its value in the previous assessment (i.e., RWI and values of other variables in previous waves were shifted down to be parallel to the current wave value), were estimated by generalized estimating equations. The correlation matrix type was independent and implemented in SAS PROC GENMOD (SAS Institute Inc., Cary, NC). Features of the complex survey design, including clustering and sampling weights, were taken into account.

Complete imputed data ($n$ = 2,659) were analyzed in four steps: (Step 1) descriptive analyses were performed to examine the percentage of participants reporting RWI in each wave and changes across waves; (Step 2) multivariate logistic regression was used to examine associations between predictors and RWI at each wave, controlling for demographic variables; (Step 3) multivariate transition logistic regression was conducted with RWI regressed on explanatory variables and covariates identified in Step 2 (criteria $p \leq .25$) (Hosmer et al., 2013) controlling for demographic variables (in this step, sequential models were conducted by adding individual variables and social contextual variables in order according to social–ecological framework; Baranowski et al., 2002); and (Step 4) environmental status variables were added to the model in Step 3 to test associations with the outcomes at W4, by including interaction terms (without main effects as environmental status variables were collected in W4 only) between wave = 4 and each environmental status variable in separate models. The interaction term is interpreted as the impact of environmental variables on RWI at W4. The analysis was repeated for each of the 50 imputed data sets. The results were combined using Rubin's combination rule (Little & Rubin, 2002), implemented in SAS PROC MIANALYZE.

Multicollinearity was tested for predictors in each model by calculating the variance inflation factor (VIF) and tolerance values (1 / VIF). A tolerance of less than 0.10 and a VIF of 10 or greater indicates a multicollinearity problem (Tabachnick & Fidell, 2001).

## Results

### *Descriptive analysis*

Of the 2,659 participants (at W1, $M_{age}$ = 16.20 years, $SE$ = 0.02), 55% (weighted, the same hereinafter) were female, 18% were Hispanic/Latino, 20% were African American,

57% were White, 5% were other minorities, 65% were from urban areas, and 35% were from rural areas. Participant's family was categorized into low (23%), moderate (49%), and high (28%) affluence families. After graduating from high school, 52% of the participants attended 4-year colleges (25% attended community or technical college and 25% did not attend any school), 13% worked full time (33% worked part time and 55% did not work), and 33% lived on campus (18% lived in own place and 49% lived at home).

*Screening multicollinearity*

Multicollinearity was tested, and VIF and tolerance values did not indicate any concern for multicollinearity (VIF < 10 and tolerance > .10 for all variables included in the final models).

*RWI transition by wave*

Overall, 33% (weighted) of adolescents reported RWI in the past 12 months in W1, which slightly declined thereafter (Table 1). Figure 1 illustrates the stability of RWI and RWI transitions across waves. Participants who reported engaging and not engaging in RWI changed in successive waves indicating transitional changes. RWI tracked strongly across waves, as shown in Figure 1.1, where 46% of those reporting RWI at W1 reported RWI at W2, 55% of those reporting RWI at W2 reported RWI at W3, and 51% of those reporting RWI at W3 reported RWI at W4. Among those who did not report RWI at a given wave, 13%–21% reported RWI in subsequent waves (Figure 1.2).

Table 1. Percentages of RWI at least once in past year at Waves 1 to 4 ($n$ = 2,659)

| Variable | Weighted % | *SE* | [95% CI] | Min. | Max. |
|---|---|---|---|---|---|
| Wave 1 | 32.92 | 1.75 | [29.49, 36.35] | 32.45 | 33.33 |
| Wave 2 | 24.09 | 1.95 | [20.26, 27.92] | 23.22 | 25.14 |
| Wave 3 | 26.72 | 1.63 | [23.53, 29.91] | 25.63 | 28.22 |
| Wave 4 | 26.11 | 1.71 | [22.74, 29.47] | 24.12 | 27.80 |

*Notes:* Min. and max. indicate the minimum/maximum computed weighted % from the 50 imputed data sets. RWI = riding with an alcohol/drug-impaired driver; CI = confidence interval.

*Bivariate models by wave*

Table 2 shows bivariate associations of RWI with baseline demographic and W4 environmental variables for all waves.

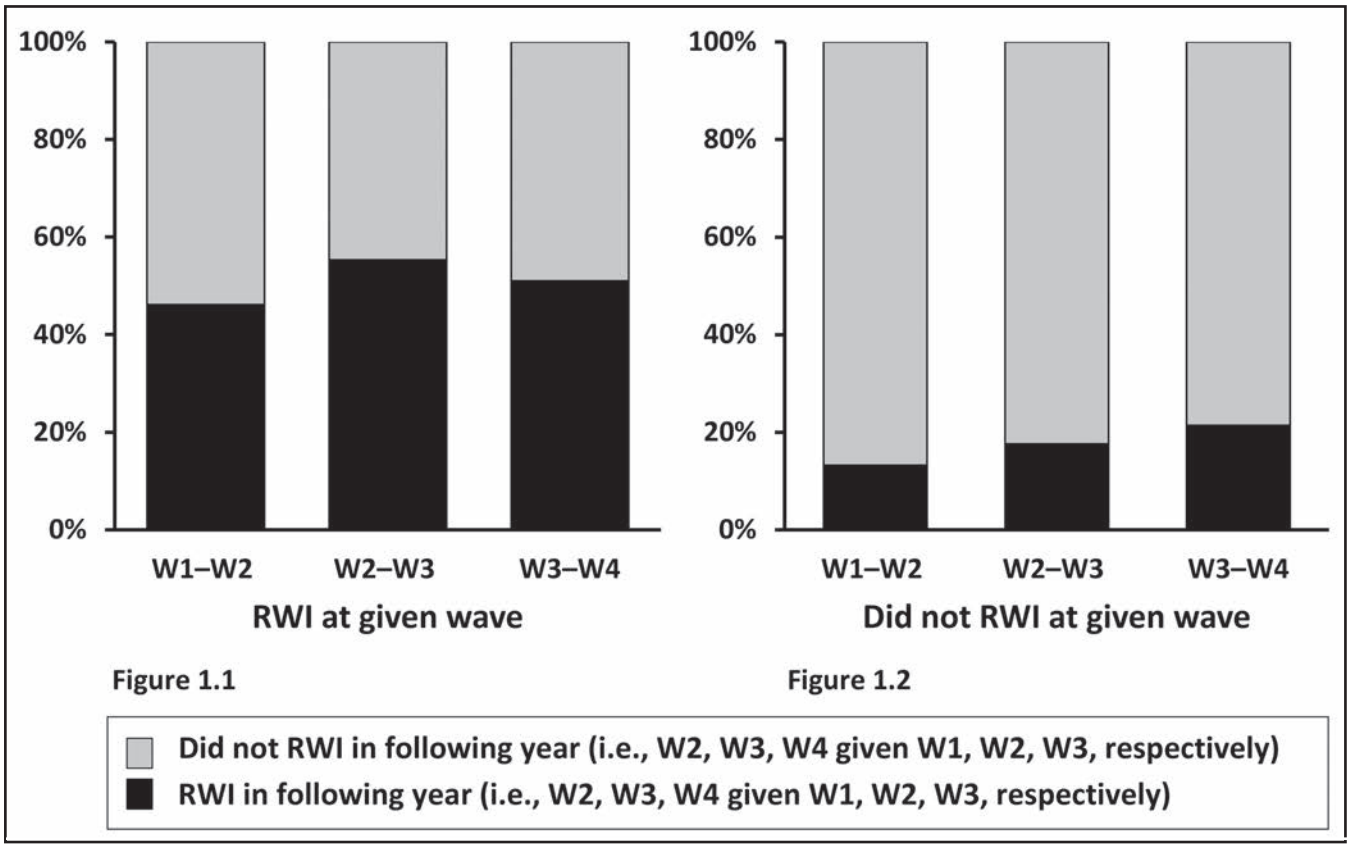


Figure 1. Riding with an alcohol/drug-impaired driver (RWI) transitions across waves Figure 1.1: % of RWI in subsequent wave among those who rode with an impaired driver in previous wave. Figure 1.2: % of RWI in subsequent wave among those who did not ride with an impaired driver in previous wave. W = wave.

Table 2. Cross-sectional associations with RWI and demographic variables in each wave

| Variable | Wave 1 OR [95% CI] | Wave 2 OR [95% CI] | Wave 3 OR [95% CI] | Wave 4 OR [95% CI] |
|---|---|---|---|---|
| Sex | | | | |
| Female | ref. | ref. | ref. | ref. |
| Male | 0.97 [0.75, 1.25] | 1.08 [0.86, 1.37] | 1.05 [0.76, 1.46] | 0.99 [0.72, 1.34] |
| Race/ethnicity | | | | |
| White | ref. | ref. | ref. | ref. |
| Hispanic | 1.65* [1.05, 2.59] | 1.71** [1.11, 2.64] | 1.22 [0.79, 1.86] | 0.87 [0.61, 1.23] |
| Black | 1.05 [0.76, 1.45] | 1.14 [0.74, 1.75] | 0.71† [0.47, 1.07] | 0.83 [0.55, 1.25] |
| Other | 0.95 [0.48, 1.90] | 1.00 [0.37, 2.70] | 0.89 [0.35, 2.31] | 0.67 [0.27, 1.65] |
| Family affluence | | | | |
| Low | ref. | ref. | ref. | ref. |
| Moderate | 1.01 [0.75, 1.36] | 0.93 [0.63, 1.37] | 0.98 [0.70, 1.38] | 1.20 [0.87, 1.66] |
| High | 1.03 [0.68, 1.55] | 1.05 [0.67, 1.66] | 1.33 [0.87, 2.02] | 1.34 [0.84, 2.13] |
| Parent, highest education | | | | |
| <High school diploma | ref. | ref. | ref. | ref. |
| High school diploma or GED | 0.62 [0.33, 1.17] | 0.79 [0.44, 1.42] | 0.77 [0.44, 1.35] | 1.18 [0.74, 1.87] |
| Some degree | 0.66 [0.37, 1.18] | 0.57* [0.32, 1.00] | 0.81 [0.49, 1.34] | 1.08 [0.67, 1.76] |
| Bachelor's or graduate degree | 0.55† [0.27, 1.10] | 0.58 [0.30, 1.12] | 0.90 [0.50, 1.62] | 1.26 [0.80, 1.97] |
| Urban/rural at Wave 1 | | | | |
| Urban | ref. | ref. | ref. | ref. |
| Rural | 1.08 [0.78, 1.49] | 1.02 [0.68, 1.54] | 1.03 [0.68, 1.58] | 0.99 [0.69, 1.40] |
| Work status at Wave 4 | | | | |
| Not working | – | – | – | ref. |
| Work part time < 30 hours | – | – | – | 1.02 [0.67, 1.55] |
| Work full time ≥ 30 hours | – | – | – | 1.01 [0.66, 1.53] |
| School status after at Wave 4 | | | | |
| College/graduate school | – | – | – | ref. |
| Not attending school | – | – | – | 1.10 [0.77, 1.56] |
| Tech./voca./comm. | – | – | – | 0.85 [0.56, 1.29] |
| Residence at Wave 4 | | | | |
| At home | – | – | – | ref. |
| On campus | – | – | – | 1.49** [1.10, 2.03] |
| On own place | – | – | – | 1.32 [0.90, 1.92] |

*Notes:* RWI = riding with an alcohol/drug-impaired driver; OR = odds ratio; CI = confidence interval; ref. = reference; GED = General Educational Development credential; tech./voca./comm. = technical or vocational school or community college.
†$.05 < p \leq .10$; *$p \leq .05$; **$p \leq .01$.

Race/ethnicity and parental education were included in the subsequent multivariate models because they were associated with RWI at the $p = .25$ level in at least one wave. Driving licensure and seat belt use were not associated with RWI simultaneously and prospectively at the $p = .25$ level and were not included in the models.

*Multivariate models by wave*

Multivariate logistic regressions of RWI on variables in previous wave and W4 environmental status controlling for demographic variables were conducted in separate models by wave (W2–W4). RWI at W2, W3, and W4 were associated with RWI in the previous wave (Table 3). Alcohol use, substance use, heavy episodic drinking, and peer alcohol and substance use predicted higher RWI in all three models. Father's and mother's monitoring knowledge were protective factors against RWI in W2 and W3 models.

For environmental variables, residence was significantly associated with RWI (OR = 1.47, $p < .05$ for living on campus) at W4. School status and work status were not significantly associated with RWI.

*Transition models*

Five transition models for RWI are shown in Table 4. Overall, ORs in all models increased from W2. Significant increases were found between W2 and W3 and/or between W2 and W4 in all models except Model 4. Model 1 examined the predictive effects of two individual variables (substance use and heavy episodic drinking) in previous waves on RWI, controlling for demographic variables and previous RWI. All three individual risk factors (substance use: OR = 1.94, 95% CI [1.60, 2.35], $p < .001$; heavy episodic drinking: OR = 2.00, 95% CI [1.56, 2.56], $p < .001$; and the history of RWI: OR = 3.72, 95% CI [2.91, 4.76], $p < .001$) in previous waves predicted current RWI. In Model 2, we added three social context variables (father's and mother's monitoring knowledge and friend's alcohol and substance use) in previous waves to Model 1 to examine the predictive effects of social context variables on RWI above and beyond individual variables. None of the social context variables were significantly associated with RWI in Model 2 when we controlled for demographic and individual variables. Because environmental variables were assessed only in W4,

Table 3. Multivariate association between RWI and previous wave variables

| Previous year | Wave 2 AOR [95% CI] | Wave 3 AOR [95% CI] | Wave 4 AOR [95% CI] |
|---|---|---|---|
| RWI | | | |
| No | ref. | ref. | ref. |
| Yes | 5.58*** [4.00, 7.77] | 5.94*** [3.99, 8.85] | 5.15*** [3.57, 7.43] |
| Substance use | | | |
| No | ref. | ref. | ref. |
| Yes | 2.92*** [2.16, 3.95] | 4.18*** [2.90, 6.01] | 3.69*** [2.61, 5.21] |
| Heavy episodic drinking | | | |
| No | ref. | ref. | ref. |
| Yes | 4.16*** [2.76, 6.29] | 4.50*** [3.14, 6.45] | 3.29*** [2.26, 4.81] |
| Alcohol use | | | |
| No | ref. | ref. | ref. |
| Yes | 3.62*** [2.50, 5.26] | 4.29*** [3.02, 6.09] | 3.01*** [2.10, 4.33] |
| Father's monitoring knowledge | 0.85* [0.73, 0.98] | 0.76*** [0.68, 0.85] | 0.88† [0.76, 1.02] |
| Mother's monitoring knowledge | 0.58*** [0.44, 0.76] | 0.79* [0.64, 0.97] | 0.85 [0.67, 1.08] |
| Peer alcohol and substance use | 1.74*** [1.38, 2.18] | 1.78*** [1.42, 2.24] | 1.77*** [1.48, 2.10] |
| Work status at Wave 4 | | | |
| Not working | – | – | ref. |
| Work part time < 30 hours | – | – | 1.00 [0.66, 1.51] |
| Work full time ≥ 30 hours | – | – | 0.98 [0.63, 1.51] |
| School status after at Wave 4 | | | |
| College/graduate school | – | – | ref. |
| Not attending school | – | – | 1.12 [0.77, 1.62] |
| Tech./voca./comm. | – | – | 0.89 [0.59, 1.33] |
| Residence at Wave 4 | | | |
| At home | – | – | ref. |
| On campus | – | – | 1.47* [1.07, 2.02] |
| On own place | – | – | 1.30 [0.89, 1.89] |

*Notes:* The model controlled for race/ethnicity and parental education. RWI = riding with an alcohol/drug-impaired driver; AOR = adjusted odds ratio; CI = confidence interval; ref. = reference; tech./voca./comm. = technological or vocational school or community college.
†.05 < $p \leq .10$; *$p \leq .05$; ***$p \leq .001$.

an interaction term of *variable by wave* was used and added to Model 2 in separate regressions (Models 3, 4, and 5). In all three models, the three individual risk factors (substance use, heavy episodic drinking, and the history of RWI) were still significantly associated with RWI. Only the interaction between Residence × Wave was modestly associated with RWI (Model 5)—for example, participants living on campus (OR = 1.38, 95% CI [0.97, 1.97], .05 < $p$ < .10) at W4 were more likely to engage in RWI compared with those who were living at home at W4.

When we reanalyzed the final model, replacing heavy episodic drinking with drinking alcohol in the last 30 days, all the results remained the same.

## Discussion

DWI in teenage and young adult drivers has been widely studied. However, the extent of examination of risk and protective factors in teenagers who ride with impaired drivers remains limited despite its considerable contribution to teen and young adult morbidity and mortality (NHTSA, 2014a). Other research, as well as our own, shows that teens exposed to RWI are significantly more likely to drive while intoxicated after licensure (Leadbeater et al., 2008; Li et al., 2014c).

In our study, 52% of the teenagers reported RWI in at least one wave. RWI was consistently prevalent, with an average frequency of 27% across all four waves. For teenagers who did not report RWI at any one wave yet had remaining subsequent waves of assessment to participate in, nearly one in six reported RWI in a later wave. Previous RWI, alcohol use, substance use, and heavy episodic drinking were associated with subsequent RWI in high school and in the first post–high school year.

Overall, our findings contribute to the RWI literature in several ways. First, this four-wave study affirms and builds on previously identified findings that included only two assessment waves (10th and 11th grades; Li et al., 2014b) and showed prospective association between previous RWI and later RWI, as well as between drinking and RWI. We replicate these findings and show that they extend into both 12th grade and the first year after high school.

Second, we show that the teen's perception of peer alcohol and substance use is longitudinally and prospectively associated with, as well as predictive of, RWI. Although previous research identifies association between teens' perceptions about their friends' drinking and their own drinking (Borsari & Carey, 2001; Brooks-Russell et al., 2013; Rimal & Real, 2005) and associations between risk-taking behavior and teenagers' risky driving (Simons-Morton et al., 2011), this

Table 4. Transition models of RWI: Multivariate association between RWI and previous wave predictors

| Variable | Model 1 AOR [95% CI] | Model 2 AOR [95% CI] | Model 3 AOR [95% CI] | Model 4 AOR [95% CI] | Model 5 AOR [95% CI] |
|---|---|---|---|---|---|
| Wave | | | | | |
| 2 | ref. | ref. | ref. | ref. | ref. |
| 3 | 1.58* [1.04, 2.41] | 1.59 [1.05, 2.41] | 1.59* [1.05, 2.41] | 1.27 [0.86, 1.88] | 1.76*** [1.23, 2.51] |
| 4 | 1.32 [0.91, 1.91] | 1.31 [0.91, 1.89] | 1.31 [0.91, 1.89] | 1.15 [0.81, 1.63] | 1.43* [1.04, 1.97] |
| RWI | | | | | |
| No | ref. | ref. | ref. | ref. | ref. |
| Yes | 3.72** [2.91, 4.76] | 3.64 [2.84, 4.67] | 3.64*** [2.84, 4.67] | 3.63*** [2.82, 4.67] | 3.66*** [2.84, 4.71] |
| Variables in previous wave | | | | | |
| Substance use | | | | | |
| No | | | | | |
| Yes | 1.94*** [1.60, 2.35] | 1.81 [1.50, 2.19] | 1.81*** [1.50, 2.19] | 1.82*** [1.50, 2.22] | 1.81*** [1.49, 2.20] |
| Heavy episodic drinking | | | | | |
| No | | | | | |
| Yes | 2.00*** [1.56, 2.56] | 1.86 [1.43, 2.42] | 1.86*** [1.43, 2.42] | 1.85*** [1.42, 2.42] | 1.86*** [1.43, 2.42] |
| Father's knowledge | | 0.95 [0.87, 1.04] | 0.95 [0.87, 1.04] | 0.95 [0.86, 1.04] | 0.95 [0.87, 1.04] |
| Mother's knowledge | | 1.00 [0.84, 1.19] | 1.00 [0.84, 1.19] | 0.99 [0.83, 1.18] | 1.00 [0.84, 1.19] |
| Peer alcohol and substance use | | 1.11 [0.95, 1.29] | 1.11 [0.95, 1.29] | 1.11 [0.95, 1.29] | 1.10 [0.94, 1.29] |
| Interaction of Wave 4 × Environmental Status | | | | | |
| Work status | | | | | |
| W4 × Not Working | | – | ref. | – | – |
| W4 × Work Part Time <30 Hours | | – | 1.07 [0.67, 1.70] | – | – |
| W4 × Work Full Time ≥30 Hours | | – | 0.96 [0.61, 1.50] | – | – |
| School status | | | | | |
| W4 × College/Graduate School | | – | – | ref. | – |
| W4 × Not Attending School | | – | – | 1.02 [0.72, 1.47] | – |
| W4 × Technical/Community College | | – | – | 0.88 [0.58, 1.32] | – |
| Residence at W4 | | | | | |
| W4 × At Home | | – | – | – | ref. |
| W4 × On Campus | | – | – | – | 1.38† [0.97, 1.97] |
| W4 × On Own Place | | – | – | – | 1.32 [0.78, 2.23] |

*Notes:* The model controlled for demographic variables and included variables listed. RWI = riding with an alcohol/drug-impaired driver; AOR = adjusted odds ratio; CI = confidence interval; ref. = reference.
†.05 < $p \leq .10$; *$p \leq .05$; ***$p \leq .001$.

association to RWI is new. This finding is consistent with other literature associating perceived social norms to risky driving behavior (Scott-Parker et al., 2014; Simons-Morton et al., 2011) and suggests that harm-reduction strategies should focus on early identification of RWI and consider social normative change perspectives.

Third, a wide range of research has been conducted in parental behavioral control, parental monitoring knowledge, and their effects on teenage drug and alcohol use and other problem behaviors (Barnes et al., 2000; Dols et al., 2010; Laird et al., 2003; Li et al., 2014b; Roche et al., 2008). Our multivariate logistic regressions of RWI on variables in previous wave findings show that the teenager's parental monitoring knowledge may be protective of RWI. These findings were evident in both W2 (11th grade) and W3 (12th grade) and suggest that there could be benefit from efforts to enhance parental monitoring and suppress its fading in the final years of high school. Furthermore, this same timing could yield unique opportunities to engage parents and their teens to promote reappraisal of behaviors that not only put health at risk but also have more salient legal, employment, and academic implications as adolescents transit into early adulthood. Bolstering parental monitoring could further protect teens from RWI and subsequently reduce DWI during emerging adulthood.

Finally, the result of our transition model analysis suggests that, as teens move out of high school and into their first post–high school year, the location and setting in which teens choose to take up residence may affect their RWI. Whether enrolled in higher education or not, teens encounter new changes in the context in which they live (e.g., where, with whom, employment), with the need to extend/develop new peer/friend groups and networks. Consequently, changes in exposure pattern and access to alcohol, other drugs, and a vehicle could lead to more RWI and DWI. This finding alone has important implications for prevention efforts, particularly from a higher education institution policy perspective. Across the country, alcohol and drug related harm-reduction education routinely occurs during the orientation of new students to a college campus. During this time, the opportunity exists to incorporate prevention messages and actions specifically directed at mitigating RWI. Moreover, university and college campus programs and policies could be enhanced to detract students from engaging in RWI.

### *Limitations*

First, our measure of RWI did not differentiate between those teens who use alcohol more than other drugs, vice versa, or in combination at the times that they engaged in RWI. Further, it did not identify the driver in the RWI episode as a teenage friend, parent, or other adult. It is also likely that there was some variability in the rider's ability to accurately identify drivers as impaired. Finally, our study uses adolescent self-reports instead of direct parental reports in assessing parental monitoring knowledge.

Despite these limitations, our study is strengthened by the use of a recent, very large, nationally representative sample of high school students. Also, we used transition model analysis. This offers several advantages over common longitudinal approaches and includes the ability to trace the development of RWI over time by taking into account autocorrelation of repeated measures of covariates and outcomes. Transition models examine the combined effects over multiple assessments of the history of an outcome variable (i.e., RWI) and the most proximal past measurement of covariates on the outcome of interest, thus capturing accumulated dynamic factors affecting transition or change in outcome over time (Diggle et al., 2002).

### *Conclusions*

Substance use, heavy episodic drinking in previous waves, and a history of RWI were persistent factors of RWI in a dynamic pattern. Living on campus the first post–high school year increased the risk of engaging in RWI. The findings suggest the need for prevention strategies that address peer effects and bolster parental influence in college freshmen.

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