Drinking and Parenting Practices as Predictors of Impaired Driving Behaviors Among U.S. Adolescents

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ABSTRACT. Objective: The purpose of this study was to identify the extent to which 10th-grade substance use and parenting practices predicted 11th-grade teenage driving while alcohol-/other drug-impaired (DWI) and riding with alcohol-/other drug-impaired drivers (RWI). **Method:** The data were from Waves 1 and 2 of the NEXT Generation study, with longitudinal assessment of a nationally representative sample of 10th graders starting in 2009–2010. Multivariate logistic regression analysis was used to examine the prospective associations between proposed predictors (heavy episodic drinking, illicit drug use, parental monitoring knowledge and control) in Wave 1 and DWI/RWI. **Results:** Heavy episodic drinking at Wave 1 predicted Wave 2 DWI (odds ratio [OR] = 3.73, $p < .001$) and RWI (OR = 3.92, $p < .001$) after controlling for parenting practices and selected covariates. Father's monitoring knowl-

edge predicted lower DWI prevalence at Wave 2 when controlling for covariates and teenage substance use (OR = 0.66, $p < .001$). In contrast, mother's monitoring knowledge predicted lower RWI prevalence at Wave 2 when controlling for covariates only (OR = 0.67, $p < .05$), but the effect was reduced to nonsignificance when controlling for teen substance use. **Conclusions:** Heavy episodic drinking predicted DWI and RWI. In addition, parental monitoring knowledge, particularly by fathers, was protective against DWI, independent of the effect of substance use. This suggests that the enhancement of parenting practices could potentially discourage adolescent DWI. The findings suggest that the parenting practices of fathers and mothers may have differential effects on adolescent impaired-driving behaviors. (*J. Stud. Alcohol Drugs*, 75, 5–15, 2014)

MOTOR VEHICLE CRASHES are a leading cause of injury and death for teenage drivers (Centers for Disease Control and Prevention [CDC], 2010a). Teenagers ages 16–19 years have a fatal crash rate per mile driven that is almost three times that of drivers ages 20 and older, and the risk for the youngest of drivers, ages 16–17, is almost two times that of 18- to 19-year-olds (Insurance Institute for Highway Safety, 2010). Around the same time adolescents begin driving, the prevalence of substance use increases in this population (CDC, 2012), potentially increasing crash risk.

Alcohol-/other drug-related crash risk

A substantial body of research (Elvik, 2013; Li et al., 2012) has established that an elevated crash risk results at all ages from impaired driving caused by alcohol (Blomberg et al., 2009), other drugs (Elvik, 2013; Li et al., 2012), or alcohol and other drugs used in combination (Kuypers et al.,

2012). For example, drivers younger than 21 with a positive blood alcohol concentration experienced twice the crash risk of those ages 25 and older (Peck et al., 2008). Novice teen drivers have especially high crash rates because of inexperience, contributing to the disproportionate effect on this population of driving while impaired by alcohol and/or other drugs (DWI; Peck et al., 2008; Voas et al., 2012).

Current national prevalence estimates of teenage drinking and driving in the past month among 11th-grade students range from 9.1% (CDC, 2012) to 12.5% (Li et al., 2013), and two national studies found that 24% of high school students report riding with an impaired driver (RWI) in the past month (CDC, 2012) or in the past year (Li et al., 2013). The National Roadside Survey conducted for the National Highway Traffic Safety Administration in 2007 found that, among drivers ages 16–20 tested at night, 16.1% tested positive for drugs other than alcohol (based on oral fluids) and 7.2% tested positive for alcohol (based on breath alcohol measurements) (Lacey et al., 2009a, 2009b). Given that alcohol-impaired driving fatalities accounted for 31% of the total motor vehicle traffic fatalities in the United States in 2011 (National Highway Traffic Safety Administration, 2012), identifying predictors of teenage drinking and driving and RWI is critical to preventing teenage injuries and fatalities.

Factors associated with teenage DWI and RWI

Cross-sectional studies have found that male gender (Sabel et al., 2004), previous driving offenses (Copeland

Received: March 15, 2013. Revision: May 22, 2013.

This research was supported by the Intramural Research Program of the Eunice Kennedy Shriver National Institute of Child Health and Human Development (Contract no. HHSN267200800009C); the National Heart, Lung and Blood Institute; the National Institute on Alcohol Abuse and Alcoholism; and the Maternal and Child Health Bureau of the Health Resources and Services Administration, with supplemental support from the National Institute on Drug Abuse.

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et al., 1996), risky driving (Li et al., 2013), RWI (Sabel et al., 2004), and poor family relationships (Tomas Dols et al., 2010) are associated with teenage DWI. Predictors of teenage RWI have been less frequently examined, but prior studies indicate similarities with the predictors of DWI, including substance use (alcohol or marijuana use) (Cartwright and Asbridge, 2011; Li et al., 2013; Sabel et al., 2004) and having previously driven under the influence (Cartwright and Asbridge, 2011). A growing number of studies have examined predictors of teenage DWI and RWI. The most consistent predictor of DWI in studies with adolescent samples, as well as young adult and adult samples, is problem drinking, including heavy alcohol use and drinking-related problems (LaBrie et al., 2011; Li et al., 2013; Sabel et al., 2004; Shope et al., 2003; Shults et al., 2009; Tomas Dols et al., 2010; Zakrajsek and Shope, 2006).

Parenting practices and drinking and driving

Parenting practices such as parental knowledge or parental monitoring knowledge and parental control have been associated with many adolescent behaviors, including tobacco use (Castrucci and Gerlach, 2006; Harakeh et al., 2010; Simons-Morton et al., 2004), alcohol use (Simons-Morton and Chen, 2005), marijuana use (Chen et al., 2005), and risky sexual behaviors (Roche et al., 2008). It is well established that parenting practices are related to teenage drinking (Barnes et al., 2000; Roche et al., 2008). A recent systematic review found that many different measures of positive parenting practices (i.e., increased parental monitoring and communication and positive parent-child relationship) were related to delayed alcohol initiation and reduced drinking (Ryan et al., 2010). Parental control (Coker and Borders, 2001) and monitoring knowledge (Hawkins et al., 1992) could protect against adolescent problem drinking behavior by limiting exposure or establishing expectations and enhancing parent-child communication through which trust and expectations can be established.

Despite the connection between parenting practices and alcohol use and risky driving, very few studies have examined the relationship between parenting practices and risk for DWI or RWI. A cross-sectional study with a nationally representative sample of 9th-, 10th-, and 11th-grade students found that teenagers with authoritative parents who exhibited both warmth/support and monitoring were 71% less likely to drive while impaired compared with those who had uninvolved parents (Ginsburg et al., 2009). However, the analyses did not control for the teenager's substance use. Bingham et al. (2006) found that high parental monitoring during high school was protective against alcohol-related offenses at ages 20–24 for men, but not women, and not at age 19. These findings suggest that parenting practices, such as parental monitoring, might be associated with lower rates of DWI. Although parents could exert direct effects on teenage DWI

and RWI, as purported with a teenage-to-young-adult cohort (Bingham et al., 2006), much of their effect is likely to be indirect through their concerns and efforts to discourage their teenage children from drinking or other substance use. In a regional administration of the Youth Risk Behavior Survey, parental support was related to DWI but not RWI, and effects were reduced to nonsignificance after accounting for the teenager's substance use behaviors (Sabel et al., 2004). Thus, to assess the protective effect of parenting practices, it is necessary to control for teenage substance use.

Last, the influence of parenting practices may differ for fathers and mothers. Family activities play an important role in protecting adolescents from risky behaviors, but fathers and mothers may not be equally alert to or react the same in the face of problem behaviors (Coley et al., 2009). For example, father's and mother's communication with adolescents worked differently in protecting against smoking and substance use for sons and daughters (Luk et al., 2010).

Summary and purpose of the current study

There is substantial evidence that alcohol drinking and substance use results in impaired driving behaviors (DWI and RWI) in teenagers. However, few studies have examined prospective associations between alcohol drinking, especially heavy episodic drinking and illicit drug use, and DWI and RWI. In addition, little is known about how parenting practices predict DWI and RWI over time among adolescents.

The purpose of the current study was to determine prospective associations of independent variables assessed in the 10th grade and DWI and RWI assessed in the 11th grade. Consistent with previous cross-sectional studies, we hypothesized that (a) teenage substance use would be prospectively associated with both DWI and RWI, and (b) positive parenting practices (parental monitoring knowledge and control) would be prospectively associated with decreased risk of teenage DWI and RWI. Given that the relationship between teenagers' and their parents' behavior can differ by gender (Coley et al., 2009; Luk et al., 2010), we explored possible differences in the associations in mother's and father's parenting practices and teenage RWI and DWI. However, we did not have pre-specified hypotheses about the role of mothers versus fathers for decreasing the risk of DWI or RWI.

Method

Sampling

The data used were from Waves 1 and 2 of the NEXT Generation study, a longitudinal, nationally representative study with a probability cohort starting with 10th-grade students in the 2009–2010 school year (Li et al., 2013). Primary sampling units were stratified by the nine census divisions. Within each census division, the sample of primary sampling

TABLE 1. Means, standard deviations and skewness of raw variables including drinking alcohol, heavy episodic drinking, and illegal drug use at Wave 1

Raw variable	<i>n</i>	<i>M</i>	<i>SD</i>	Min.	Max.	Skewness
Heavy episodic drinking last 30 days	2,142	1.48	1.07	1	6	2.40
Drank alcohol last 30 days	2,157	1.58	1.12	1	7	2.50
Marijuana last 12 months	2,150	1.65	1.49	1	7	2.51
Ecstasy last 12 months	2,147	1.06	0.36	1	7	7.47
Amphetamines last 12 months	2,149	1.02	0.27	1	7	16.64
Opiates last 12 months	2,144	1.03	0.30	1	7	14.45
Medication to get high last 12 months	2,149	1.11	0.59	1	7	6.43
Cocaine last 12 months	2,147	1.03	0.29	1	7	11.98
Glue or solvents last 12 months	2,148	1.01	0.22	1	7	18.38
LSD last 12 months	2,148	1.02	0.25	1	7	16.07
Anabolic steroids last 12 months	2,141	1.02	0.22	1	7	16.49
Other drug last 12 months	2,016	1.06	0.47	1	7	10.12
Baltok last 12 months	2,147	1.01	0.15	1	7	32.87

Notes: Min. = minimum; max. = maximum; LSD = lysergic acid diethylamide. Baltok, a fake drug name, was used as an indicator that the respondent might not be taking the survey seriously. We identified two participants who reported having used Baltok as well as all other drugs by checking the option 7 (40+ times) and assumed that they have over reported substance use, so they were excluded from the analysis. Therefore, the same size used for analysis was reduced to $n = 2,177$.

units was first selected with probability proportional to the total enrollment. Within each selected primary sampling unit, 137 schools with 10th grade were randomly recruited, and 81 agreed to participate. We then randomly selected 10th-grade classes within each selected school and recruited 3,796 students to participate. Of those students, 2,619 students' assent or parental consent were obtained (response rate = 69.0%) at Wave 1. A total of 2,524 students finally completed the survey at Wave 1 (participation rate = 93.5%) and of those, 2,179 participated at Wave 2 (retention rate = 86.3%). African American participants were oversampled to provide better population estimates and to provide an adequate sample to examine racial/ethnic differences. Of the 2,179 participants at Wave 1, 55.4% were female, 19.3% were Hispanic/Latino (vs. 17.6% African American, 58.9% White, and 4.2% other minorities), 21.9% were from low-affluence families (vs. 50.4% and 27.8% from moderate and high affluence families, respectively), and 8.1% of students had one parent with less than a high school diploma as the highest education level (vs. 24.0% with a high school diploma/General Educational Development [GED] credential; 40.7% with some college, technical school, or advanced degree; and 27.2% with a bachelors or higher degree). The weighted percentages used were representative of the national population of 10th-grade students.

Parental consent was obtained. 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

DWI and RWI. DWI and RWI were measured using two questions derived from the Youth Risk Behavior Survey

questionnaire (CDC, 2010b). DWI was measured by asking participants how many days in the last 30 days they drove after drinking alcohol or using illegal drugs. The DWI score was coded as a dichotomous variable: 1 (one day or more) and 0 (no days). RWI was measured by asking participants how many times during the last 12 months they rode in a vehicle driven by someone else who had been drinking alcohol or using illegal drugs, with five options (1 = 0 times through 5 = six or more times). Because of the low frequencies of frequent substance use, the RWI score was coded as a dichotomous variable: 1 (one or more times) and 0 (never). Wave 2 DWI and RWI were used as outcome variables, and Wave 1 DWI and RWI were used as covariates.

Alcohol drinking. At Wave 1, alcohol drinking was measured using one question, "On how many occasions (if any) have you drunk alcohol in the last 30 days?" with response options 1 (*never*) to 7 (*40 times or more*). Because of the severe floor effect and nonnormal distribution of the data (Table 1, and the same reason for substance use and heavy episodic drinking below), the scores were then dichotomized, 1 (at least once) versus 0 (none). The question was derived from the Health Behavior in School-aged Children questionnaire (Currie et al., 2004).

Heavy episodic drinking. At Wave 1 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 response options from 1 (*none*) to 6 (*10 or more times*). The scores were dichotomized, 1 (at least once) versus 0 (none). The question was adapted from the Monitoring the Future national survey (Johnston et al., 2010).

Substance use. Substance use was measured in Wave 1 by asking participants 10 questions derived from the Monitoring the Future national survey (Johnston et al., 2010) on how

often they have ever used drugs (e.g., marijuana, Ecstasy, medication to get high) in the last 12 months, with seven options from 1 (*never*) to 7 (*40 times or more*). A dichotomous variable was then generated as 1 (have used any of those drugs as least once) and 0 (none). One fake drug named “Baltok” was included in the questions; a positive response for this drug indicated that the respondent might not be taking the survey seriously.

Parenting practices. Parenting practices include mother’s and father’s monitoring knowledge and parental control. Parental monitoring knowledge was measured in Wave 1 using questions adapted from a validated five-item scale (Brown et al., 1993). Adolescents reported their perceptions of their mother’s and (on separate items) father’s monitoring knowledge about their activities. Teens were asked to indicate how much their father or mother really knew about who their friends were, how they spent their money, where they were after school, where they went at night, and what they did with their free time, 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*). Higher scores reflect higher levels of parental knowledge. The Cronbach’s α values for adolescents’ responses to mother- and father-related questions were .83 and .95, respectively.

Parental control was measured using questions adapted from Hetherington et al. (1992) and Hartos et al. (2000). An eight-item scale was used to measure student-perceived parental control (mother’s and father’s control were not asked separately) on their health-related behaviors by asking participants how important it is to your parents/guardians that you get daily physical activity and/or exercise, eat a healthy diet, limit your TV/computer time, do not use alcohol, do not smoke, do not use marijuana, do not hurt a romantic partner, and do not insult/treat disrespectfully a romantic partner, with response options from 1 (*not at all*) to 7 (*extremely*). Higher scores reflect higher levels of parental control. The Cronbach’s α for adolescents’ responses was .86.

Demographic and control variables. Participants reported age ($M = 17.30$ years, $SE = 0.02$), gender, racial/ethnic background, family socioeconomic status, parental education (reported by the parent), family structure, and days driven in the last 30 days.

Family socioeconomic status was estimated using the Family Affluence Scale (Currie et al., 2004), including cars owned, computers owned, whether the student had his or her own bedroom, and the number of family vacations in the last 12 months. Students were then categorized as low, moderate, and high affluence (Spriggs et al., 2007).

Students’ family structure was collapsed into five categories: both biological parents; one biological parent, one stepparent; single parent, mother only; single parent, father only; and other.

The education level of both parents was categorized based on the highest level of education of either parent: less than high school diploma, high school diploma/GED, some college/technical school/advanced degree, and bachelors/graduate degree.

Statistical analyses

Statistical analyses were performed using SAS version 9.3 (SAS Institute Inc., Cary, NC). Features of complex survey design (i.e., stratification, clustering, and longitudinal sampling weights) were taken into account. Binary logistic regression was first conducted to examine associations between predictors and potential covariates, and the outcome variables (DWI and RWI). Then multivariate logistic regression models were run including selected covariates. Last, a series of logistic models of DWI and RWI were conducted including three blocks of predictor variables, controlling for selected covariates and other predictors within the model. Model 1 included heavy episodic drinking and illicit drug use, Model 2 included father and mother’s monitoring knowledge and parental control, and Model 3 included all variables of Model 1 and Model 2. Covariates selected into the adjusted logistic regression were based on bivariate logistic regression at a significance level of $p = .10$. Wave 1 DWI and RWI were used to control for the lagged effect of dependent variables.

For questions related to DWI, the analysis was limited to those who had a license allowing independent, unsupervised driving at Wave 2 ($n = 820$). For questions related to RWI, the analysis was limited to those who completed a survey at Wave 2 ($n = 2,177$; 2 participants overreported drug use based on their responses to the fake drug item and were excluded from the analysis). Domain analysis (referring to the computation of statistics for subpopulations in addition to the computation of statistics for the entire study population) was applied for the analyses when using the subsample. Multicollinearity was tested for predictors in each model by calculating the variance inflation factor (VIF) and tolerance values ($1 / \text{VIF}$). A tolerance of less than 0.10 and a VIF of 10 or greater indicates a multicollinearity problem (Tabachnick and Fidell, 2007).

Results

Table 2 shows the prevalence of DWI and RWI in Wave 2, and Tables 2 and 3 show their bivariate associations with potential predictors and covariates. Twelve percent (weighted) of participants with an independent license (allowing them to drive without supervision) reported DWI at least once in the past month, and 23% (weighted) of participants reported RWI at least once in the past year. At Wave 1, 35% (34% at Wave 2) reported drinking alcohol, 26% (24% at Wave 2) reported heavy episodic drinking in the last 30 days, and

TABLE 2. Percent of DWI in the past month and RWI in the past year among 11th-grade students

Predictor (Wave 1)	At least 1 day DWI (Wave 2) (<i>n</i> = 820 [†])				At least 1 time RWI (Wave 2) (<i>n</i> = 2,177)			
	<i>n</i>	Wtd. %	SE of %	OR	<i>n</i>	Wtd. %	SE of %	OR
Total DWI	789 [‡]	12.34	1.44	—	2,155 [‡]	23.34	2.46	—
No	597	10.26	1.29	ref.	—	—	—	—
Yes	39	45.32	9.72	7.25***	—	—	—	—
RWI								
No	—	—	—	—	1,395	11.39	1.34	ref.
Yes	—	—	—	—	603	45.77	4.40	6.57***
Gender								
Female	394	8.17	2.34	ref.	1,126	21.94	2.36	ref.
Male	353	17.83	1.83	2.44**	882	22.95	2.42	1.06
Race/ethnicity								
White	579	13.13	1.69	ref.	900	20.02	2.79	ref.
Hispanic	74	8.22	2.44	0.59	621	31.17	3.24	1.81**
Black	61	10.16	6.11	0.75	377	20.73	3.86	1.05
Other	30	21.26	9.69	1.79	98	20.26	4.80	1.02
Family affluence								
Low	93	15.99	5.06	ref.	605	21.80	3.79	ref.
High	261	12.74	2.14	0.77	442	24.95	3.05	1.19
Moderate	392	12.38	2.41	0.74	956	21.27	2.90	0.97
Education level, higher of both parents								
Less than high school diploma	21	4.43	4.47	ref.	255	32.36	6.74	ref.
High school diploma/GED	126	12.23	3.88	3.00	475	26.73	3.02	0.76
Some college/technical school/AD degree	317	11.97	2.32	2.93	707	18.68	3.52	0.48 [§]
Bachelor's/graduate degree	261	14.28	3.47	3.59	467	21.30	3.63	0.57
Drank alcohol in last 30 days								
No	476	4.67	1.44	ref.	1,383	13.03	1.95	ref.
Yes	268	27.10	3.02	7.58***	610	39.23	3.45	4.31***
Heavy episodic drinking in last 30 days								
No	550	6.20	1.43	ref.	1,554	13.61	1.87	ref.
Yes	189	30.45	3.86	6.63***	426	47.00	4.53	5.63***
Illicit drug use in the last year								
No	573	7.22	1.73	ref.	1,494	16.41	1.99	ref.
Yes	174	27.69	4.34	4.92***	514	37.27	4.24	3.03***
Family structure								
Both biological	478	13.17	2.51	ref.	1,092	23.96	2.41	ref.
Single parent, mother only	105	19.52	6.40	1.60	331	14.46	2.35	1.07
Single parent, father only	20	11.98	7.38	0.90	346	25.18	4.59	1.37
One biological, one stepparent	109	9.30	2.68	0.68	46	30.18	4.78	0.54***
Other	35	4.04	3.17	0.28	193	21.64	4.20	0.88

Notes: DWI = driving while alcohol/other drug impaired; RWI = riding with alcohol/other drug impaired driver; wtd. = weighted; wtd. = weighted; OR = odds ratio; ref. = reference; GED = General Educational Development; AD = advanced. [†]Only including those who had independent driver's license (*n* = 820) in Wave 2; [‡]the actual sample sizes may not be equal to expected sample as a result of missing values.

p* ≤ .01; *p* ≤ .001; [§]*p* > .05 to ≤ .10.

29% (26% at Wave 2) reported using illicit drugs in the past year.

Mother's monitoring knowledge (Table 3), parental control (Table 3), heavy episodic drinking in the last 30 days (Table 2), and illicit drug use in the last year (Table 2) were significantly (from *p* < .001 to .05) associated with both DWI and RWI in Wave 2 (father's monitoring knowledge was marginally associated with DWI with .05 < *p* ≤ .10). The covariates meeting the criteria for inclusion (*p* ≤ .10) in subsequent models were gender and DWI in Wave 1 for DWI (in Table 2) and race/ethnicity, parental education, family structure, and RWI in Wave 1 for RWI (in Table 2).

Table 4 shows associations between each of the potential predictors and DWI and RWI when controlling

for selected covariates in multivariate logistic regression analyses. For DWI, drank alcohol in the last 30 days (odds ratio [OR] = 7.71, *p* < .001), heavy episodic drinking in the last 30 days (OR = 5.79, *p* < .001), illicit drug use in the last 30 days (OR = 3.48, *p* < .01), mother's monitoring knowledge (OR = 0.39, *p* < .001), father's monitoring knowledge (OR = 0.56, *p* < .001), and parental control (OR = 0.75, *p* < .01) in Wave 1 significantly predicted DWI at Wave 2. RWI in Wave 2 was significantly predicted by Wave 1 drinking in the last 30 days (OR = 3.21, *p* < .001), heavy episodic drinking in the last 30 days (OR = 4.09, *p* < .001), illicit drug use in the last 30 days (OR = 1.98, *p* < .001), and mother's monitoring knowledge (OR = 0.71, *p* < .05).

TABLE 3. Unadjusted association of predictors with DWI in the past month and RWI in the past year

Predictor (Wave 1)	DWI in past 30 days (Wave 2) [†] (n = 820)							RWI in past year (Wave 2) (n = 2,177)						
	Yes			No			OR	Yes			No			OR
	n	M	SE	n	M	SE		n	M	SE	n	M	SE	
Age, years	93	17.33	0.07	648	17.35	0.04	1.03	453	17.32	0.06	1,539	17.29	0.03	1.15
Mother's monitoring knowledge ^a	93	3.36	0.08	652	3.66	0.02	0.27***	453	3.43	0.05	1,550	3.58	0.03	0.59***
Father's monitoring knowledge ^a	92	2.88	0.17	652	3.14	0.03	0.71§	452	2.91	0.07	1,548	2.99	0.05	0.92
Parental control ^b	93	5.07	0.22	652	5.47	0.07	0.79*	455	5.10	0.07	1,544	5.31	0.06	0.89*
No. of driving days in past 30 days, Wave 2 [‡]	92	26.20	1.22	651	24.23	0.44	1.04	—	—	—	—	—	—	—

Notes: DWI = driving while alcohol/other drug impaired; RWI = riding with alcohol/other drug-impaired drivers; OR = odds ratio; no. = number. [†]Includes only those who had independent driver's license (n = 820) in Wave 2; [‡]five participants were excluded because they reported more than 30 days. ^aMother's and father's monitoring knowledge was measured with a five-item parental monitoring knowledge scale (scores range from 1 to 4, and higher scores reflect higher levels of parental knowledge) for mothers and fathers; ^bparental control was measured with an eight-item parental control scale (scores range from 1 to 7, and higher scores reflect higher levels of parental control).

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$; § $p > .05$ to $\leq .10$.

Screening multicollinearity

Drinking, heavy episodic drinking, and illicit drug use are significantly correlated with mother's and father's monitoring knowledge and parental control, but correlation coefficients were moderate (from $-.08$ to $.25$) and much lower than the recommended value (i.e., $r = .70$; Tabachnick and Fidell, 2007). Multicollinearity was tested and VIF and tolerance values did not indicate any multicollinearity concern (VIF < 10 and tolerance $> .10$ for all variables).

Driving while impaired

Table 5 shows a series of logistic models of DWI including three blocks of predictor variables. For Block 1 (Model

1), heavy episodic drinking in Wave 1 was a significant predictor (OR = 4.06, $p < .001$) of DWI 1 year later, but illicit drug use in Wave 1 was no longer significant when controlling for selected covariates and heavy episodic drinking. For Block 2 (Model 2), father's monitoring knowledge was shown to be a significant predictor (OR = 0.62, $p < .01$), but neither mother's monitoring knowledge nor parental control was, after controlling for selected covariates and the other predictors. For Block 3 (Model 3), predictive effects of heavy episodic drinking (OR = 3.73, $p < .001$) and father's monitoring knowledge (OR = 0.66, $p < .05$) in Wave 1 maintained significance when controlling for selected covariates and all other proposed predictors. The results indicate that when controlling for covariates, heavy episodic drinking predicts a higher likelihood of DWI, and more father's

TABLE 4. Multivariate logistic regression models of substance use and parenting practices in Wave 1 predicting DWI and RWI in Wave 2, controlling for selected covariates

Predictor (Wave 1)	DWI in past 30 days (Wave 2) (n = 820)			RWI in past year (Wave 2) (n = 2,177)		
	AOR [†]	[95% CI]	p	AOR [‡]	[95% CI]	p
Drank alcohol in last 30 days						
No	ref.	ref.				
Yes	7.71	[4.03, 14.74]	<.001	3.21	[2.29, 4.50]	<.001
Heavy episodic drinking in last 30 days						
No	ref.	ref.				
Yes	5.79	[2.89, 11.59]	<.001	4.09	[2.87, 5.83]	<.001
Illicit drug use in the last year						
No	ref.	ref.				
Yes	3.48	[1.62, 7.50]	<.01	1.98	[1.38, 2.84]	<.001
Mother's monitoring knowledge	0.39	[0.22, 0.68]	<.001	0.71	[0.52, 0.98]	<.05
Father's monitoring knowledge	0.56	[0.39, 0.80]	<.001	1.01	[0.76, 1.33]	.96
Parental control	0.75	[0.60, 0.93]	<.01	1.00	[0.89, 1.13]	.96

Notes: DWI = driving while alcohol/other drug impaired; RWI = riding with alcohol/other drug impaired drivers; AOR = adjusted odds ratio; CI = confidence interval; ref. = reference. [†]Controlled for gender and DWI in Wave 1; [‡]controlled for family structure, race/ethnicity, parental education, and RWI in Wave 1.

TABLE 5. Multivariate logistic regression models of substance use and parenting practices in Wave 1 predicting DWI in Wave 2 ($n = 820$), controlling for selected covariates and the other predictor(s) within the model

Predictor (Wave 1)	Model 1 predictors: 1 + 2			Model 2 predictors: 3 + 4 + 5			Model 3 predictors: 1 + 2 + 3 + 4 + 5		
	AOR [†]	[95% CI]	<i>p</i>	AOR [†]	[95% CI]	<i>p</i>	AOR [†]	[95% CI]	<i>p</i>
1. Heavy episodic drinking in last 30 days									
No	ref.	ref.							
Yes	4.06	[2.19, 7.52]	<.001	—	—	—	3.73	[1.90, 7.32]	<.001
2. Illegal drug use in the last year									
No	ref.	ref.							
Yes	1.89	[0.90, 3.96]	.09	—	—	—	1.40	[0.67, 2.94]	.38
3. Mother's monitoring knowledge	—	—	—	0.58	[0.30, 1.11]	.10	0.74	[0.36, 1.54]	.42
4. Father's monitoring knowledge	—	—	—	0.62	[0.42, 0.88]	<.01	0.66	[0.46, 0.96]	<.05
5. Parental control	—	—	—	0.82	[0.65, 1.04]	.11	0.88	[0.66, 1.16]	.36

Notes: DWI = driving while alcohol/other drug impaired; AOR = adjusted odds ratio; CI = confidence interval; ref. = reference. [†]Controlled for selected covariates (gender and DWI in Wave 1) and the other predictor(s) within the model.

monitoring knowledge predicts a lower likelihood of DWI 1 year later. Additional analyses were conducted to test the interactions between predictors and demographic variables (especially for teen gender and mother's and father's monitoring knowledge) and between predictors in Models 2 and 3, but no significant interactions were found. Similar results were seen when drinking alcohol in the past month was substituted for heavy episodic drinking in the logistic regression models of Table 5, but analyses are not shown because of the limited space. The adjusted odds for DWI of 30-day drinking (OR = 6.74, $p < .001$) were about two times that of heavy episodic drinking (OR = 3.73, $p < .001$).

Riding with an impaired driver

Table 6 shows a series of logistic models of RWI including three blocks of predictor variables. For Block 1 (Model 1), heavy episodic drinking in Wave 1 was a significant predictor (OR = 3.78, $p < .001$) of RWI 1 year later, but illicit drug use in Wave 1 was no longer significant when controlling for selected covariates and heavy episodic drinking. For Block 2 (Model 2), mother's monitoring knowledge

was shown to be a significant predictor (OR = 0.67, $p < .05$) when controlling for selected covariates and the other two predictors of parenting practices within the model, but father's monitoring knowledge and parental control were not. For Block 3 (Model 3), heavy episodic drinking (OR = 3.92, $p < .001$) was the only variable at Wave 1 that was significantly associated with RWI at Wave 2 when controlling for selected covariates and all other predictors in the model. The results indicate that heavy episodic drinking predicts a higher likelihood of adolescent RWI 1 year later when controlling for covariates and parenting practices. Similar results were seen when drinking alcohol in the past month was substituted for heavy episodic drinking in the logistic regression models of Table 6, but the analyses are not shown because of the limited space.

Discussion

Our primary findings from multivariate analyses were that heavy episodic drinking and father's monitoring knowledge protected teenagers against DWI, and heavy episodic drinking predicted RWI. These findings support our

TABLE 6. Multivariate logistic regression models of substance use and parenting practices in Wave 1 predicting RWI in Wave 2 ($n = 2,177$), controlling for selected covariates and the other predictor(s) within the model

Predictor (Wave 1)	Model 1 predictors: 1 + 2			Model 2 predictors: 3 + 4 + 5			Model 3 predictors: 1 + 2 + 3 + 4 + 5		
	AOR [†]	[95% CI]	<i>p</i>	AOR [†]	[95% CI]	<i>p</i>	AOR [†]	[95% CI]	<i>p</i>
1. Heavy episodic drinking in last 30 days									
No	ref.	ref.							
Yes	3.78	[2.52, 5.67]	<.001	—	—	—	3.92	[2.60, 5.90]	<.001
2. Illegal drug use in the last year									
No	ref.	ref.							
Yes	1.21	[0.82, 1.79]	.34	—	—	—	1.23	[0.84, 1.80]	.29
3. Mother's monitoring knowledge	—	—	—	0.67	[0.47, 0.95]	<.05	0.81	[0.55, 1.18]	.26
4. Father's monitoring knowledge	—	—	—	1.10	[0.81, 1.49]	.55	1.12	[0.81, 1.55]	.50
5. Parental control	—	—	—	1.02	[0.90, 1.16]	.76	1.12	[0.95, 1.31]	.18

Notes: RWI = riding with alcohol/other drug impaired drivers; AOR = adjusted odds ratio; CI = confidence interval; ref. = reference. [†]Controlled for selected covariates (family structure, race/ethnicity, parental education, and RWI in Wave 1) and the other predictor(s) within the model.

hypothesis that teenage substance use, particularly heavy episodic drinking, is a prospective predictor of DWI and RWI, which has previously been found in cross-sectional research (LaBrie et al., 2011; Li et al., 2013; Shope et al., 2003; Shults et al., 2009). To extend prior research on the relationship between parenting practices and risky driving (Bingham et al., 2004; Hartos et al., 2000, 2002; Shope et al., 2001), the current study also explored the longitudinal association between parenting practices and DWI/RWI. The results indicate the importance of father's monitoring knowledge in protecting against the risk of DWI (but not RWI) among adolescents. Mother's monitoring knowledge and parental control were not found to be prospectively associated with either DWI or RWI in multivariate models, although they were in unadjusted models of DWI, and mother's monitoring knowledge was associated with RWI in a bivariate model. The results suggest that fathers may be distinctive in their potential to protect against DWI. This relationship is particularly interesting in that it does not vary by the gender of the teenager.

The findings that both heavy episodic drinking and 30-day alcohol drinking are associated with future DWI and RWI are consistent with previous research (Fell et al., 2009; Shope and Bingham, 2002; Sweedler et al., 2004). Logically, alcohol use increases the likelihood of DWI and RWI, particularly in the absence of alternative transportation and strong cultural norms that discourage driving after use. The link between drinking/heavy episodic drinking and DWI and RWI may also reflect peer group norms that would lead to exposure to other teenage drinkers (Botvin and Griffin, 2007), and consequently, being a passenger of an impaired driver. Despite significant effects of both heavy episodic drinking and recent alcohol drinking on DWI/RWI, alcohol drinking was more strongly associated, reflecting that even moderate amounts of drinking can impair teenagers' judgment about driving and that drinking increases exposure to opportunities for DWI/RWI. This finding suggests that primary prevention of alcohol use, not limited to heavy episodic drinking, may be an important element in teenage DWI and RWI prevention. Of note, for drivers younger than age 21, it is illegal in every state to drive after drinking, not just with a blood alcohol concentration of .08%, which is the limit for adults ages 21 and older and is typically reached by heavy episodic drinking.

These current longitudinal findings as well as earlier cross-sectional findings (Li et al., 2013) affirm the importance of prevention efforts in reducing the multiple consequences of substance use, including motor vehicle crashes (Shope et al., 2001). For example, improved substance use prevention programs (Griffin et al., 2004) and the general decline in adolescent drinking (Simons-Morton et al., 2009) may have contributed to the reductions in DWI prevalence since the 1980s in the United States and worldwide. These

findings support sustaining and enhancing substance use prevention for reducing DWI and RWI.

There is emerging evidence that parents play distinct roles in predicting youth problem behaviors; moreover, the role of fathers may be more important compared with mothers, according to the findings of two recent studies (Fosco et al., 2012; Kelly, 2012). In a study that examined the predictive effects of family relationships and parental monitoring knowledge during middle school on early adolescent problem behavior, Fosco et al. (2012) found that parental monitoring knowledge (mother and father monitoring knowledge were not asked separately) and father-youth connectedness but not mother-youth connectedness were associated with reductions in problem behaviors, including substance use over time. Although we did not measure connectedness, it can be argued that our measure of parental knowledge, with its emphasis on parent monitoring knowledge, largely reflects teen-parent trust and communication, concepts that are related to connectedness (Kerr and Stattin, 2000). In another study, Kelly (2012) examined the prospective association between perceived mother's and father's care and smoking behavior among mid-teens and found that father's care distinctively protected high school students against smoking. Although neither mother's nor father's monitoring knowledge alone protected teenagers against DWI (Table 3), the reason father's monitoring knowledge outweighed mother's in the current study remains unclear. Fosco et al. (2012, pp. 210–211) hypothesized that the distinct outcomes for fathers and mothers in terms of teen problem behaviors may be attributable to "mothers' and fathers' parenting roles differ[ing] in terms of susceptibility to change in response to family stressors (Cummings et al., 2004) or family dynamics between mothers and fathers shap[ing] father involvement (Peck et al., 2008)." We speculate that fathers may be particularly credible referents regarding teenage drinking and driving. More research is needed to clarify the mechanisms by which (a) parental monitoring influences teenage drinking and driving behavior and (b) what aspect of parental monitoring contributes to the differing influence of mothers and fathers on teen DWI. Nevertheless, previous research and the current longitudinal findings provide a strong argument for engaging fathers in substance use prevention approaches.

In contrast to the results for DWI, it should be noted that the relationship between parenting practices and RWI was less robust. Neither mother's nor father's monitoring knowledge was related to RWI in multivariate models controlling for substance use. It is possible that parenting practices are felt more directly on the teen's own behavior (DWI) and less directly on the behaviors of their peer group (RWI or peer's DWI). Future studies could ask teenagers questions concerning the perceived parental knowledge specifically related to impaired driving and rid-

ing with impaired drivers. Enhancing parental monitoring knowledge and parental control may not prevent a teenager from being exposed to an impaired driver as much as it would prevent a teenager from driving while impaired. Therefore, programs that seek to reduce teenage RWI may benefit from a targeted focus on RWI (e.g., identifying alternative ways to and from locations) rather than a general focus on parenting practices.

Strengths and limitations

The limitations of this study should be noted. First, our measures of DWI and RWI did not distinguish between drinking and driving versus using other drugs and driving. Thus, it is not possible to know the extent to which teenagers were using alcohol or other drugs separately or in combination. Second, the outcome measures were also limited in that they did not specify if the driver in the RWI situation was a teenager or adult, or the respondent's parent. Third, teenage passengers may not have known for certain if the driver was or was not impaired (or the level of impairment). This is related to the previous limitation in that the teen's ability to judge impairment may be different for a peer, whom they might have observed drinking (e.g., at a party), versus a parent or other adult. If anything, this may lead to a conservative estimate of the prevalence of RWI. Fourth, only two of many possible parenting practices were assessed. Future research could include a more comprehensive assessment of parenting practices, such as the influence of parental modeling of drinking behaviors. Fifth, we did not measure peer influence on teenagers' DWI and RWI, and this could also be an area for future research. Finally, additional waves of data would help elucidate the relationship between parental monitoring knowledge and DWI and RWI over time. For example, it is possible that parental monitoring knowledge would increase in response to problem behavior.

A major strength of the study is the large nationally representative sample of high school students. By using two waves of data, this study was able to account for temporality in the association between parenting practices (including both mother's and father's monitoring knowledge) and substance use in the prediction of DWI and RWI.

Conclusions

The high prevalence of teenage DWI and RWI and the effects of crash risk constitute a public health concern. We found that teenage substance use was prospectively related to DWI and RWI, and parental monitoring knowledge (among fathers) was protective against DWI, primarily through lower alcohol use. Preventing teenage substance use can prevent DWI and RWI, and enhancing parenting practices may discourage teenage DWI.

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