Longitudinal Associations of 12th-Grade Binge Drinking With Risky Driving and High-Risk Drinking

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abstract

OBJECTIVE: To study the longitudinal associations of 12th-grade binge drinking with driving while impaired (DWI), riding with an impaired driver (RWI), blackouts, extreme binge drinking, and risky driving (self-reported Checkpoints Risky Driving Scale) among emerging adults up to 4 years after leaving high school.

METHODS: The data were all 7 waves (W 1 to W 7 of the NEXT Generation Health Study; a US nationally representative study (N = 2785) with a probability cohort of 10th-graders (mean age = 16.2 years; SE = 0.03) starting in the 2009–2010 year. Binary and ordinal logistic regressions were used for the analysis.

RESULTS: Binge drinking prevalence in W1 to W3 was 27.2%, 23.8%, and 26.8%, respectively. Twelfth-grade binge drinking was associated with a higher likelihood of DWI, RWI, blackouts, and risky driving in W4 to W7 and extreme binge drinking in W7. Adolescents who binged ≥3 times in high school were more likely to DWI, RWI, blackout (W4 to W7), be involved in extreme binge drinking (W7), and report riskier driving several years after high school. In some waves, parental practices appeared to have enduring effects in protecting against DWI, RWI, and blackouts.

CONCLUSIONS: Twelfth-grade binge drinking is a robust predictor of early adulthood DWI, RWI, blackout, extreme binge drinking, and risky driving. Our study suggests that ongoing parental practices could be protective against DWI, RWI, and blackouts once adolescents transition from high school into early adulthood. Prevention programs that incorporate binge drinking–focused screening and bolster parental practices may reduce the likelihood of later major alcohol-related health-risk behaviors and consequences in emerging adults.

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WHAT'S KNOWN ON THIS SUBJECT: The prevalence of alcohol binge drinking and extreme binge drinking remain high among US high school students. This has implications for later driving while impaired (DWI) and riding with an impaired driver (RWI).

WHAT THIS STUDY ADDS: Binge drinking in 12th grade is a robust predictor of early adulthood DWI, RWI, blackout, extreme binge drinking, and risky driving. Parental practices may have enduring effects protecting emerging adults against DWI, RWI, and blackouts several years after high school.

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ARTICLE

As a key contributor to motor vehicle crash injuries and deaths in adolescents and emerging adults, alcohol-impaired driving remains a major public health challenge. From 2015 to 2016, the number of young drivers (15–20 years old) involved in fatal crashes increased (from 4352 to 4514) as did the number of passenger deaths in which the driver was a young driver (from 982 to 1018).[1] Among young driver fatalities, 24% were alcohol-related, and 82% of drivers had a blood alcohol concentration (BAC) of ≥0.08 g/dL; this is at or above the national legal BAC limit allowed for adults to drive a vehicle and is the level of BAC that is generally reached when binge drinking.[2]

The prevalence of alcohol use and binge drinking increases during high school.[3–5] Estimates of past-30-day alcohol use (≥1 alcoholic drink on ≥1 day) and binge drinking (≥5 drinks in a row on ≥1 days) by 12th grade are ~42% and 25%, respectively.[5] Recently, there have been growing concerns of "high-intensity drinking" or "extreme binge drinking" and its implications for driving while impaired (DWI), riding with an impaired driver (RWI), and other risky driving.[6–8] Experts note that persistence in prevalence of higher levels of extreme binge drinking (eg, ≥15 drinks on a single occasion)[6] among high school teenagers and emerging adults will continually contribute to significant increases in major short- and long-term negative outcomes (eg, risky driving and serious and fatal crashes).[8–11] Furthermore, even without binging at extreme levels, early persistent typical-level binge drinking in high school (eg, cumulative episodes over consecutive years in high school) logically portends a host of negative outcomes shortly and several years after leaving high school. Therefore, there is a need to understand the relationships between the chronicity of binge drinking in high school adolescents and long-term negative outcomes. In this context, expanding the knowledge base of predictors of typical binge and extreme binge drinking among adolescents and emerging adults could yield considerable benefit to crash-injury prevention activities.[6,8]

It has been well documented that early exposure to alcohol may have longer-lasting effects into adulthood than originally thought.[12–14] The extent to which underage drinking is associated with later DWI, RWI, blackout, extreme binge drinking, and risky driving in emerging adulthood needs further study in a longitudinal context. Moreover, although parenting practices have been found to be protective against adolescent alcohol use,[15–17] the study of endurance of protective effects of parenting practices during adolescence on early adulthood risky driving and binge or extreme binge drinking is limited and needs testing to effectively guide prevention efforts.

In addition to extreme binge drinking, as Wilhite and Fromme[18] note, our knowledge of alcohol-related blackouts has been relatively slow to advance, adding to growing public health concern. To date, studies have characterized predictors and consequences, and explored cognitive and neurobiological mechanisms of blackouts.[19–22] More research is needed to further characterize predictors of blackouts and their relationships to other alcohol-related health-risk outcomes (eg, DWI and RWI). Findings could inform the practicality and utility of using remote or recent history of blackouts to strengthen alcohol use disorder screening efficacy, thus enhancing identification of adolescents and emerging adults who are at the greatest risk for DWI and RWI injury.[23]

Our purpose in this study was to examine the associations of 12th-grade binge drinking with DWI, RWI, blackouts, extreme binge drinking, and risky driving among emerging adults up to 4 years after leaving high school.

METHODS

Data were from all 7 waves (W1 to W7) of the NEXT Generation Health Study, a nationally representative longitudinal study starting in 10th grade (2009–2010 year [W1]; sampling details previously published).[15,24] From W1 to W7, 91%, 88%, 86%, 78%, 79%, 84%, and 83% of the full sample (N = 2785) completed the survey during the spring time each year. Parent consent and participant assent were obtained for those under age 18. After turning age 18, participants were consented as adults. African American participants were oversampled. The study protocol was approved by the Institutional Review Board of the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development.

MEASURES

Dependent Variables

DWI (W4 to W7)

DWI was assessed with 3 items asking participants how many days they drove after drinking alcohol or using marijuana or illicit drugs (past 30 days). Questions were collapsed and dichotomized as DWI ≥1 day versus no DWI (past 30 days).

RWI (W4 to W7)

RWI was measured by asking participants, "During the last 12 months, how many times did you ride in a vehicle driven by someone who had been drinking alcohol?" The same question was repeated for "smoking marijuana" and "using illicit drugs other than alcohol or marijuana." Questions were collapsed and dichotomized as RWI ≥1 time versus no RWI (last 12 months).

Blackout (W4 to W7)

Blackout was measured by asking participants, "In the last 6 months, how often has your drinking caused you to black out?" with 5 options: not at all, once, twice, 3 times, and 4+ times. Options were dichotomized as blackout ≥1 time versus no blackout (last 6 months).

Extreme Binge Drinking (W7 Only)

Extreme binge drinking was measured with an open-ended question, "During the past 12 months, what was the largest number of drinks that you drank on a single day?" with 2 options: either "write in number of drinks" or check "I do not drink." Answers were recoded as a 5-level categorical variable including no drinking, drinking but no binge drinking (males: 1 to 4; females: 1–3 drinks), binge (males: 5–9; females: 4–7 drinks), 2 times binge drinking (males: 10–14; females: 8–11 drinks), and 3 times binge drinking or more (males: 15+; females: 12+ drinks) in the past 12 months.[25]

Self-Reported Checkpoints Risky Driving Scale (W4 to W7)

Risky driving was measured by using 21 questions derived from the validated self-reported Checkpoints Risky Driving Scale (C-RDS)[26–28] to measure unsafe driving behavior (eg, on how many days in the last 30 days have you exceeded the speed limit in residential or school zones?). Internal consistency of the C-RDS was good (Cronbach α = 0.90). We dichotomized responses on each of the 21 questions (1 = at least 1 day; 0 = none) and summed them to make a continuous variable, with possible scores ranging from 0 to 21.

Independent Variables

Binge Drinking in 12th Grade (W3)

Binge drinking was measured with 1 question from the Monitoring the Future national survey[29]: "Over the last 30 days, how many times (if any) have you had 4 (for females), 5 (for males), or more drinks in a row within 2 hours?" Response options ranged from 1 (none) to 6 (≥10 times). Scores were dichotomized: binge ≥1 time versus no binge. We used binge drinking reported in 12th grade (W3) to predict outcome variables in W4 to W7.

Sum of Waves for High School Binge Drinking (W1 to W3)

To explore dose-response effects on the association between binge drinking and outcome variables in W4 to W7, the sum of high school binge drinking in W1 to W3 (grades 10–12) was created by summing the 3 dichotomous variables (ie, binge ≥1 time versus no binge in W1, W2, and W3), creating a 4-level categorical variable (none, once, twice, or 3 times in the last 30 days). This sum reflects the chronicity of binge drinking while in high school.

Parental Monitoring Knowledge (Grand Mean of W1 to W3)

Adolescents reported perceptions of their father's and mother's monitoring knowledge (separate items) from a 5-item scale[30] 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 4 response options (1 = do not have or see father, mother, or guardian; 2 = he or she does not know anything; 3 = he or she knows a little; and 4 = he or she knows a lot). The means of these 5 items were calculated for each wave. Because monitoring knowledge in W1 to W3 is highly correlated, we calculated a grand mean of father's and mother's monitoring knowledge separately across W1 to W3.

Parental Support of Not Using Alcohol (Grand Mean of W1 to W3)

One question derived from the National Survey on Drug Use and Health[31] asked participants how important it was to their parents or guardians that they do not use alcohol (response options: 1 = not at all; 7 = extremely) to measure student-perceived parental support of not using alcohol. Like parental monitoring knowledge, the grand mean of father's and mother's support of not using alcohol was calculated from W1 to W3.

Driving Licensure

Driving licensure (domain variable) was generated from students reporting if they had a license allowing independent, unsupervised driving and used in the domain analyses with DWI as the outcome variable.

Demographic and Other Potential Control Variables

Participants reported age in W1 (mean = 16.3 years; SE = 0.03), sex, race and/or ethnicity, family affluence, and residence at W4 to W7; 1 parent provided the parent education levels and participant's living areas in W1 (variable details in the Table 1 legend).

Statistical Analysis

Our analyses considered features of complex survey design (ie, stratification, clustering, and sampling weights) with SAS 9.4 (SAS Institute, Inc, Cary, NC). The measures in W1 to W7 were assessed from the 2010–2011 through the 2016–2017 school years. Binary logistic regression was used for DWI, RWI, and blackout; linear regression was used for C-RDS; and ordinal logistic regression was used for extreme binge drinking. To select the variables that would be included in adjusted models, bivariate association of each outcome variable in all 4 waves with any of the potential covariates was examined. The variables that are associated (P = .10 level) with any outcome variable were included in adjusted models. Unadjusted (Supplemental Tables 7–11) and adjusted model analyses were conducted. Missing data were listwise deleted in the analysis for each wave,

TABLE 1 Demographic Information and Outcome Variables in W4 to W7

	W4			W5			W6			W7		
	N	Weighted %	95% CI	*N*	Weighted %	95% CI	*N*	Weighted %	95% CI	*N*	Weighted %	95% CI
Sex												
Female	1264	58.9	54.7 to 63.1	1298	59.2	55.4 to 63.1	1345	59.6	56.1 to 63.2	1347	58.7	55.1 to 62.3
Male	913	41.1	37.0 to 45.3	904	40.8	36.9 to 44.6	961	40.4	36.8 to 43.9	976	41.3	37.7 to 44.9
Race and/or ethnicity												
Hispanic	643	19.8	10.9 to 28.8	656	20.2	12.2 to 28.3	693	19.6	12.2 to 27.0	695	19.6	12.0 to 27.1
African American	557	13.5	6.6 to 20.3	572	13.6	6.6 to 20.6	598	19.3	9.4 to 29.2	595	19.3	9.6 to 29.1
White	862	61.8	49.8 to 73.9	858	60.8	49.6 to 71.9	598	19.3	9.4 to 29.2	914	56.6	44.3 to 69.0
Other	109	4.9	2.9 to 6.9	108	5.4	3.3 to 7.6	113	4.8	2.2 to 7.3	113	4.5	2.1 to 6.9
Family affluence												
Low	692	22.2	16.7 to 27.8	711	23.0	17.5 to 28.4	736	23.0	17.0 to 29.0	750	24.4	18.6 to 30.1
Moderate	1008	48.8	45.2 to 52.4	1019	48.6	45.6 to 51.5	1072	48.9	45.8 to 52.1	1079	48.2	44.9 to 51.5
High	476	29.0	23.5 to 34.5	470	28.5	23.0 to 34.0	496	28.1	22.4 to 33.8	492	27.4	21.9 to 33.0
Parental education												
High school	748	32.2	26.5 to 37.9	764	32.3	26.0 to 38.6	798	31.7	26.3 to 37.1	809	32.7	26.8 to 38.7
Some college	726	39.1	35.3 to 42.8	749	38.6	34.3 to 42.9	773	38.8	34.6 to 43.0	784	39.5	35.1 to 43.9
Bachelor's degree	517	28.7	22.8 to 34.7	498	29.1	22.0 to 36.3	534	29.5	22.6 to 36.4	528	27.7	20.8 to 34.7
Urban or rural location												
Urban	716	12.9	0.0 to 26.8	742	12.7	0.0 to 26.4	768	13.8	0.0 to 28.3	761	13.8	0.0 to 28.3
Suburban	656	49.6	28.9 to 70.3	670	50.0	29.1 to 70.8	710	50.7	29.8 to 71.7	725	50.9	29.9 to 71.8
Rural	593	37.5	21.3 to 53.7	575	37.3	21.2 to 53.4	602	35.4	19.7 to 51.2	616	35.3	19.6 to 51.0
Residence												
Parent's home	1277	52.3	46.0 to 58.9	1317	48.6	41.1 to 56.1	1153	41.4	34.4 to 48.4	1146	38.9	32.3 to 45.5
Own place or rented room	262	16.2	12.4 to 20.0	449	28.8	21.7 to 35.8	708	38.8	32.1 to 45.5	939	50.7	45.0 to 56.4
Dorm, sorority, or fraternity	533	26.3	21.5 to 31.1	256	13.1	9.2 to 17.0	200	8.9	5.4 to 12.3	37	2.63	0.91 to 4.4
Other (barracks, hospital, relatives, etc)	60	5.0	2.9 to 7.1	162	9.5	5.4 to 13.6	202	10.9	8.2 to 13.6	178	7.8	5.7 to 9.8
DWI												
No	1067	85.4	81.9 to 88.8	1200	84.2	80.8 to 87.6	1258	79.0	75.9 to 82.0	1311	76.5	72.7 to 80.3
Yes	185	14.6	11.2 to 18.1	227	15.8	12.4 to 19.2	336	21.0	18.0 to 24.1	438	23.5	19.7 to 27.3
RWI												
No	1618	75.2	71.0 to 79.5	1449	67.0	62.5 to 71.6	1501	64.7	61.0 to 68.4	1539	67.6	64.0 to 71.2
Yes	531	24.8	20.5 to 29.1	694	33.0	28.4 to 37.5	756	35.3	31.6 to 39.0	754	32.4	28.8 to 36.0
Blackout												
No	1268	84.1	80.4 to 87.8	1345	83.7	78.2 to 89.2	1568	83.9	79.9 to 87.9	1544	82.1	77.7 to 86.6
Yes	196	15.9	12.2 to 19.6	216	16.3	10.8 to 21.8	263	16.1	12.2 to 20.1	280	17.9	13.4 to 22.3
Extreme binge drinking in past 12 mo												
No drinking	—	—	—	—	—	—	—	—	—	505	18.5	14.5 to 22.6
Drink but no binge (male: 1–4; female: 1–3)	—	—	—	—	—	—	—	—	—	551	19.6	16.0 to 23.2
Binge (male: 5–9; female: 4–7)	—	—	—	—	—	—	—	—	—	703	33.2	27.7 to 38.6
2 times binge (male: 10–14; female: 8–11)	—	—	—	—	—	—	—	—	—	316	15.9	12.3 to 19.4
3 times binge or more (male: 15+; female: 12+)	—	—	—	—	—	—	—	—	—	210	12.8	9.7 to 16.0
	N	Mean	95% CI	*N*	Mean	95% CI	*N*	Mean	95% CI	*N*	Mean	95% CI
C-RDS	1421	7.3	6.7 to 7.9	1526	6.9	6.5 to 7.3	1668	7.3	6.7 to 7.9	1807	7.6	7.3 to 7.9

Family Affluence Scale[32] categorized students as low, moderate, and high affluence on the basis of the Family Affluence Scale tertiles.[33] Parent education level was categorized as less than a high school diploma; high school diploma or general equivalency diploma; some college, technical school, or associate's degree; and bachelor's or graduate degree. Surrounding areas where students lived at W1 were coded as urban, suburban, and rural areas. Residence at W4 to W7: parent or guardian's home, own place (eg, rented room or apartment), on campus (eg, school dormitory or residence hall), and other places. CI, confidence interval; —, not applicable.

TABLE 2 Association (Adjusted Binary Logistic Regressions) of W4 to W7 DWI With W1 to W3 Binge Drinking and Parenting Variables Among Emerging Adults

	W4 (*N* = 1252)			W5 (*N* = 1427)			W6 (*N* = 1594)			W7 (*N* = 1749)		
	aOR	95% CI	*P*	aOR	95% CI	*P*	aOR	95% CI	*P*	aOR	95% CI	*P*
Binge drinking in W3, yes versus no	5.7	3.0 to 10.8	<.001	5.9	3.0 to 11.6	<.001	4.3	2.6 to 7.0	<.001	2.7	1.4 to 5.3	<.01
Binge drinking												
3 times versus none	8.1	3.5 to 18.5	<.0001	10.8	4.9 to 23.7	<.0001	4.5	2.2 to 9.1	.0002	3.3	1.8 to 6.1	.0006
Twice versus none	9.3	3.3 to 26.1	.0002	5.8	2.2 to 14.9	.001	3.5	2.0 to 6.0	.0001	2.6	1.1 to 6.6	.0394
Once versus none	2.0	1.0 to 3.9	.0425	2.6	0.9 to 7.2	.0676	2.4	1.4 to 4.1	.0046	1.3	0.8 to 2.0	.2556
W1 to W3 father monitoring knowledge (grand mean)	0.8	0.6 to 1.0	>.05	0.7	0.6 to 1.0	<.05	0.8	0.6 to 1.0	<.05	0.9	0.7 to 1.2	>.05
W1 to W3 mother monitoring knowledge (grand mean)	0.4	0.3 to 0.7	<.01	0.7	0.4 to 1.2	>.05	0.8	0.5 to 1.6	>.05	0.7	0.5 to 1.1	>.05
W1 to W3 parental support of not using alcohol (grand mean)	0.6	0.5 to 0.8	<.001	0.6	0.5 to 0.8	<.001	0.9	0.7 to 1.1	>.05	0.7	0.5 to 0.9	<.01

Less than or greater than *P* values are reported when there are no pairwise comparisons, and exact *P* values are reported when there are pairwise comparisons. Controlling for race and/or ethnicity, parent highest education, family affluence, urbanicity, current residence, and sex. W1 to W3: 10th grade to 12th grade; W4 to W7: 1 to 4 y after high school. *N* was the total number of participants who had valid DWI values and an independent driving license in the corresponding wave. aOR, adjusted odds ratio; CI, confidence interval.

and domain analysis was applied for analyses when using the driving subsample.

RESULTS

Demographic and outcome variable information in W4 to W7 is provided in Table 1. Binge drinking prevalence in W1 to W3 (27.2%, 23.8%, and 26.8%, respectively) was calculated. Paired *t* tests (Bonferroni-based adjustment; significance at $P = .02$) indicate no significant difference between W1 and W3 ($P > .05$) or W2 and W3 ($P = .03$). Thus, we used 12th-grade (W3) binge drinking to indicate purposeful versus early-experimental drinking to get drunk.

Table 2 shows that binge drinking in W3 was associated with higher odds of DWI in W4 to W7. Of note, in W5, the odds were nearly 6 times greater, and in W7, the odds were still >2 times greater. Compared with adolescents who reported never binging in high school, those who binged in more years during high school had higher odds of DWI at later waves. Furthermore, although binging in at least 2 high school years was associated with higher odds of DWI in all later waves, a dose-response relationship was not observed after Bonferroni correction (Supplemental Table 12).

Binge drinking in W3 was associated with higher odds of RWI, with odds ranging from >4 times in W4 to >2.5 times in W7 (Table 3). Compared with adolescents who reported never binge drinking while in high school, those who binged at least once while in high school had higher odds of RWI in W4 and W5. Those who binged in at least 2 high school years had higher odds of RWI in all subsequent waves. However, a dose-response relationship was not observed after Bonferroni correction (Supplemental Table 12).

TABLE 3 Association (Adjusted Binary Logistic Regressions) of W4 to W7 RWI With W1 to W3 Binge Drinking and Parenting Variables Among Emerging Adults

	W4 (*N* = 2149)			W5 (*N* = 2143)			W6 (*N* = 2257)			W7 (*N* = 2293)		
	aOR	95% CI	*P*	aOR	95% CI	*P*	aOR	95% CI	*P*	aOR	95% CI	*P*
Binge drinking in W3, yes versus no	4.2	2.8 to 6.4	<.001	3.1	2.1 to 4.6	<.001	3.6	2.2 to 5.9	<.001	2.6	1.4 to 4.8	<.01
Binge drinking												
3 times versus none	8.2	4.3 to 15.6	<.0001	4.2	2.3 to 7.7	<.0001	5.5	2.7 to 11.4	<.0001	3.2	1.5 to 7.0	.0052
Twice versus none	3.8	2.5 to 5.8	<.0001	3.2	1.8 to 5.9	.0005	1.8	1.1 to 2.8	.0146	2.4	1.2 to 4.7	.0148
Once versus none	2.7	1.4 to 5.3	.005	2.5	1.6 to 3.7	.0002	1.5	1.0 to 2.4	.0678	1.3	0.9 to 1.9	.1119
W1 to W3 father monitoring knowledge (grand mean)	0.8	0.7 to 0.9	<.01	0.9	0.8 to 1.2	>.05	0.9	0.7 to 1.1	>.05	0.8	0.7 to 1.0	<.05
W1 to W3 mother monitoring knowledge (grand mean)	0.8	0.6 to 1.1	>.05	0.9	0.6 to 1.3	>.05	0.7	0.4 to 1.2	>.05	0.9	0.5 to 1.6	>.05
W1 to W3 parental support of not using alcohol (grand mean)	0.8	0.7 to 1.0	<.05	1.0	0.8 to 1.1	>.05	0.9	0.8 to 1.0	>.05	0.9	0.7 to 1.1	>.05

Less than or greater than *P* values are reported when there are no pairwise comparisons, and exact *P* values are reported when there are pairwise comparisons. Controlling for race and/or ethnicity, parent highest education, family affluence, urbanicity, current residence, and sex. W1 to W3: 10th grade to 12th grade; W4 to W7: 1 to 4 y after high school. *N* was the total number of participants who had valid RWI values in the corresponding wave. aOR, adjusted odds ratio; CI, confidence interval.

TABLE 4 Association (Adjusted Binary Logistic Regressions) of W4 to W7 Blackout With W1 to W3 Binge Drinking and Parenting Variables Among Emerging Adults

	W4 (N = 1464)			W5 (N = 1561)			W6 (N = 1831)			W7 (N = 1824)		
	aOR	95% CI	P	aOR	95% CI	P	aOR	95% CI	P	aOR	95% CI	P
Binge drinking in W3, yes versus no	2.7	1.4 to 5.2	<.01	4.0	2.2 to 7.5	<.001	2.7	1.3 to 5.5	<.01	3.0	1.8 to 4.8	<.001
Binge drinking												
3 times versus none	6.9	2.9 to 16.3	.0001	9.5	3.9 to 23.0	<.0001	5.0	1.7 to 14.3	.0049	3.2	1.9 to 5.3	.0001
Twice versus none	2.6	1.0 to 7.1	.0603	2.5	1.2 to 5.2	.0183	1.8	0.8 to 3.9	.1541	1.9	1.2 to 3.0	.0051
Once versus none	3.4	1.4 to 8.1	.0082	2.2	1.0 to 4.8	.1541	1.5	0.8 to 2.6	.1810	1.5	1.0 to 2.4	.0614
W1 to W3 father monitoring knowledge (grand mean)	0.9	0.6 to 1.3	>.05	0.9	0.6 to 1.4	>.05	0.9	0.6 to 1.2	>.05	0.9	0.8 to 1.2	>.05
W1 to W3 mother monitoring knowledge (grand mean)	0.8	0.4 to 1.4	>.05	0.7	0.5 to 1.0[a]	<.05	1.1	0.6 to 2.1	>.05	1.5	0.8 to 2.8	>.05
W1 to W3 parental support of not using alcohol (grand mean)	0.8	0.6 to 1.0[a]	<.05	0.8	0.6 to 1.0[a]	<.05	0.9	0.7 to 1.3	>.05	1.0	0.8 to 1.3	>.05

High father monitoring knowledge was related to lower odds of DWI and RWI, decreasing the odds of DWI in W5 and W6 by 30% and 20%, respectively, and decreasing the odds of RWI in W4 and W7 by 20% and 20%, respectively. High mother monitoring knowledge was also related to DWI in W4, lowering the odds by 60%, but the odds were not lowered in any of the waves for RWI. Parental support for not drinking alcohol was related to DWI, lowering the odds in W4, W5, and W7 by 40%, 40%, and 30%, respectively, and similarly lowering the odds of RWI in W4 by 20%.

As shown in Table 4, binge drinking in W3 was associated with ≥2.5 times greater odds of blackout throughout W4 to W7. Compared with adolescents who report never binge drinking while in high school, those who reported binge drinking in at least 3 high school years had higher odds of blackout in all subsequent waves. Moreover, those who reported binge drinking in at least 2 high school years, compared with those who reported never binge drinking while in high school, had higher odds of blackout in W5 and W7. Finally, those reporting binge drinking in at least 1 high school year, compared with those who reported never binge drinking while in high school, had higher odds of blackout in W4 and W5.

Binge drinking in W3 was associated with 2 times greater odds of W7 extreme binge drinking (Table 5). Compared with those who never binged, adolescents who reported binging in at least 2 high school years had higher odds of extreme binge drinking at W7.

There was no association between father's monitoring knowledge and blackout (Table 4). However, high mother monitoring knowledge was associated with 30% decreased odds of blackout in W5 (Table 4), whereas high parental support for not using alcohol reduced the odds of blackout by 20% in both W4 and W5 (Table 4).

Father's monitoring knowledge, mother's monitoring knowledge, and parental support of not using alcohol were not associated with W7 extreme binge drinking (Table 5).

Binge drinking in W3 was positively and significantly associated with W4–W7 risky driving (ie, C-RDS scores; Table 6). Compared with those who never binged, adolescents who binged in at least 2 years of high school had higher C-RDS scores in W4, and those reporting binge drinking in at least 3 years of high school had higher C-RDS scores for W4, W5, and W7. Mother's monitoring knowledge was associated with lower C-RDS scores only in W4. Otherwise, all other parental monitoring knowledge

TABLE 5 Association (Adjusted Binary Logistic Regressions) of W7 Extreme Binge Drinking With W1 to W3 Binge Drinking and Parenting Variables Among Emerging Adults

	W7 (N = 2285)		
	aOR	95% CI	P
Binge drinking in W3, yes versus no	2.0	0.2 to 3.6	<.05
Binge drinking			
3 times versus none	2.6	0.3 to 5.0	.0001
Twice versus none	1.6	1.1 to 2.3	.0093
Once versus none	1.2	0.7 to 1.8	.4923
W1 to W3 father monitoring knowledge (grand mean)	1.0	−0.5 to 1.0	>.05
W1 to W3 mother monitoring knowledge (grand mean)	1.0	−1.7 to 0.6	>.05
W1 to W3 parental support of not using alcohol (grand mean)	0.9	−0.9 to 0.2	>.05

Less than or greater than P values are reported when there are no pairwise comparisons, and exact P values are reported when there are pairwise comparisons. Controlling for race and/or ethnicity, parent highest education, family affluence, urbanicity, current residence, and sex. N was the total number of participants who had valid values for extreme binge drinking in the corresponding wave. W1 to W3: 10th grade to 12th grade; W4 to W7: 1 to 4 y after high school. aOR, adjusted odds ratio; CI, confidence interval.

TABLE 6 Association (Adjusted Linear Regression) of W4 to W7 C-RDS With W1 to W3 Binge Drinking and Parenting Variables

	W4 (N = 1253)[b]			W5 (N = 1429)[b]			W6 (N = 1595)[b]			W7 (N = 1751)[b]		
	β	95% CI	*P*	β	95% CI	*P*	β	95% CI	*P*	β	95% CI	*P*
Binge drinking in W3, yes versus no	1.9	0.9 to 2.9	<.001	2.1	.7 to 3.6	<.01	1.6	0.2 to 3.1	<.05	1.9	0.2 to 3.6	<.05
Binge drinking												
3 times versus none	3.3	1.4 to 5.3	<.01	3.3	.5 to 6.0	<.05	2.0	−1.1 to 5.0	>.05	2.6	0.3 to 5.0	<.05
Twice versus none	2.6	1.5 to 3.8	<.001	1.1	−.3 to 2.6	>.05	1.1	−0.8 to 2.9	>.05	1.3	−0.1 to 2.7	>.05
Once versus none	.4	−0.8 to 4.6	>.05	.9	−.4 to 2.2	>.05	1.1	−0.1 to 2.4	>.05	.3	−0.7 to 1.3	>.05
W1 to W3 father monitoring knowledge (grand mean)	−.1	−0.6 to 0.5	>.05	.1	−.7 to 0.9	>.05	.1	−0.5 to 0.8	>.05	.3	−0.5 to 1.0	>.05
W1 to W3 mother monitoring knowledge (grand mean)	−1.5	−2.5 to −0.4	<.01	−1.0	−2.4 to 0.4	>.05	.4	−1.1 to 1.9	>.05	−.5	−1.7 to 0.6	>.05
W1 to W3 parental support of not using alcohol (grand mean)	−.5	−1.1 to 0.1	>.05	.1	−.7 to 0.9	>.05	.0	−0.6 to 0.6	>.05	−.4	−0.9 to 0.2	>.05

Less than or greater than *P* values are reported when there are no pairwise comparisons, and exact *P* values are reported when there are pairwise comparisons. Controlling for race and/or ethnicity, parent highest education, family affluence, urbanicity, current residence, and sex. W1 to W3: 10th grade to 12th grade; W4 to W7: 1 to 4 y after high school. *N* was the total number of participants who had valid values for C-RDS and an independent driving license in the corresponding wave. CI, confidence interval.

findings and parental support for not using alcohol were not associated with C-RDS score.

DISCUSSION

Our study examined prospective associations of 12th-grade binge drinking with later risky driving (ie, C-RDS) and high-risk drinking in a nationally representative sample of emerging adults. The timing and magnitudes of these associations reflect several important transitions in emerging adults, including developmental transitions (eg, adolescence into emerging adulthood), environmental transitions (eg, high school, then out of high school), policy context transitions (eg, underage drinking into minimum legal-aged drinking), and youth-parent relational transitions (eg, parental-dependent stage into more independent stage). Our analyses show that 12th-grade binge drinking is associated with a high likelihood of DWI, RWI, blackouts, engaging in more frequent risky driving up to 4 years after high school, and extreme binge drinking 4 years after high school. This is consistent with previous risky-driving research among binge drinking adolescents.[8] Furthermore, adolescents who binged in at least 3 high school years, compared with those who did not, were more likely to DWI, RWI, blackout, be involved in extreme binge drinking, and report more risky driving. Parental practices appeared to have some enduring effect in protecting emerging adults against DWI, RWI, and blackouts in some but not all waves.

An association between early exposure to substance use and later risk behaviors among youth has been well established.[13,34] Our findings incrementally and importantly advance the understanding of a similar relationship for the extent of chronicity of high school binge drinking in a longitudinal context. Moreover, our results indicate that for those adolescents who do not abstain from alcohol use in high school, reduced frequency and in particular intensity of alcohol use (ie, avoidance of binge drinking and lower chronicity of binge drinking while in high school) can decrease the magnitude of much later major health-risk behaviors. This could reduce major harm due to alcohol-related adverse health outcomes (ie, alcohol-related DWI and/or RWI injury or fatal crash).

Study findings on lasting effects of parental influence on risk behaviors when adolescents transition into emerging adulthood have been somewhat mixed, with more evidence observed for female than male adolescents.[16] However, several studies report that facets of good parenting (eg, parental monitoring knowledge and parental trust and support) provide important protective effects against adolescent risk behaviors, including in the context of DWI and RWI.[15,17,35,36] Our study shows limited but important parenting influence on DWI, RWI, and to some extent blackouts. Although the relationships are not consistent across all assessment waves and all outcomes, there is evidence of positive influence through parenting practices that may last 2 or more years after the adolescent leaves high school.

We recognize that our study has limitations. First, although the NEXT study was longitudinal, we chose to conduct a series of 2–time-point prospective analyses rather than multiple–time-point prospective analyses because of the wave-dependent changing sample size (ie, waves with a sequentially increasing number of participants who were eligible for driver licensure who could then be included in analyses). The changing sample sizes were not consistent across waves, especially for driving-related variables (ie, DWI and C-RDS). Furthermore, only 1 wave of data for extreme binge drinking is available in the NEXT study data set. Therefore, for

consistency, we used a longitudinal approach and variables in earlier waves to predict outcomes at later waves. Second, we examined dichotomous outcomes of DWI, RWI, and blackouts because of sparse and skewed responses. As such, the transition probabilities and their correlates are only for "no" DWI, RWI, or blackouts to "yes" DWI, RWI, or blackouts. The severity and frequency of those outcomes were left for future investigation. Third, our study uses participant self-reports instead of direct parent reports in assessment of parental monitoring knowledge and parental support of not using alcohol. This inherently introduces potential for reporting bias.

CONCLUSIONS

Binge drinking in 12th grade predicted a significantly higher likelihood of DWI, RWI, blackout, and extreme binge drinking and led to more risky driving when transitioning into early adulthood. To an important but limited extent, parental practices while the teenager is in high school may protect against DWI, RWI, and blackouts as adolescents move into early adulthood. Our findings are relevant to prevention programs that seek to incorporate alcohol screening with intentional inquiry about binge drinking. Moreover, our results may be instructive to programs that seek to leverage facets of parental practices to reduce health-risk contexts for youth. Such prevention activities coupled with strengthening of policies and practices reducing adolescents' access to alcohol could reduce later major alcohol-related health-risk behaviors and their consequences.

ABBREVIATIONS

BAC: blood alcohol concentration
C-RDS: self-reported Checkpoints Risky Driving Scale
DWI: driving while impaired
RWI: riding with an impaired driver
W: wave

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