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Does One Day of Drinking Matter? 21st Birthday Drinking Predicts Subsequent Drinking and Consequences

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Abstract

Objective—There has been ample research on college student risks and consequences related to 21st Birthday Drinking. To date, no studies we are aware of have examined how 21st birthday drinking impacts subsequent drinking and related consequences. This study evaluates the effect of a single night of drinking on peak drinking, heavy drinking, and negative consequences over 12 months following the event. Furthermore, we examine if typical drinking behavior prior to 21st birthday moderates the relationship between the event drinking and subsequent use.

Method—Participants included 599 college students (46% male) who intended to consume at least five/four drinks (men/women respectively) on their 21st birthday. Screening and baseline assessments were completed approximately four weeks before turning 21. A follow-up assessment was completed approximately one week after students' birthdays and every 3 months for one year thereafter.

Results—Those who drank more on their 21st birthday, also reported higher peak consumption, increased likelihood of consequences, and increased number of consequences throughout the year. Additionally, baseline peak drinking moderated the relationship such that those who drank less at peak occasion prior to turning 21 showed the strongest effects of 21st BD drinking on subsequent consumption.

Conclusions—21st BD drinking could impact subsequent choices and problems related to alcohol. Interventions are warranted and implications discussed.

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Contributors

Example: Authors Lee, Lewis, and Larimer designed the study and wrote the protocol and edited the manuscript. Dr. Geisner conducted literature searches and provided summaries of previous research studies, outlined and wrote sections of the introduction and discussion. Angela Mittman wrote the methods section and conducted the day to day study execution. Dr. Rhew conducted the statistical analysis and wrote the results section. All authors contributed to and have approved the final manuscript.

Conflict of Interest

All authors declare that they have no conflicts of interest.

Keywords

event-specific drinking; 21st birthday; alcohol; alcohol-related problems; college students

Heavy drinking among young adult college students is prevalent and problematic (Fromme & Quinn, 2012; Hingson & White, 2012; Johnston, O'Malley, Bachman, & Schulenberg, 2013; O'Malley & Johnston, 2002; Schulenberg & Patrick, 2012). Recent data show nearly 40% of college students drink heavily, that is consuming five or more drinks in a row (4 for women) in the prior two-week period (Johnston, O'Malley, Bachman, & Schulenberg, 2013), and experience a number of alcohol-related consequences, including but not limited to increased college dropout, poor academic performance, unwanted and/or regretted sex, and injuries (Hingson, Heeren, Winter, & Wechsler, 2005; Hingson & White, 2012). Further, there is growing literature on event-specific drinking demonstrating that college students drink heavily during known periods of risk, such as tail-gating, Spring Break, holidays (e.g., New Year's, Halloween), and in particular during their 21st birthday celebrations (Brister, Sher, & Fromme; 2011; Neighbors et al., 2011a; Neighbors, Foster, Fossos & Lewis; 2012; Neal & Fromme 2007; Lee, Lewis, & Neighbors, 2009; Lefkowitz, Patrick, Morgan, Bezemer, & Vasilenko, 2012; Patrick, Morgan, Maggs, & Lefkowitz, 2011). Furthermore, students experience more adverse consequences during these specific occasions than on typical occasions (Brister, Sher, & Fromme; 2011; Lee et al., 2009; Lewis, Lindgren, Fossos, Neighbors, & Oster-Aaland, 2009; Lewis, Patrick, Lee, Kaysen, Mittman, Neighbors, 2012; Wetherill & Fromme, 2009). Studying etiology and prevention of event-specific drinking allows us to better understand when and how to prevent or reduce harm associated with these events, however it is unclear to what extent these events may be the impetus for changes (i.e., increases or decreases) in future drinking behavior. The present study focuses on alcohol use during 21st birthday celebrations and the association with alcohol use during the next year. No research to our knowledge has looked at whether a single event of drinking increases risk beyond the event. Understanding longer term implications of specific events will impact prevention and intervention efforts.

21st Birthday Drinking

The legal drinking age in the United States is 21, and thus turning 21 is seen as a legal rite of passage. Many students who might have not tried alcohol before, can now legally do so. Thus the 21st birthday celebration becomes a perfect event for looking at the impact of drinking on this day and implications for subsequent drinking. The recognition of high risk drinking associated with 21st birthday celebrations has received wide attention in both media (with highly publicized deaths of students such as Brad McCue) and research (Brister et al., 2011; Lewis et al., 2008, 2012; Neighbors et al., 2009, 2011; 2012a; 2012b; Patrick, Neighbors, & Lee, 2012). Up to 90% of college students report drinking on their 21st birthday, students reach an average BAC of .186 (Neighbors, Spieker, Oster-Aaland, Lewis, & Bergstrom, 2005; Neighbors et al., 2011) on this occasion, and the majority (68%) of students drink more than they intended (Brister, Wetherill, & Fromme, 2010). Of those who do drink, up to 12% report drinking 21 or more drinks (Rutledge et al., 2008). A higher proportion of students consume alcohol on 21st birthdays and reach higher estimated BACs

than on any other specific event (e.g., New Years, Spring Break, etc.; Neighbors et al., 2011). Rates of alcohol-related consequences for 21st birthday drinking such as vomiting, hangovers, and blackouts range from 30 to 50% (Lewis et al., 2009; Wetherill & Fromme, 2009), and students at greatest risk for experiencing negative consequences on 21st birthdays are those who typically do not drink heavily (Lewis et al., 2009). Thus, research has documented the need to study 21st birthday drinking and develop methods to prevent or reduce associated risks (Neighbors et al., 2012b).

Despite the growing body of research surrounding specific high-risk drinking events, 21st birthday is defined as a cultural marker for drinking, and we have yet to show that heavy drinking associated with a single occasion or event is associated with subsequent drinking and risk. Developmental psychologists disagree about how maturation occurs (continuously over time or with sudden events shifting trajectories), and understanding the role of 21st birthday drinking can help answer some interesting questions. Does more drinking on one's 21st birthday put them on a path toward riskier behavior or is it merely a selection effect (where only those who were already heavier drinkers drink more on their 21st birthdays)? Do light drinkers or non-drinkers face greater risks as a result of drinking more on their 21st birthdays? If high-risk drinking during a single event is shown to impact future drinking and consequences, focusing on etiology and prevention of event-specific drinking, will become essential in minimizing consequences associated with the events.

The Present Study

The present study examined the potential longer-term impact of 21st birthday drinking on peak drinking and negative consequences over the course of a year following the 21st birthday. We will examine if heavier 21st birthday drinking will be associated with heavier peak drinking and negative consequences over the course of the year following turning 21 when controlling for typical peak drinks and negative consequences prior to turning 21. Further, we will explore the relationship between 21st birthday drinking and subsequent drinking behavior (i.e., peak drinks and negative consequences) and whether this relationship will be moderated by typical drinking behavior prior to turning 21 (i.e., peak drinks and negative consequences).

Method

Procedures

Between December 2008 and December 2009 enrolled students at a large public northwestern university who were about to turn 21 ($N=3,043$) were e-mailed and mailed invitations to participate in a brief online screening survey within 4 weeks prior to their 21st BD. The survey included demographic questions, plans/intentions for the week of their BD—including drinking intentions and typical drinking behaviors and related consequences, as well as other relevant psychosocial measures. Of the 1,558 (51.2%) who completed the screening assessment, demographic characteristics included 68.1% White, 15.9% Asian, 7.7% Multi-Ethnic, 8.3% other and 53.9% women. These were representative of the population on campus.

A key inclusion criteria for the longitudinal study was intending to consume at least 4 (for women) or 5 (for men) drinks on a single occasion during their 21st BD celebrations. A total of 642 screened participants met criteria (41.2%) and of these 599 (93.3%) completed a baseline assessment, and were randomly assigned to one of 6 groups (5 interventions and an assessment only control). Detailed descriptions of the sampling methods, main outcomes, and intervention descriptions are found in Neighbors et al. (2010). Intervention condition was controlled for in the current analyses.

Post-Birthday Follow-Up Assessments

One-week after the 21st BD, participants received an invitation email and letter to complete the Post-BD follow-up on-line survey. The survey contained questions about the BD celebration(s) taking place during the week of the 21st BD—including one's own drinking and related consequences. The response rate was 97.5% (N=584). On-line follow-up assessments took place with participants at 3, 6, 9, and 12 months after the BD. Participation rates ranged from 94.7% at 3-month follow-up to 80.3% at 12-month follow-up. These surveys did not ask birthday specific questions, but were oriented around assessing long-term intervention effects on typical drinking and associated consequences. Participants were paid \$10 for completing the screening assessment and \$30 for the baseline and each subsequent assessment.

Measures

Measures included in the present analyses focused on evaluating long-term effects on drinking patterns over the year following the 21st birthday. Each measure was administered at baseline, 1-week post-BD, and at each of the 3-, 6-, 9-, and 12-months follow-ups. Intervention condition (coded 1 for intervention and 0 for control) and gender (coded 1 for males and 0 for females) were controlled for in the analyses.

Typical drinking

The Daily Drinking Questionnaire (DDQ; Collins et al., 1985; Dimeff et al., 1999) was used to assess the typical number of standard drinks participants reported consuming on each day of a typical week in the past 3-months. Responses for all seven days of the week were summed to create the total average number of weekly drinks consumed. The Quantity/Frequency Questionnaire (QF; Dimeff, Baer, Kivlahan, & Marlatt, 1999; Marlatt et al., 1998) was used to assess peak drinking by asking participants to report the highest number of standard drinks they consumed on a single occasion in the past 30 days. Both the DDQ and the QF measure were administered at all time points used in this analysis.

Alcohol-related consequences

The widely used Rutger's Alcohol Problem Index (RAPI, White & Labouvie, 1989) was used to assess the number of times each of 25 drinking-related consequence occurred over the past 3 months. Responses ranged from 0 (*0 times*) up to 4 (*More than 10 times*). Scores have a possible range of 0 to 100. Items included: neglected responsibilities, drove shortly after drinking more than two drinks, kept drinking when you promised yourself not to.

Internal reliability for the RAPI was .93. This measure was administered at all time-points used in this analysis.

21st birthday drinking

A modified version of the Daily Drinking Questionnaire (DDQ; Collins et al., 1985; Dimeff et al., 1999) was administered in the 1-week post-BD assessment to assess the number of standard drinks participants consumed on the day of their 21st birthday. To aid in interpretation of findings, we rescaled the variable such that a unit of 1 represented the interquartile range by dividing the number of drinks consumed on 21st birthday by 9 (75th percentile (14) – 25th percentile (5)). Thus, regression estimates for this variable describe differences in the outcome associated with moving from the 25th percentile to the 75th percentile in 21st birthday drinking.

Data Analyses Plan

Correlations among variables were assessed using Spearman's rank correlation coefficients. Peak number of drinks and alcohol-related consequences (RAPI total score) across follow-up (3-, 6-, 9-, and 12-months) were assessed as primary study outcomes. Both drinking outcomes are non-negative discrete integers and showed non-normal distributions. Mixed effects (also known as random effects, hierarchical linear or multilevel) models were used to account for the correlation of repeated observations within individuals by allowing the intercept to vary by participants (Atkins, 2005). To account for the skewed distributions, count regression models were used. For peak drinking as an outcome, Poisson mixed effects models were performed.

Alcohol consequences, in addition to being non-normally distributed, showed an excess number of zeros (i.e., participants reporting no alcohol consequences) which would lead to poor model fit when using standard Poisson or negative binomial count regression. To account for the excess zeros, we used hurdle mixed effects models for analyses of this outcome (Hilbe, 2007; Atkins et al., 2013). Hurdle models fit two separate regression models: a logistic regression model that examines the likelihood of any non-zero value (i.e., any consequences vs. no consequences) and a truncated count regression model, in this case a negative binomial model, that analyzes the non-zero counts. Count regression uses a natural log link function to connect covariates to the outcome. Regression coefficients are typically exponentiated (i.e., e^{β}) and interpreted as rate ratios (RRs) that describe the proportional change in the count associated with a 1-unit increase in the covariate.

For analyses of both outcomes, we included study visit (i.e., follow-up time point) as a continuous covariate (0: 3-month; 1: 6-month; 2: 9-month; 3: 12-month). Dummy coding for study visit was considered, but drinking over time showed a reasonably linear trend and inclusion of dummy coded study visit did not significantly improve model fit over the continuous coding. Other covariates included the baseline level of the outcome (peak number of drinks or total RAPI score) and sex (Male: 0; Female: 1). We also included intervention assignment as a covariate, but collapsed the 5 intervention arms into a single group (0: control; 1: any intervention). Tests of interactions between 21st birthday drinking and time (study visit), and 21st birthday drinking and baseline level of typical drinking were

assessed in separate models with intervention assignment and gender added in the model as covariates.

Participants missing covariate data and/or all data on the outcome (i.e., missing all follow-up data for peak drinking or alcohol consequences) were excluded from respective analyses. Of the 584 participants who completed the 1-week post-birthday assessment, the final sample size was 579 (99.1%) for analyses of long-term peak drinking and 577 (98.8%) for analyses of consequences.

Descriptive statistics were run in Stata 12.0 (Stata Corporation, College Station, TX), and count regression mixed effects models were performed in R, version 2.14 (R Core Team, Vienna, Austria) using the “*lme4*” package (Bates, 2009) for analyses of peak drinking and the “*glmmADMB*” package for analyses of consequences (Fournier et al, 2012).

Results

Table 1 presents demographic characteristics and distribution of key study variables for those participants included in the analyses. The mean number of 21st birthday drinks consumed was 9.6 (SD = 6.5). The mean peak number of drinks consumed on the highest consumption day in the past 3 months prior to baseline was 7.3 (SD = 4.8) and the mean RAPI score at baseline was 7.5 (SD = 9.9).

Rate ratios from Poisson mixed effects models for peak drinking over the course of follow-up according to 21st birthday drinking as well as other covariates are shown in Table 2. Individuals who consumed more alcohol on their 21st birthday reported a higher number of peak drinks over the course of follow-up after adjusting for baseline level of peak drinks, sex, study visit, and intervention condition ($RR = 1.100$; 95% CI: 1.047, 1.155; $p < .001$). When testing interactions, we observed that this association varied over time (interaction- $p = .026$) such that the magnitude of the association diminished from 3- to 12-month follow-up. Despite this attenuated association later in time, higher 21st birthday drinking remained significantly associated with peak drinking at 12-month follow-up ($RR = 1.063$; 95% CI: 1.004, 1.126; $p = .037$). We also observed a statistically significant interaction between 21st birthday drinking and baseline level of peak drinking ($p < .001$). The effect of 21st birthday drinking on later peak drinking was strongest among those who reported lower levels of peak drinking at baseline (e.g., RR for those reporting no drinking at baseline = 1.17; 95% CI: 1.11, 1.24; $p < .001$) compared to those with higher levels of peak drinking (e.g., RR for those reporting 10 drinks at peak occasion = 1.09; 95% CI: 1.04, 1.14; $p < .001$).

Table 3 shows hurdle mixed model regression estimates for associations between 21st birthday drinking and alcohol-related consequences. When examining the logit portion of the model, 21st birthday drinking was associated with a higher likelihood of any non-zero consequences score ($OR = 2.30$; 95% CI: 1.57, 3.35; $p < .001$). This association did not vary over time (interaction- $p = .36$) or by baseline level of consequences (interaction- $p = .22$). When examining the count portion of the model among those with non-zero RAPI scores, individuals who drank more on their 21st birthday had higher levels of consequences over the course of follow-up ($RR = 1.13$; 95% CI: 1.01, 1.27; $p = .027$) after adjusting for

baseline level of consequences and other covariates. Similar to the peak drinking findings, a statistically significant time interaction was observed where the association between 21st birthday drinking and alcohol consequences became attenuated over the course of follow-up (interaction- $p = .011$); at 12-months there was no longer any statistically significant association ($RR = 1.03$; 95% CI: .91, 1.18; $p = .63$). There was no statistically significant interaction between 21st birthday drinking and baseline levels of drinking or consequences.

Discussion

Engaging in heavy drinking during specific events, such as one's 21st birthday (BD), is a well-known and risky phenomenon among college students (Bristol et al. 2010; Neighbors et al. 2005, 2011; Weatherill & Fromme, 2009). The current study tested the extent to which heavy drinking during the 21st birthday celebration predicts a more general increase in peak alcohol use and negative consequences over the subsequent year. Those who consumed more alcohol on their 21st birthday reported higher peak consumption throughout the remaining year, controlling for baseline peak alcohol use prior to the 21st birthday, reported increased likelihood of at least one alcohol-related negative consequence throughout the follow-up period, and reported an increased number of alcohol-related consequences up to 9-months post-birthday. Further, baseline peak alcohol consumption moderated the relationship between 21st birthday consumption and follow-up peak drinking, such that those who drank less on their peak occasion at baseline prior to their BD showed the strongest effects of 21st BD excessive consumption on later alcohol consumption.

Results suggest that a single day of heavy drinking, often viewed as a rite of passage into legal drinking age, can have effects on subsequent drinking patterns. Given that the effect on peak alcohol consumption at follow-up was strongest for those who drank less at baseline, it may be that the experience of heavy drinking on the 21st BD serves as a gateway into subsequent heavy drinking among those who have not previously engaged in this behavior. Although there was less impact of 21st BD drinking on subsequent drinking patterns for students who routinely drank more prior to their birthday, this was not true of effects for subsequent negative consequences. Rather, students who drank heavily on their 21st BD experienced more harmful consequences of their drinking in subsequent months regardless of their baseline level of drinking, in addition to acute consequences such as vomiting, black-outs, and alcohol poisoning incidents already associated with the 21st BD celebration itself (Lewis et al. 2009; Weatherill & Fromme, 2009), demonstrating the longer-range public health significance of intervening to reduce drinking associated with the 21st BD for all students.

Recently, researchers and colleges have begun to target the 21st BD with event-specific prevention approaches, motivated primarily by concerns regarding acute harmful consequences of drinking on this occasion (LaBrie, Migliuri, & Cail, 2009; Lewis et al., 2008; Neighbors et al., 2005; Neighbors et al. 2012; Smith, Bogle, Talbott, Gant, & Castillo, 2006). Although several approaches have been tried, only recently have researchers identified efficacious approaches involving provision of brief, personalized feedback regarding general and event-specific drinking norms, discussion of harmful consequences, and protective behavioral strategies to avoid harmful consequences on the 21st BD and more

generally (Neighbors et al., 2009; 2012). Both web-based and in-person interventions utilizing these approaches are timed to occur just prior to the 21st BD and have shown some evidence of efficacy, with some support also shown for the inclusion of friends likely to accompany the participant during the 21st BD in the intervention (Neighbors et al. 2012). The current study would suggest such interventions may benefit from including information regarding longer-term impacts on drinking patterns and consequences related to heavy drinking on the 21st BD, and by targeting not only those students who typically drink to excess but also those who typically drink in low to moderate amounts but are at risk for excessive consumption associated with the 21st BD celebration.

The current findings suggest the utility of event-specific alcohol interventions, such as 21st BD interventions, may extend beyond the acute harms associated with the event itself and have the potential to prevent increases in risky alcohol use and related harmful consequences over an extended period of time. Given that these events are known in advance, represent a specific window of risk, and are associated with longer-term harmful drinking patterns, targeted event-specific prevention approaches may have greater utility and thus be more cost-effective than previously believed.

Limitations

The current study has several limitations. First, all data are based on self-report, which can be subject to problems with reliability and validity. Steps to increase reliability and validity of self-report in the current study included use of well-validated standardized measures of all predictor and outcome variables, assurances of confidentiality for all participants, obtaining a federal Certificate of Confidentiality to protect the security of research data from subpoena, and use of web-based assessments which has been shown to increase likelihood of reporting stigmatizing or illegal behaviors particularly among adolescents and young adults. An additional limitation is that all data are from a single campus, which may limit generalizability of the findings. Another limitation to generalizability is the inclusion criteria for the study. Students had to be intending to drink 5/4 (male/female) for their 21st BD, thus the study results are based on a specific sub-population of high-risk students that intended to engage in heavy episodic drinking during their 21st BD celebration, and may not apply to moderate drinkers. Additional studies replicating these findings and broadening both the scope (i.e. different campuses) and population (include all levels of drinkers) are needed to increase confidence in the generalizability of the findings. Data are taken from a RCT of event-specific prevention, thus although intervention condition was controlled for in analyses, it's possible that stronger relationships between baseline drinking, 21st BD drinking, and follow-up drinking and consequences would be found if a larger sample of students who had received no prior intervention was included. The current findings likely represent a conservative estimate of those relationships.

Future directions

The results from the present paper have interesting theoretical and practical implications for future research, including understanding the mechanisms by which alcohol use on 21st birthdays leads to increased use in the subsequent year, especially for lighter drinkers. Did they have a good time on 21st BD? Did their norms change as a result of 21st BD drinking?

More specific research is needed on how event specific drinking interventions can reduce or prevent both drinking during the event itself and on longer term drinking after the event is over.

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Highlights

- Examines impact of 21st birthday drinking (BD) on subsequent drinking and problems
- Regression analysis revealed higher 21st BD had subsequent higher peak drinking
- Higher 21st BD had increased likelihood of and number of consequences in year
- Less baseline peak drinks had strongest effect of 21st BD on subsequent consumption

Table 1

Demographic and baseline characteristics of study sample

Characteristic	n (%) or mean (SD)
Female sex	314 (54.2)
Race/ethnicity	
White, non-Hispanic	379 (68.7)
African American, non-Hispanic	12 (2.2)
Asian American, non-Hispanic	82 (14.9)
Other, non-Hispanic	53 (9.6)
Hispanic, any race	26 (4.7)
Any intervention condition	484 (83.6)
Baseline peak number of drinks in past 3 months	7.3 (4.8)
Baseline RAPI score	7.5 (9.9)
Number of drinks on 21 st birthday	9.6 (6.5)

Table 2

Rate ratios for peak drinking over follow-up according to covariates

Covariate	RR	95% CI	p-value
Intercept	5.463	4.695, 6.355	<.001
21 st birthday drinks	1.100	1.047, 1.155	<.001
Baseline peak drinks	1.057	1.049, 1.065	<.001
Intervention	.964	.890, 1.046	.380
Female sex	.839	.786, .894	<.001
Study visit (time)	.993	.978, 1.007	.314

Table 3

Odds ratios and rate ratios from hurdle mixed models for alcohol consequences.

Covariate	Logit model for any consequences			Count model for RAPI score among non-zero counts		
	OR	95% CI	p-value	RR	95% CI	p-value
Intercept	1.677	.557, 5.045	.36	3.168	2.184, 4.594	<.001
21 st birthday drinks	2.296	1.574, 3.348	<.001	1.134	1.014, 1.267	.027
Baseline RAPI	1.178	1.131, 1.226	<.001	1.051	1.043, 1.059	<.001
Intervention	1.100	.543, 1.879	.97	.790	.642, .973	.026
Female sex	.833	.515, 1.350	.46	.937	.797, 1.101	.427
Study visit (time)	.790	.702, .889	<.001	.999	.967, 1.033	.965