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Turning 21 and the Associated Changes in Drinking and Driving after Drinking Among College Students

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Abstract

Objective—We examined drinking and driving after drinking before and after turning 21.

Participants—Participants were drawn from first time college students who were taking part in a 4-year longitudinal study of alcohol use and behavioral risks.

Methods—Web-based longitudinal surveys collected data on drinking and driving after drinking from August 2004 through November 2007 (n = 1817). A subset of participants (n = 224) also monitored their daily behavior during the month they turned 21 (January through May, 2007).

Results—Typical frequency and quantity of alcohol use increased from ages 18 to 21 years, whereas quantity decreased between 21 and 23 years of age. Driving after drinking showed a 72% relative increase (6% absolute increase) in the two weeks after turning 21.

Conclusions—Reaching the legal drinking age is associated with decreases in the amount of alcohol consumed per drinking occasion, but an increase in driving after drinking.

Although most students arrive on college campuses with some drinking experience, alcohol use and alcohol-related negative consequences increase during the early college years.^{1,2} For example, 70% of college-enrolled youth report drinking alcohol on a monthly basis³ and 44% report binge drinking (defined as the consumption of four or more drinks for women and five or more drinks for men during a single drinking occasion) at least once during the previous two week period.⁴ In addition, approximately 2.8 million college students (ages 18-24) report driving under the influence of alcohol⁵ and over 1,800 die annually from unintentional alcohol-related injuries.⁶

Despite the high overall rates of collegiate drinking, there is also significant variability in students' drinking patterns over time. About 1 in 3 college students reliably increase their alcohol use and related problems throughout the college years, another third do not change, and a third reliably decrease in these areas.⁷ In their 7-year longitudinal study of college students, Sher and colleagues also noted that individuals moved into and out of large effect drinking patterns over the course of their college years and beyond graduation.⁸ Developmental changes are associated with this variability in alcohol use during college.⁹

An especially important developmental milestone during the college years is reaching the legal age to purchase and consume alcohol in the United States. Considered a rite of passage by many emerging adults, the 21st birthday is typically an occasion of excessive alcohol consumption, with blood alcohol concentrations often reaching more than twice the legal

limit of intoxication.¹⁰ Surprisingly little is known, however, about the overall effects of “becoming legal” on subsequent alcohol use among college drinkers.

Reaching the legal drinking age could increase consumption through increased accessibility. Clearly the extent to which alcohol is available to college students is a large determinant of their drinking.¹¹ The ability to purchase alcohol from bars, liquor stores and restaurants (either with or without a fake I.D.), as well as the presence of alcohol at parties, tailgates and Greek events ensures high alcohol availability even for under-age drinkers. The ability to legally purchase alcohol should only increase that accessibility, and thereby possibly increase consumption.

On the other hand, because alcohol is no longer a forbidden fruit, it may lose its allure and consumption could decrease upon turning 21.¹² According to reactance theory,¹³ the act of rebellion against the law may contribute to excessive underage drinking. Consistent with this perspective, a study of 2142 college students found that underage students drank more heavily than their legal-age peers.¹⁴ Because this study was cross-sectional, however, differences between the two groups may stem from being members of different cohorts.

Questions also remain about the effects of legal access to alcohol on related behavioral risks, such as driving after drinking. By 1988, all states in the U.S. had raised their legal drinking age from 18 to 21 years and an analysis of 57 published studies on the effects of this change concluded that higher legal drinking ages reduced alcohol-related vehicle crashes.¹⁵ Although some argue that this decrease was related to tougher drunk driving penalties, enforcement of stronger sanctions does not sufficiently explain the drop in alcohol-related driving fatalities when the legal age was increased. There may instead be developmental differences between 18 and 21 year olds that contributed to these changes in alcohol-related driving.

The current research addresses critical questions about what happens when college students turn 21. Longitudinal assessment of 1817 college students (ages 18 to 23) allowed an examination of their alcohol use and driving after drinking across time and, more importantly, at the critical juncture of reaching 21 years of age. Daily monitoring by 224 of these individuals further allowed a detailed day-by-day examination of behavior immediately before, on, and after their 21st birthdays. As such, the current research provides the most detailed longitudinal and event-level examination to date of the alcohol use and drinking and driving behavior of college students before and after they “become legal.”

Method

Recruitment and Procedures

Initial eligibility for the project was limited to unmarried, first time college students, between the ages of 17 and 19 years of age who were admitted to a large public university for the fall of 2004. Student status and birthdates were obtained from official information provided by the Registrar’s Office, and participants were recruited from 6391 eligible students during the summer before they began college (see Corbin, Vaughan, and Fromme¹⁶ for additional recruitment information). Of 4832 (75.6%) who agreed to be contacted, 2985 were randomly assigned to an annual assessment condition, and 2247 (72.6%) provided on-line consent via a secure server. These longitudinal participants then completed web-based surveys about the last 3 months for their senior year of high school, each college semester for their freshman, sophomore, and junior years of college, and a single survey about the fall semester of their senior year of college. For completing these surveys, participants were paid \$35 for high school, \$20 for fall of freshmen, sophomore, and junior years, \$25 for all spring assessments, and \$40 for the single senior year assessment.

All longitudinal participants were also randomly assigned once annually to complete 30 consecutive days of web-based daily monitoring. They were paid \$1 for each day of monitoring and received a \$30 bonus if they completed all 30 consecutive days. For more information on the daily monitoring portion of the study, see Neal and Fromme.¹⁷ All survey and monitoring procedures were approved by the university's Institutional Review Board.

Measures

Demographic information, including gender, ethnicity, and birth date was collected as part of the web-based surveys.

Typical Alcohol Use—The Daily Drinking Questionnaire (DDQ)¹⁸ was used to collect information about typical alcohol consumption during the 3 months prior to each survey assessment. For each day of the week, respondents indicated the number of standard drinks they typically consume on that day. A standard drink was defined as 12 ounces of beer, 5 ounces of wine, and 1 shot of liquor (straight or in a mixed drink). Frequency of drinking was the number of days each week that alcohol was typically consumed, and quantity of consumption was the average number of drinks consumed per drinking day. Test-retest reliability of the DDQ is excellent (one week $r = .90$).

Monitored Daily Alcohol Use—At login, participants were presented with a 30 day calendar for their monitoring period, but they had access to only the current seven day period. For each day participants provided the number of discrete drinking occasions and the number of standard drinks consumed for the previous day/night. All reports were time and date stamped, and previous analyses have indicated no data degradation based on limited retrospective reporting.¹⁷

Driving after Drinking—Using items from the Cognitive Appraisal of Risky Events scale,¹⁹ surveys prompted participants to indicate the frequency with which they “drove home from a bar or party after drinking,” “drove after having 1-3 alcoholic beverages,” and “drove after having 4 or more alcoholic beverages” during the past 3 months (response options were 0, 1, 2, 3-5, 6-10, 11-20, and 20+ times). An average of these three items formed a composite variable for driving after drinking (Cronbach's $\alpha = 0.92$). For the daily monitoring assessment, participants reported whether they drove after drinking on the preceding day/night.

Statistical Analyses

Non-normal distributions in alcohol consumption and driving after drinking were log transformed to normalize the distributions. Longitudinal analyses used Hierarchical Linear Modeling (HLM; version 6.0)²⁰ to model individual change in alcohol consumption and driving after drinking between ages 18 to 23. We tested unconditional growth models for the frequency and quantity of drinking and for the frequency of driving after drinking predicted by age, to determine whether there was significant within-subject variability in these outcomes over time. Separate models assessed the three outcome variables from 18 up to 21 years of age and then from 21 to 23.

Analysis of daily monitoring data was conducted on daily drinks per drinking occasion and driving on drinking occasions. Analyses were implemented using Generalized Estimating Equations (GEE)²¹ with days nested within individuals and using an autoregressive covariance matrix. Focused tests contrasted event-level behaviors in the 2 weeks prior to the 21st birthday, on the 21st birthday, and in the 2 weeks following the 21st birthday.

Results

Changes in Alcohol Use and Driving after Drinking from 18 to 23 Years of Age Participant Description

Of 2247 individuals in the longitudinal sample, data from 1817 were included in the longitudinal analyses. This sample represents the usable number of responses due to nonparticipation at more than two follow-ups ($n = 348$) or missing data at baseline ($n = 82$); thus, participants were included in final analyses if they provided data during 3 or 4 years of data collection. This approach for handling missing data is appropriate given that HLM yields unbiased parameter estimates when data are missing at random (MAR) or missing completely at random (MCAR). The longitudinal sample comprises 63% women, 54% Caucasian, 18% Asian, 15% Hispanic, 7% Multi-ethnic, 4% African American, 0.5% Pacific Islander/Native American, and 1.5% not reporting ethnicity. Comparisons between this sample and the incoming freshman population revealed non-significant differences (all $ps > .05$), indicating similarity to the population from which it was drawn. Table 1 provides descriptive data for frequency and quantity of drinking from ages 18 to 23.

Longitudinal Analysis of Alcohol Use

Unconditional growth models for frequency and quantity of alcohol use during the years prior to turning 21 showed significant intercepts ($p < .001$) and slopes ($p < .001$). Significant fixed effects for the slopes indicated increases in both drinking frequency, $t_{1816} = 19.26$, $p < .001$, and quantity of alcohol consumed from ages 18 to 21, $t_{1816} = 8.31$, $p < .001$. Analyses of change over time after turning 21 again indicated significant intercepts ($p < .001$) and slopes ($p < .001$). Fixed effects of slopes for drinking frequency were not significant ($p = .24$), but they were significant for quantity, indicating decreases in quantity of alcohol consumed after the 21st birthday ($p < .05$). See Figure 1 for frequency and quantity of drinking across time.

Longitudinal Analysis of Driving After Drinking

Abstainers were not included in the growth models for driving after drinking. Both models (i.e., before and after turning 21) indicated significant variance components for intercepts ($p < .001$) and slopes ($p < .001$). In addition, significant fixed effects for the slopes reflected increases for driving after drinking from ages 18 up to 21, $t_{1229} = 3.25$, $p < .001$, and again after turning 21, $t_{1229} = 2.90$, $p < .004$. Mean levels of driving after drinking increased 5% per year prior to turning 21 and 18% per year after turning 21. These numbers indicate that over the previous 3 months individuals drove after drinking approximately 1-2 times prior to 21 years of age, but approximately 2-3 times after turning 21. See Figure 2 for the mean frequency of driving after drinking at each age.

Daily Alcohol Use and Driving after Drinking Before and after Turning 21 Participant Description

A subsample of the longitudinal participants ($n = 224$) also provided daily monitoring during the month they turned 21 years of age, but only participants who reported drinking ($n = 113$) were included in analyses of the daily monitoring data. This subsample was 65% female, with an ethnic representation of 56% Caucasian, 13% Asian American, 12% Hispanic/Latino, 4% African American, and 15% mixed or other ethnicities.

Event-level Analysis of Alcohol Use Before, on, and After the 21st Birthday

Analyses of the daily monitoring data surrounding the 21st birthday indicated that participants consumed an average of 4.5 ($SD = 3.6$) drinks per drinking occasion in the 2 weeks prior to their 21st birthday, 7.4 ($SD = 6.1$) drinks on their 21st birthday, and 4.8 ($SD =$

3.7) drinks per drinking occasion in the 2 weeks after their 21st birthday. The 21st birthday was a significantly heavier drinking day relative to drinking days before turning 21 ($n = 113$, $z = 4.77$, $p < .001$) and after turning 21 ($n = 113$, $z = 4.98$, $p < .001$). There was no difference, however, between daily drinks per drinking occasion 2 weeks before or 2 weeks after the 21st birthday ($n = 113$, $z = 1.04$, $p = .30$). Rates of drinks per drinking day across all 29 days are presented in Figure 3.

Event-level Analysis of Driving after Drinking Before, on, and after the 21st Birthday

Driving occurred on 8.7% of drinking occasions in the 2 weeks before turning 21, 2.9% of drinking occasions on the 21st birthday, and 15.0% of drinking occasions in the 2 weeks after the 21st birthday. Rates of driving after drinking on the 21st birthday were not significantly different from those before turning 21 ($n = 112$, $z = 1.24$, $p = .22$), but were significantly lower than rates of driving after drinking after turning 21 ($n = 112$, $z = 2.37$, $p = .02$). Rates of drinking and driving before and after turning 21 were also significantly different ($n = 112$, $z = 1.96$, $p = .05$), with a greater prevalence of driving after drinking after the 21st birthday. Driving after drinking across all 29 days is presented in Figure 4.

Comment

Longitudinal surveys of 1817 college students from ages 18 to 23 indicated that their typical frequency and quantity of drinking increased from 18 to 21 years of age, whereas the amount they consumed per drinking occasion decreased from 21 to 23 years. Driving after drinking increased across the entire age range of 18 to 23, but there was a larger increase from 21 to 23 than from 18 to 21 years. Daily monitoring by 224 of the longitudinal participants during the month they turned 21 revealed an overall 6% increase, which is a 72% relative increase, in driving after drinking in the two weeks after they reached the legal drinking age. Thus despite a reduction in the typical amount of alcohol consumed per drinking occasion, the frequency of driving after drinking increased. Although many reports on college drinking do not distinguish between those under and over the legal age to purchase and consume alcohol,⁴ our findings indicate that the patterns and consequences of drinking may differ in important ways among under-age and legal-age college students.

Our finding of greater quantity of alcohol consumed per drinking occasion prior to age 21 is consistent with a binge style that often characterizes underage drinking.²² This includes consuming large quantities of alcohol prior to attending events where youth do not have legal access to alcohol.²³ Referred to as “pre-gaming” or “pre-partying,” this style of consumption contributes to high blood alcohol concentrations and increases the risk of alcohol poisoning.^{24,25} Our finding that amount consumed per drinking occasion decreased after turning 21 suggests that older students may not feel compelled to “pre-party” as when they had more limited, illegal access. Although our findings also indicated that legal age drinking occurs as frequently as underage drinking, the fact that it involves lower amounts of alcohol per drinking occasion may be a safer style of consumption.

When students are no longer dependent upon older friends or others to provide them with alcohol, they can express greater autonomy in decisions about when and where to drink. Unfortunately our findings suggest that as students become able to purchase alcohol legally, they may also drive to their drinking locations, for example to bars and clubs. The risks of driving-related accidents are therefore increased for legal-age drinkers.

Spanning the ages of 18 to 23 and the transition from under-age to legal-age drinking, the current study covered a period of time in which a number of important developmental events have implications for drinking. In addition to reaching legal status for alcohol, many 21 year olds are also beginning to place a greater focus on achieving academic and career success.

As with previous studies that have shown a gradual decrease in heavy drinking in the later years of college,⁷ we observed a decrease in the amount of alcohol students consumed after they turned 21. It will be important for future research to determine whether this lower quantity of consumption is related to students' legal status, other socio-environmental factors (e.g., changes in peer groups) or a general "maturing out" process.²⁶ Moreover, additional longitudinal studies are needed to more precisely parse the effects of age and developmental milestones (like turning 21) on changes in other behavioral risks such as driving after drinking.

The differences we observed in the patterns of drinking and driving after drinking among underage and legal-age drinkers suggest possible changes in the content and delivery of existing intervention efforts. For example, successful multi-component college prevention efforts frequently provide students with individualized feedback about their alcohol use in relation to the normative consumption of other students,²⁷ with the effectiveness of this feedback being greatest when the referent is most similar to the recipient.²⁸ Our findings suggest that the effectiveness of individualized feedback might therefore be enhanced by use of age-specific norms that recognizes the different patterns of consumption by underage and legal age students.

Our findings also suggest that recent efforts to target events (e.g., 21st birthdays and spring break) and activities (e.g., pre-gaming and drinking games) which promote consumption of large amounts of alcohol are best focused on underage drinkers.^{23,29,30} On the other hand programs to prevent driving after drinking might achieve maximal effectiveness by targeting individuals who are turning 21. As they become more likely to drink in locations that require transportation, students might be encouraged to make alternative plans before they begin drinking. The fact that students can and do make alternative transportation plans was evident in the current study, with only 2.9% of students driving on their 21st birthday, compared to 8.7% who drove in the two weeks before their 21st birthday and 15% who drove in the two weeks after turning 21. By discouraging the most dangerous drinking practices among underage students (e.g., pre-partying) and legal-age students (e.g., driving after drinking), college programs can best reduce the overall risks associated with college alcohol use.

Limitations and Conclusions

Despite being the first longitudinal study to illustrate the effects of turning 21 on drinking and on driving after drinking among college students, several important limitations should be noted. First, the study is limited to a single cohort of students at a large public university. Regional differences in 21st birthday celebrations have been noted³¹ and such differences may extend to drinking and driving practices. Although our sample is more ethnically diverse than most longitudinal studies of college students (with up to 88-90% Caucasians^{32,33}), it is still comprised of 54% Caucasians and a majority of women. The data are also limited to self-report, which may be susceptible to social desirability. Other research, however, has found that self-reports are reliable whenever confidentiality is assured³⁴ and that collateral reporters of drinking behavior are no more accurate than self-report.³⁵

In conclusion, as students transition from being underage to legal age drinkers, they also experience different risks. Pre-partying represents a particularly high risk for underage drinkers, whereas driving after drinking may be the greatest risk for legal age drinkers. Thus, educators and prevention specialists might focus greater attention on the development of targeted, age-specific prevention programs for the particular risks that dominate underage and legal age alcohol use by college students.

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Figure 1.
Typical Frequency and Quantity of Alcohol Consumption over Time

Figure 2.
Frequency of Driving After Drinking over Past 3 Months at Each Age

Figure 3.
Prevalence Rates of Monitored Daily Drinking

Figure 4.
Prevalence Rates of Monitored Driving after Drinking

Table 1

Descriptive Data for Alcohol Use

	Age 18		Age 19		Age 20		Age 21		Ages 22-23	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Number of Drinking Days per Week	1.02	1.28	1.34	1.44	1.43	1.46	1.98	1.71	2.01	1.77
Number of Drinks per Drinking Day	1.58	2.05	2.01	2.15	2.01	2.30	2.25	2.27	2.16	2.03