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High-intensity drinking and hours spent drinking

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Abstract

Background—High-intensity drinking (HID) is associated with negative consequences, but it remains unclear whether a time qualifier (i.e., time spent drinking) is needed to identify those at highest risk. In order to improve the measurement and conceptualization of HID, we sought to examine the utility of adding a time qualifier to define what constitutes an occasion of HID using repeated daily surveys in a sample of young adults.

Methods—Participants were selected from a nationally representative sample of 12th grade students in the U.S. who participated in the Monitoring the Future (MTF) study in Spring 2018. In 2019 and 2020, young adults (at modal ages 19-20) responded to annual and daily (14 consecutive days per year) online surveys about their alcohol use.

Results—Comparing moderate drinking (less than 4/5 drinks for women/men), binge drinking (4-7/5-9 drinks), and HID days (8+/10+ drinks), HID days had the longest duration of drinking (5.2 hours), highest peak estimated blood alcohol concentration (eBAC, 0.30%), and greatest drinking pace (2.58 drinks/hour). HID was associated with a greater number of negative consequences relative to both moderate and binge drinking; adjusting for time spent drinking did not impact this interpretation. HID was reported on 10.9% of days; when defined as 8/10+ drinks in 4 hours or 2 hours, HID was reported on 4.8% and 1.0% of days, respectively. Nearly all differences in eBAC and negative consequences persisted across drinking intensity despite the introduction of time constraints.

Conclusions—HID days were characterized by both a longer time spent drinking and a higher pace of drinking. Adding a time qualifier to the definition of HID would restrict variability by only describing the minority of days and did not improve distinguishing between levels of risk.

Keywords

alcohol; binge; high-intensity; drinking pace; blood alcohol

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Introduction

Alcohol use among young adults is a leading cause of morbidity and mortality, making it a costly threat to public health (Hingson et al. 2009; 2017). Drinking heavily poses both acute (i.e., impaired driving, injury, passing out, death) and long-term (i.e., alterations to the developing brain, liver damage, development of alcohol use disorder, early mortality) risks among the young adult population (Connor et al. 2016; Evans-Polce et al. 2022; Patrick & Azar 2018; SAHMSA 2022). Because risk for acute consequences increases exponentially when consuming large quantities of alcohol, researchers have called for increased attention to the measurement of high-intensity drinking (HID), consuming 10+ drinks in a row (or 8+ for women and 10+ for men; Hingson & White 2013; NIAAA 2017; Patrick 2016; Patrick et al. 2013).

HID is a relatively common behavior among young adults; in 2021, over 1 in 10 young adults aged 19-30 reported engaging in HID in the past 2 weeks, a historic high since 2005 (Patrick et al. 2022). About half of all young adults who engage in binge drinking also report HID (Hingson et al. 2017; Patrick & Terry-McElrath 2017) and the average number of drinks consumed by young adults aged 18-24 during a binge drinking occasion is 9.5 drinks, or 10.1 for men and 8.1 for women (Naimi et al. 2010). Furthermore, national data demonstrate that HID peaks at age 21/22 and sharply declines thereafter, suggesting risk is concentrated in the early 20s (Patrick et al. 2016; Terry-McElrath & Patrick 2016).

HID among young adults is risky and concerning. Yet, some researchers have questioned whether it is not the amount that young people are drinking, but the specific patterns of drinking (e.g., rate of consumption) that puts them at risk of consequences (Kuntsche et al. 2015). This has been reflected in changes to definitions of binge drinking over time. For decades, binge drinking was defined as 5 or more drinks in a single session, measured in this manner by multiple large longitudinal studies including Monitoring the Future (MTF; Patrick et al. 2022), the Behavioral Risk Factor Surveillance System (BRFSS; CDC 2022), Youth Risk Behavior Surveillance System (YRBSS; Mpofu 2020), and National Survey on Drug Use and Health (NSDUH; SAMHSA 2022). Sex-specific values (4+ drinks for women and 5+ drinks for men) were adopted by BRFSS and the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) following evidence regarding sex differences in weight and alcohol metabolism (Weschler et al. 1994). This definition was further refined by NIAAA in 2004 to include a time limit: i.e., consuming 4+/5+ standard drinks for women/men within a 2-hour period (NIAAA 2004). The time qualifier was added in hopes of more accurately reflecting drinking occasions that resulted in a blood alcohol concentration (BAC) of 0.08% or greater and, thus, would be more predictive of negative consequences. While sex-based HID cutoffs of 8+ for women and 10+ for men have been suggested and examined in the literature, whether a time qualifier would further refine the definition remains an open question.

No studies to date have examined the utility of a time qualifier for HID, although this type of research is needed (Patrick 2016). Related research has examined the utility of the 2-hour limit for binge drinking. Other research has investigated drinking pace, rate, or speed more broadly. Studies examining binge drinking definitions suggest that the addition of a

time frame does not improve predictive utility of reaching a BAC of 0.08% or negative consequences. For example, one study of individuals surveyed as they were leaving a bar found that those who reported drinking 4+/5+ drinks within 2 hours had a lower BAC than those who reported drinking 4+5+ drinks over a longer time period (Beirness et al. 2004). Furthermore, of those who reported drinking 4+/5+ drinks, only 7% did so in two hours, suggesting the time-qualifier may exclude the majority of heavy drinking episodes (Beirness et al. 2004). Corbin and colleagues (2014) examined relationships between 4+/5+ definitions with and without the time qualifier with frequency of drinking to an eBAC of 0.08% and with negative consequences of alcohol use. Among both social and heavy (4+ occasions of binge drinking in the past 28 days) drinkers, defining binge drinking as occurring in a two-hour time period did not increase the association between frequency of binge drinking and eBAC of 0.08%, compared to defining binge drinking without a time qualifier (Corbin et al. 2014). Furthermore, the binge measure without a time qualifier was a better predictor of negative drinking consequences across both social drinking and heavy-drinking samples (Corbin et al. 2014).

Other work investigating the pace or rate of consumption suggests there are particularly high levels of risk associated with consuming “too much, too fast” (Leeman et al. 2010; Li et al. 2007). Higher drinking rate accelerates the rise of BAC due to a greater alcohol concentration gradient, which can lead to individuals spending more time at higher BACs, experiencing greater acute cognitive impairments, and taking more risks (Bernosky-Smith et al. 2012; Cederbaum 2012; Jones & Vega 1972; Moskowitz & Burns 1976). Using daily-level data, Kuntsche and colleagues (2015) found that individuals who accelerated their drinking rate across an evening experienced more negative consequences. Similarly, Carpenter and Merrill (2021) found that the amount of alcohol consumed and rate of consumption were both associated with greater likelihood of experiencing a negative consequence (e.g., blackout, hangover) the next morning. Finally, Gunn et al. (2022) found that both consuming more drinks during the peak hour of drinking and faster daily rate of drinking were associated with experiencing negative consequences, even when controlling for the amount of alcohol consumed. Taken together, these findings suggest that accounting for the rate of drinking is important when assessing risk for negative alcohol consequences. However, adding a specific time period to qualify drinking threshold definitions may actually limit predictive ability as any time period would be somewhat general and arbitrary. The current study is the first examination of whether the addition of a time qualifier would improve measurement of HID.

In order to improve the measurement and conceptualization of HID, we sought to examine the utility of adding a time qualifier to define what constitutes an occasion of HID using repeated daily surveys in a sample of young adults (modal ages 19-20). Our research questions were (1) what is the typical number of hours over which HID is reported, (2) to what extent does controlling for number of hours spent drinking affect associations between HID and consequences, and (3) does the addition of a specific time qualifier for HID lead to differences in the occurrence of HID days, mean eBAC, or negative consequences?

Methods

Sample & Procedures

Data came from the Young Adult Daily Life (YADL) study, which follows adolescents across the transition to adulthood. YADL participants were drawn from a sample of nationally representative 12th grade students (N=14,502) in the U.S. who participated in the Monitoring the Future (MTF) study in Spring 2018 (see Miech et al. 2019 for detailed methodology on the MTF 12th grade study procedures). Participants were eligible if they were not selected for the MTF longitudinal study (for detailed MTF panel study methods, see Patrick et al. 2022), and if they reported past 30-day alcohol use in 12th grade. Of the 4,240 MTF 12th grade respondents who reported past 30-day drinking, 828 were excluded because they were randomly selected for participation in the MTF longitudinal study. An additional 1,208 were excluded for not providing contact information necessary for follow-up, resulting in 2,204 eligible YADL participants. Out of the 2,204 individuals eligible to participate in YADL, the final analytic sample for the current project included a total of 609 participants (59.3% male; 66.8% non-Hispanic White, 20.8% Hispanic, 12.4% non-Hispanic and another or multiple race/ethnicity categories) with 1,938 drinking days. The analytic sample was constructed by including participants who had any daily data in either 2019 or 2020 and who reported drinking on at least one day. However, pair-wise deletion was used for missing data, with the smallest sample for any analyses being 1,923 days and 605 individuals. The average age of the sample at the time of data collection in 2020 was 20.3 years (SD=0.40).

Response to the daily surveys was good: among participants who completed any daily survey, over 78% completed at least 11 of 14 daily surveys in both 2019 and 2020. The majority (75%) of participants who completed daily surveys completed all 14 daily burst surveys. We included only drinking days that occurred prior to the onset of the COVID-19 pandemic to reflect drinking days that are more generalizable and not potentially influenced by the early stages of the pandemic when daily life was substantially altered. Most data collection occurred before the pandemic onset, with only 7.6% of all days of data (N=1,384) collected during the pandemic. Further, we found no differences in drinking intensity at the day level between pre- and during-pandemic days.

There were multiple factors that predicted initial participation in YADL based on MTF 12th grade data. Being female (vs. male; $p<0.001$), having 2 parents in the household (vs. 1 or fewer; $p<0.001$), Northeast residence (vs. other regions; $p=0.014$), having high school grades of B− or above (vs. C+ or below; $p=0.004$), having definitive plans to graduate from a 4-year college (vs. not; $p<0.001$), reporting no binge drinking as high school seniors (vs. reporting any high school binge drinking; $p=0.030$), and reporting lower past 30-day high school drinking frequency ($p<0.001$) all significantly predicted participation. Other factors such as race/ethnicity, high school religiosity, high school truancy, or parental education did not predict participation. Factors related to participation were used to construct survey weights used in analyses. Weights used in the analyses also accounted for the complex survey design, selection, and attrition; therefore, weighting accounted for any potential biases associated with including or excluding individuals who tend to drink more intensely All surveys were

completed online. The study was approved by a University of Michigan Institutional Review Board.

Measures

Drinking intensity—Drinking intensity was assessed using reported alcohol use on a given day. Respondents were asked about the number of drinks they consumed (1-25+ drinks), and the measure was recoded into a measure of drinking intensity using sex-specific thresholds: 1=moderate drinking measured as 1-3 drinks for women and 1-4 drinks for men, 2=binge drinking measured as 4-7 drinks for women and 5-9 drinks for men, and 3=high-intensity drinking measured as 8+ drinks for women and 10+ drinks for men (Patrick 2016). Approximately 57.3% of drinking days were moderate drinking days, while 31.8% and 10.9% of drinking days were binge and HID drinking days, respectively. The unweighted percent of individuals who reported any HID days was 21.4%.

Time spent drinking—For drinking days, participants were asked, "how many total hours did you drink on [day]?", with response options ranging from <1 hour to 12 or more hours (0=<1 hours, 1=1-2 hours, 2=2-3 hours, 3=3-4 hours, 4=4-5 hours… 11=11-12 hours, 12=12 hours or more). This original measure was recoded to create a continuous hours spent drinking measure (.5=<1 hours, 1.5=1-2 hours, 2.5=2-3 hours… 11.5=11-12 hours, 12.5=12 hours or more). Two additional dichotomous measures were used to assess different time constraints: drinking for <2 hours (1=<2 hours, 0=other), and <4 hours (1=<4 hours, 0=other). See Table 1 for overall mean.

eBAC—Estimated blood alcohol concentration (eBAC) was calculated based on self-reported weight in pounds, biological sex, number of drinks, and hours spent drinking each day.

Drinking pace—Drinking pace was measured by dividing the number of drinks in a drinking episode by the number of hours spent drinking during the drinking episode. See Table 1 for overall mean.

Negative consequences—Negative consequences of drinking were assessed each day using 10 items (Lee et al. 2017; Patrick & Terry-McElrath 2021) that were in response to following the question, "Did any of the following things happen to you as a result of your drinking on [day]?" (response options: yes/no). A count measure was generate using the sum of the following 10 negative consequences: I had a hangover; I became aggressive; I hurt or injured myself by accident; I couldn't remember what I did while drinking; I was rude or obnoxious; I did something that embarrassed me; I had a sexual experience I wish I hadn't; I felt nauseated or vomited; I passed out; and I drank more than I planned (mean=0.54, SD=1.16).

Covariates—We included biological sex, which was coded as male versus female (1=male, 0=female).

Plan of Analysis

RQ1: Typical Hours by Drinking Intensity—To address RQ1, we compared mean hours, peak eBAC on drinking days, mean pace (drinks per hour), mean number of drinks total, and mean number of negative consequences for moderate drinking (less than 4/5 drinks), binge drinking (4-7/5-9 drinks), and HID (8+/10+ drinks). We used ANOVAs with Bonferroni corrections for multiple comparisons in order to assess the typical number of hours over which HID is reported and to compare hours spent drinking and number of drinks for moderate, binge, HID levels of drinking intensity. We considered these differences across drinking intensity overall and by biological sex in supplemental analyses.

RQ2: Drinking Intensity and Hours Predicting Consequences—To address RQ2, we examined the relationship between alcohol consequences and different levels of drinking (i.e., moderate, binge, HID) while accounting for hours spent drinking and biological sex. We used two-level negative binomial multilevel regression models that assessed the extent to which controlling for number of hours spent drinking alters the associations between HID and negative consequences. These models allowed us to assess associations at the day level while accounting for variance at the person levels. We conducted 4 different models: a null model to assess variance components, a model that included only drinking intensity dummy variables, a model that included drinking intensity and time spent drinking, and finally a model that included all previous variables plus sex at the person level. We also conducted a supplemental model that tested the interaction between hours spent drinking, drinking intensity, and biological sex (reported in the text). We used Stata (v.17.0) and the *menbreg* command, which generates a multilevel negative binomial regression model with conditional overdispersion that is a function of the conditional mean (given random effects).

RQ3: Occurrence of Drinking Intensity with Various Time Qualifiers—To address RQ3, we assessed occurrence of each drinking intensity, as well as differences in eBAC and negative consequences across drinking intensity (using the same statistical tests as RQ1), using three different time specifications (i.e., 2 hours, 4 hours, no time qualifier). Consequently, we compared differences across drinking intensity among three different samples: (1) all drinking episodes (no time spent drinking constraints), (2) only episodes that occurred within 2 hours (a time limit of 2 hours), and (3) only episodes that occurred within 4 hours. Although moderate drinking is typically not defined with a time qualifier, we applied the 2- and 4-hour limits to all three levels of drinking intensity for consistency. Consequently, we compared differences across drinking intensity with different time constraints imposed.

We also conducted supplemental analyses that consisted of rotating the reference group in multilevel models in order to compare HID to binge drinking (reported in text), as well as analyses that used survey weights that considered the complex survey design of the study, selection into daily surveys, and attrition. We found no differences in weighted and unweighted analyses, and, therefore, we have elected to only report the unweighted results (weighted results are available upon request).

Results

RQ1: Typical Hours by Drinking Intensity

Overall, participants reported on average 2.6 hours of drinking, with substantial differences across categories of drinking intensity. Average number of hours spent drinking was highest for HID at nearly 5.2 hours, which was significantly higher compared to other levels of drinking intensity: on average, there were 3.6 and 1.8 more hours spent drinking for HID compared to moderate and binge drinking, respectively. HID also had the highest eBAC compared to both moderate and binge drinking, with eBAC being nearly double for HID compared to binge drinking. Drinking pace was also highest for HID compared to both moderate and binge: HID consisted of approximately 0.6 more drinks per hour compared to binge and 0.7 more drinks per hour compared to moderate drinking. The number of drinks for HID was nearly double the drinks consumed for binge drinking and over 6 times higher than moderate drinking. Negative consequences were also markedly higher on HID days (M=1.73) compared to binge (M=0.85) and moderate (0.14) drinking days. Results are summarized in Table 1.

In supplemental analyses shown in Table S1, females had higher eBAC, and males had faster drinking pace and a greater number of drinks. Females had higher eBAC at higher levels of drinking intensity compared to males, while males had a faster drinking pace and more drinks at higher levels of drinking intensity compared to females.

Drinking Intensity and Hours Predicting Consequences

Negative binomial multilevel regression models are summarized in Table 2. There was significant variance at the person level in the null model (Model 1, Table 2). Across all models, the most person-level variance explained was from adding drinking intensity to the model (adding hours spent drinking and sex explained minimal to no variance at the person level). Binge drinking and HID were associated with an increased count of negative consequences compared to moderate drinking (respectively, IRR=6.89, 95% CI=5.50, 8,64; IRR=14.89, 95% CI=11.34, 19.56), and these differences remained relatively unchanged after adjusting for hours spent drinking and sex. Sex did not moderate the associations between drinking intensity and negative consequences or hours spent drinking with negative consequences (a three-way interaction between sex, hours spent drinking, and drinking intensity was also non-significant). Shown in Table S2, compared to binge drinking, HID was associated with an increased count of negative consequences (IRR=2.16, 95% CI=1.72, 2.71). HID was associated with a greater number of negative consequences relative to both moderate and binge drinking, even after adjusting for time spent drinking.

Occurrence of Drinking Intensity with Various Time Qualifiers

The occurrence of HID and binge drinking was substantially reduced when time constraints were imposed on the definition of drinking intensity, with the 2-hour limit reducing occurrence most dramatically (Figure 1). Without a time constraint, 10.9% of drinking days were HID days, but this was reduced to 1.0% with a 2-hour time limit and 4.8% with a 4-hour time limit. Days classified as HID days without time constraints may be classified as binge or moderate when introducing a 2- or 4-hour time limit. Generally,

differences in eBAC across levels of drinking intensity did not change with the addition of time constraints (Table 3); HID consistently had the highest eBAC regardless of time constraints. HID also had the highest number of negative consequences across different time constraints (Table 3); however, differences between HID and other drinking intensity levels in mean negative consequences became non-significant after imposing a 2-hour time constraint. Although it was not a significant difference, HID had a lower mean number of negative consequences compared to binge drinking with a 2-hour time constraint. This was largely due to small same sizes and limited variability. However, even with the small sample of days, experiencing any consequence occurred on 50% of HID days within a 2-hour time constraint compared to only 35% and 7% of binge and moderate drinking days within a 2-hour time constraint, respectively. All differences in negative consequences across drinking intensity levels remained statistically significant when imposing a 4-hour time limit (with similar mean differences).

Discussion

Previous research has led to different conclusions about the extent to which a time constraint is needed to define high-risk drinking occasions. HID, in particular, has generally been defined without a time qualifier. However, it is important to examine whether adding a time constraint to the definition HID would provide additional information about alcohol-related risk (Patrick 2016). The current study compared young adults' reports of moderate drinking, binge drinking, and HID days. Results show that HID days, relative to moderate and binge drinking days, had the longest duration of drinking, highest peak estimated blood alcohol concentration, and greatest drinking pace. That is, on days when young adults drank at a high intensity, they not only spent more hours drinking, but also displayed a faster pace of consumption which likely led to a higher estimated blood alcohol concentration, compared to days characterized by moderate or binge drinking. Specifically, HID days among young adults were characterized by consuming more than 2.5 drinks per hour for several hours (with a mean of over 5 hours) and reaching an average estimated BAC of 0.30%, over three times the legal limit (i.e., 0.08%). Furthermore, HID was associated with a greater number of negative consequences relative to both moderate and binge drinking; adjusting for time spent drinking did not impact this interpretation. As such, HID days appear to pose a greater risk on multiple dimensions. These results confirm that HID episodes do indeed involve drinking at a higher intensity.

As far as adding a time qualifier, we compared 8/10+ drinks with no time constraint, 8/10+ drinks 2 hours, and 8/10+ drinks in 4 hours. HID was reported on 10.9% of all drinking days. When restricted to days when 8/10+ drinks were consumed in 4 hours or 2 hours, HID occurred on 4.8% and 1.0% of days, respectively. In other words, the majority of HID occasions lasted longer than 4 hours. If the HID definition were to be qualified as occurring within 2 hours (i.e., twice the number of drinks in the same amount of time as the NIAAA definition of binge drinking), the majority of HID days would be excluded. HID within 2 hours is not typical; therefore, this time constraint is not ideal. In fact, when examining number of drinks within 2 hours, there were no significant differences in negative consequences across moderate, binge, and HID. Differences in eBAC persisted across definitions with time constraints, although differences in negative consequences became

non-significant after imposing a 2-hour HID time constraint, likely due to sample size, which influenced mean comparisons. When examining the number of drinks within 4 hours, there were significantly more negative consequences reported on HID days than on moderate and binge drinking days. The addition of a time qualifier of 2 or 4 hours would restrict variability by describing only the minority of HID days, thereby restricting the occurrence and variability without a measurable improvement in distinguishing level of risk.

In general, our results align with prior work on time qualifiers for definitions of binge drinking, as well as work emphasizing the role drinking rate or pace beyond the sheer number of drinks consumed. Similar to Corbin and colleagues' (2014) work on binge drinking, our results found no additional utility of adding a time limit to the definition HID, particularly in regards to determining if more intense drinking is linked to outcomes such as negative consequences. Importantly, our work did so on a daily level, and, thus, we were able to separate within- and between-person effects. Our results also compliment other studies calling for the measurement of drinking rate or pace. In our study, HID days were associated with the quickest pace of drinking, as well as a greater number of consequences. Other work also highlights the relationship between quicker rates of drinking and negative alcohol consequences, even when controlling for quantity of drinks consumed (Carpenter & Merrill 2021; Gunn et al. 2022; Kuntsche et al. 2015). Although our measurement of HID is focused on the number of drinks consumed, it still evidenced the fastest pace and greatest number of consequences compared to other drinking levels. It is likely that both the number of drinks and pace of consumption are related but unique indicators of risk for alcohol-related consequences.

These results have important implications for continued research on HID, particularly in young adult populations. Measuring HID without a time qualifier captures a larger amount of high-risk drinking episodes and was associated with higher eBAC and a greater number of negative consequences, suggesting that researchers, who often are limited in the number of questions they can ask of their participants, should consider assessing HID without a time constraint. This is particularly salient for ongoing large epidemiologic studies, as the current research base has examined HID as 10+ drinks, or 8/10+ drinks for women/men, without a time qualifier. Changes to the measurement of HID could create challenges for assessing historical trends and developmental changes in HID across time. Any change to these measures requires clear evidence for the utility of a time qualifier, which the current study does not provide. Thus, we recommend retaining the current standard of measurement for HID (without a time qualifier). However, if researchers decide to impose a time constraint, our recommendation would be a 4-hour limit, as this generated the best balance of sample size and accuracy in terms of reported hours spent drinking (while demonstrating similar results for outcomes such as negative consequences). Alternatively, researchers could assess HID without a time qualifier along with hours spent drinking, as was done in this study, which would allow for measurement of both quantity consumed and pace of consumption without imposing a general and/or arbitrary time limit.

Limitations

Limitations include the fact that the sample originated from a sample of high school students; those who dropped out of high school are not included. Furthermore, the sample was selected based on alcohol use in high school. Results may not generalize to other samples. All measures of alcohol use and time spent drinking are self-reported. As a result of intoxication, impaired recall, or social desirability, the reported hours spent drinking or numbers of drinks may be inaccurate. However, intoxicated individuals tend to underreport the number of drinks consumed, so results regarding pace and eBAC may be underestimates.

Conclusions

This study was the first to examine the utility of adding a time qualifier (drinking within 2 or 4 hours) to the definition of high-intensity drinking. Compared to moderate and binge drinking days, high-intensity drinking days were characterized by more time spent drinking, a faster rate of consumption, and a greater number of negative alcohol-related consequences; these results persisted even with the addition of time constraints of 2 and 4 hours. However, the use of a time qualifier constrained the definition such that it included a minority of the high-intensity drinking days, which has implications for future research on this high-risk behavior. Our results support the continued use of traditional measures of high-intensity drinking that characterize such episodes as occurring on one occasion rather than within a certain number of hours.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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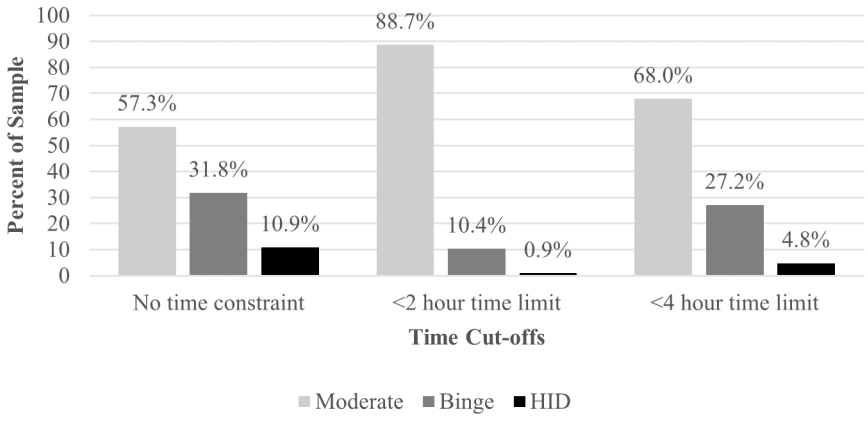

Figure 1.
Prevalence of Drinking Intensity Levels across Different Time Cut-offs.

Table 1.

Mean Comparisons According to Drinking Intensity

		Drinking Intensity			
	Total	**Moderate**	**Binge**	**HID**	
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**P-value**
Hours spent drinking	2.59 (1.95)	1.60 (1.24)	3.45 (1.52)	5.23 (2.41)	<.001
eBAC	0.11 (0.09)	0.05 (0.03)	0.16 (0.05)	0.30 (0.07)	<.001
Drinking pace	1.88 (1.23)	1.67 (1.07)	2.03 (1.36)	2.58 (1.32)	<.001
Number of drinks	4.11 (3.41)	1.87 (0.92)	5.67 (1.34)	11.31 (3.44)	<.001
Negative consequences	0.54 (1.16)	0.14 (0.50)	0.85 (1.31)	1.73 (1.86)	<.001

Note. Data shown are from drinking days only. Non-drinking days are not included. All groups were significantly different from each other in pair-wise comparisons (ps<.001); sample size varies across measures due to missing data at day level; for hours spent drinking, day N=1,928, person N=605; for eBAC, day N=1,923, person N=605; for drinking pace, day N=1,928, person N=605; for number of drinks and consequences, day N=1,938, person N=609; eBAC=estimated blood alcohol concentration; drinking pace=# of drinks/# of hours spent drinking.

Table 2.

Negative Binomial Hierarchical Regression Results for Negative Consequences Outcome

	Model 1	Model 2	Model 3	Model 4
Variables		**IRR (95% CI)**	**IRR (95% CI)**	**IRR (95% CI)**
Drinking intensity				
Moderate (ref.)				
Binge	~ ~	**6.89 (5.50, 8.64)**	**6.62 (5.18, 8.48)**	**6.62 (5.17, 8.48)**
HID	~ ~	**14.89 (11.34, 19.56)**	**13.67 (9.85, 18.97)**	**13.68 (9.86, 18.99)**
Hours spent drinking	~ ~	~ ~	1.03 (0.97, 1.08)	1.03 (0.97, 1.08)
Sex (male=1)	~ ~	~ ~	~ ~	0.92 (0.72, 1.18)
Variance component				
Person level	0.62 (.158)	0.56 (.114)	0.57 (.115)	0.57 (.115)
Model fit				
AIC	3886.08	3221.47	3214.03	3215.64
Intraclass correlation coefficient	0.11	0.16	0.16	0.16

Notes. Data are from drinking days only. Non-drinking days are not included. Bolded indicates statistical significance: p<.05; for Models 1 and 2, day N=1938; person N=609; for Models 3 and 4, day N=1928; person N=605; IRR=Incident Rate Ratio.

Table 3.

Mean Comparisons of eBAC and Consequences by Drinking Intensity across Different Time Constraints

	Time Constraints					
	None		<2 Hrs		<4 Hrs	
	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N
eBAC						
Moderate	0.05 (0.03)	1101	0.05 (0.03)	768	0.05 (0.03)	1054
Binge	0.16 (0.05)	611	0.17 (0.05)	90	0.16 (0.05)	419
HID	0.30 (0.07)	211	0.34 (0.06)	8	0.31 (0.07)	75
P-value	<.001		<.001		<.001	
# of Negative Consequences						
Moderate	0.14 (0.50)	1110	0.10 (0.41)	770	0.13 (0.48)	1056
Binge	0.85 (1.31)	617	0.90 (1.68)	90	0.82 (1.30)	422
HID	1.73 (1.86)	211	0.63 (0.74)	8	1.87 (1.98)	75
P-value	<.001		<.001		<.001	

Note. Data are from drinking days only. Non-drinking days are not included. Time constraints applied to all drinking levels. All groups were significantly different from each other in pair-wise comparisons, except HID did not signficantly differ from moderate and binge for negative consequences with the <2 hrs. limit.