

# Binge Drinking Intensity

## A Comparison of Two Measures

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**Background:** Binge drinking ( $\geq 4$  drinks for women;  $\geq 5$  drinks for men, per occasion) is responsible for more than half of the estimated 80,000 U.S. deaths annually and three-quarters of the \$223.5 billion in costs in 2006. Binge drinking prevalence is assessed more commonly than binge drinking intensity (i.e., number of drinks consumed per binge episode). Risk of binge drinking-related harm increases with intensity, and thus it is important to monitor. The largest number of drinks consumed is assessed in health surveys, but its usefulness for assessing binge intensity is unknown.

**Purpose:** To assess the agreement between two potential measures of binge drinking intensity: the largest number of drinks consumed by binge drinkers (maximum-drinks) and the total number of drinks consumed during their most recent binge episode (drinks-per-episode).

**Methods:** Data were analyzed from 7909 adult binge drinkers from 14 states responding to the 2008 Behavioral Risk Factor Surveillance System (BRFSS) binge drinking module. Mean and median drinks-per-episode from that module were compared to mean and median maximum-drinks. Analyses were conducted in 2010–2011.

**Results:** Mean (8.2) and median (5.9) maximum-drinks were strongly correlated with mean (7.4) and median (5.4) drinks-per-episode ( $r=0.57$ ). These measures were also strongly correlated across most sociodemographic and drinking categories overall and within states.

**Conclusions:** The maximum-drinks consumed by binge drinkers is a practical method for assessing binge drinking intensity and thus can be used to plan and evaluate Community Guide-recommended strategies for preventing binge drinking (e.g., increasing the price of alcoholic beverages and regulating alcohol outlet density).

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## Introduction

Excessive alcohol consumption is responsible for an average of 80,000 deaths in the U.S. each year<sup>1</sup> and \$223.5 billion in economic costs in 2006.<sup>2</sup> More than half of these deaths and three-quarters of the economic costs are due to binge drinking<sup>1,2</sup> ( $\geq 4$  drinks for women;  $\geq 5$  drinks for men, per occasion).<sup>3,4</sup> Binge drinking also is associated with a range of health and social problems, such as motor vehicle crashes, interper-

sonal violence, new HIV infections and sexually transmitted infections, liver cirrhosis, cancers, stroke, and alcohol dependence.<sup>5–8</sup>

The risk of binge drinking-related harm increases with the intensity of binge drinking (i.e., the number of drinks consumed).<sup>9</sup> Yet, adult binge drinkers often report drinking at levels that far exceed those used to define this pattern of alcohol consumption.<sup>10,11</sup> It is therefore important to routinely monitor binge drinking intensity to assess the public health impact of this behavior and to plan and evaluate evidence-based strategies to prevent it. However, questions on the number of drinks consumed by binge drinkers are not asked routinely in state health risk behavior surveys, such as the Behavioral Risk Factor Surveillance System (BRFSS). More commonly, health surveys include questions on the largest number of drinks consumed in a given time period (i.e., maximum-drinks),<sup>12,13</sup> but it is not clear whether these questions are useful for assessing binge drinking intensity.

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The purpose of the present study was to assess the agreement between the following two measures of binge drinking intensity: the mean and median maximum-drinks reported by binge drinkers on any occasion and mean and median total drinks consumed by binge drinkers during their most recent binge episode (i.e., drinks-per-binge). If there is strong agreement between these two measures, maximum-drinks may be a way to routinely measure state-specific binge drinking intensity, thus improving public health surveillance on the number of drinks consumed by adult binge drinkers.

## Methods

Data came from the 2008 BRFSS. Sampling design, purpose, and analysis descriptions are available at [www.cdc.gov/brfss/](http://www.cdc.gov/brfss/). Binge drinkers were defined as current drinkers who reported consuming  $\geq 4$  drinks (women) or  $\geq 5$  drinks (men) on an occasion during the past 30 days in the BRFSS core survey. Maximum-drinks consumed was assessed in the core survey by the largest number of drinks consumed on any occasion during the past 30 days. In 2008, a total of 14 states administered an optional module to obtain information about binge drinkers' most recent binge episode, including the number of drinks consumed by beverage type. Drinks-per-binge was calculated by summing beverage-specific consumption (i.e., beer, wine, liquor, and pre-mixed flavored drinks) from that episode.

Analyses were restricted to binge drinkers from the 14 states who administered the 2008 binge drinking module. Respondents with missing information on beverage-specific consumption, or those who reported maximum-drinks or drinks-per-binge that were  $< 4$  for women or  $< 5$  for men were excluded. The final sample consisted of 7909 respondents.

Data analysis was conducted in 2010–2011 using SAS-callable SUDAAN 9.2. Results were weighted by age, gender, and race/ethnicity to be representative of people residing in the states and to the respondent's selection probability. Means and 95% CIs, medians, and Pearson correlation coefficients of the maximum-drinks and drinks-per-binge were assessed by sociodemographic characteristics and by state. Significant differences between means were determined by non-overlapping CIs.

## Results

The study population of binge drinkers was predominantly male (58.0%); aged 18–54 years (76.9%); non-Hispanic white (83.3%); had at least some college education (63.9%); and had household incomes of  $\geq \$50,000$  (52.6%). There was a strong correlation between maximum-drinks ( $M=8.2$ ; median=5.9) and drinks-per-binge ( $M=7.4$ ; median=5.4) ( $r=0.57$ ,  $p<0.001$ ) (Table 1). These measures were strongly correlated for binge drinkers across most groups, except those with less than high school education ( $r=0.29$ ,  $p<0.001$ ); Hispanic race/ethnicity ( $r=0.38$ ,  $p<0.001$ ); and those who reported  $\geq 5$  binge drinking episodes in the past month ( $r=0.45$ ,  $p<0.001$ ). Mean and median maximum-drinks and

drinks-per-binge were also strongly correlated in all states except Georgia (Table 2).

## Discussion

Overall, binge drinkers' maximum-drinks correlated strongly with drinks-per-binge, an established measure of binge drinking intensity.<sup>10</sup> Measures generally correlated strongly within individual states as well. Further, the mean and median drinks-per-binge were approximately 90% of the mean and median maximum-drinks, respectively, further supporting the level of agreement between these two measures of binge drinking intensity. To our knowledge, this is the first study to assess the agreement between the largest number of drinks consumed by binge drinkers (maximum-drinks) and the number of drinks consumed during the most-recent binge drinking episode (drinks-per-binge) as measures of binge drinking intensity.

The findings of the current study have important implications for public health surveillance on binge drinking among adults because, unlike the drinks-per-binge measure, the maximum-drinks measure is assessed in all states annually. Therefore, it can be used routinely to assess binge intensity, and to plan and evaluate evidence-based binge drinking prevention strategies in states. Although the correlation between maximum-drinks and drinks-per-binge was generally quite strong across sociodemographic groups and within states, the correlations between these measures were weaker for respondents of Hispanic race/ethnicity and with less than high school degree, even though the mean and median maximum-drinks and drinks-per-binge within these strata were quite similar. This inconsistency may be due to the smaller sample sizes in these strata.

The greater binge drinking intensity of those reporting  $\geq 5$  binge drinking episodes/month relative to those reporting 1–2 episodes is consistent with other studies.<sup>10</sup> Among respondents reporting  $\geq 5$  episodes/month, the higher mean and median maximum-drinks than drinks-per-binge may reflect greater variability in binge intensity among frequent binge drinkers. Frequent binge drinkers ( $\geq 5$  episodes/month) had more episodes in which the maximum-drinks could exceed the drinks-per-binge measure. Consequently, there was a greater likelihood that the most recent binge episode was not the most intense. However, correlations between binge intensity measures were still strong for those who reported  $\geq 5$  episodes/month, supporting the use of maximum-drinks to assess binge drinking intensity among frequent binge drinkers too.

The present study has limitations. First, restricting the sample to those who reported alcohol consumption at or above the binge drinking threshold on multiple measures may have reduced the generalizability of the findings. However, the binge intensity estimates were not substan-

**Table 1.** Maximum-drinks among adult binge drinkers and drinks-per-episode by sociodemographic characteristics and binge drinking episode frequency<sup>a</sup>

Characteristics	n	Maximum-drinks <sup>b</sup>		Drinks-per-episode <sup>c</sup>		Pearson correlation coefficient <sup>d</sup>
		M (95% CI)	Median	M (95% CI)	Median	
<b>Overall</b>	7909	8.2 (7.9, 8.4)	5.9	7.4 (7.1, 7.6)	5.4	0.57
<b>Gender</b>						
Male	4588	9.2 (8.9, 9.6)	7.1	8.2 (7.9, 8.6)	5.9	0.53
Female	3321	5.9 (5.7, 6.0)	4.7	5.6 (5.5, 5.8)	4.2	0.53
<b>Age group (years)</b>						
18–34	2107	9.1 (8.6, 9.6)	6.9	8.1 (7.6, 8.6)	5.8	0.52
35–54	3971	7.5 (7.2, 7.8)	5.6	6.9 (6.7, 7.2)	5.3	0.64
≥55	1816	6.6 (6.3, 6.9)	5.1	6.1 (5.9, 6.4)	4.8	0.52
<b>Race/ethnicity</b>						
Non-Hispanic white	6589	7.7 (7.5, 8.0)	5.8	7.1 (6.7, 7.2)	5.2	0.69
Hispanic	653	9.2 (8.5, 9.9)	7.2	8.6 (7.8, 9.5)	6.0	0.38
Other <sup>e</sup>	630	9.0 (7.6, 10.5)	5.8	7.8 (7.1, 8.5)	5.7	0.50
<b>Education</b>						
<high school graduate	488	9.9 (8.6, 11.2)	7.5	9.0 (7.8, 10.3)	6.6	0.29
High school graduate	2368	8.9 (8.3, 9.4)	6.7	8.1 (7.5, 8.7)	5.9	0.62
Some college	2365	8.1 (7.7, 8.6)	5.9	7.1 (6.8, 7.4)	5.3	0.62
College graduate	2686	7.1 (6.7, 7.5)	5.5	6.6 (6.3, 7.0)	5.0	0.64
<b>Income (\$)</b>						
0–<49,999	3372	8.9 (8.4, 9.3)	6.6	8.0 (7.5, 8.5)	5.7	0.56
≥50,000	4162	7.7 (7.3, 8.0)	5.7	7.0 (6.7, 7.3)	5.2	0.58
<b>Binge episodes</b>						
≥5	1869	11.2 (10.5, 12.0)	9.3	8.9 (8.2, 9.6)	6.4	0.45
3–4	1451	8.4 (7.9, 8.8)	6.7	7.8 (7.3, 8.2)	5.9	0.62
1–2	4589	6.5 (6.3, 6.7)	5.2	6.5 (6.2, 6.7)	5.0	0.65

<sup>a</sup>Data were included from the 14 states that conducted the optional binge drinking module: Alaska, California, Delaware, Georgia, Iowa, Maine, Michigan, Montana, Nebraska, Nevada, New Mexico, Texas, Wisconsin, and Wyoming. All analyses were restricted to include only binge drinkers.

<sup>b</sup>Largest number of drinks consumed on any occasion during the past 30 days, among binge drinkers; data are from the BRFSS core section.

<sup>c</sup>Total number of drinks consumed in most recent binge drinking episode in the past 30 days; binge drinking was defined as consuming ≥4 drinks for women and ≥5 drinks for men per occasion in the past 30 days. Data are from the BRFSS binge drinking module.

<sup>d</sup>Correlation between maximum-drinks among binge drinkers and drinks-per-episode, within respective categories of sociodemographics and drinking patterns; all *p*-values were significant at <0.001.

<sup>e</sup>Non-Hispanic black, Asian, Native Hawaiian/Pacific Islander, American Indian/Alaskan Native, multiracial, and other

tially different from those reported in other publications and it therefore seems unlikely that the restricted study population substantially changed the relationship between the two evaluated binge drinking intensity measures.<sup>10,11</sup> Second, self-reported estimates of binge drinking intensity are likely to be underestimated because of recall bias<sup>14</sup>; social desirability response bias; non-response bias<sup>15</sup>; and because of the increasing number of

cell phone-only households, particularly among young adults.<sup>16,17</sup> In fact, a recent study found that BRFSS alcohol consumption data accounted for a median of 22%–32% of state consumption based on alcohol sales.<sup>18</sup> Therefore, it seems unlikely that either of the measures of binge drinking intensity that were assessed in the current study overestimated the actual number of drinks consumed by adult binge drinkers in the U.S.

**Table 2.** Maximum-drinks among binge drinkers and drinks-per-binge by state

State	n	Maximum-drinks <sup>a</sup>		Drinks-per-binge <sup>b</sup>		Pearson correlation coefficient <sup>c</sup>
		M (95% CI)	Median	M (95% CI)	Median	
Overall	7909	8.2 (7.9, 8.4)	5.9	7.4 (7.1, 7.6)	5.4	0.56
Alaska	313	7.3 (6.8, 7.8)	5.7	7.0 (6.6, 7.4)	5.5	0.70
California	516	8.1 (7.3, 8.7)	6.0	7.5 (6.9, 8.1)	5.3	0.58
Delaware	378	7.4 (6.9, 7.8)	5.7	7.3 (6.8, 7.8)	5.4	0.73
Georgia	393	8.1 (6.8, 9.3)	5.6	7.9 (7.1, 8.7)	5.8	0.33
Iowa	741	7.7 (7.4, 8.1)	6.1	6.9 (6.5, 7.2)	5.3	0.60
Maine	385	7.9 (7.3, 8.6)	5.7	7.5 (6.8, 8.3)	5.6	0.74
Michigan	299	7.9 (7.3, 8.5)	5.9	7.0 (6.6, 7.4)	5.5	0.56
Montana	726	8.1 (7.6, 8.6)	5.9	6.8 (6.3, 7.3)	4.8	0.60
Nebraska	596	7.3 (6.8, 7.8)	5.6	6.7 (6.3, 7.1)	5.3	0.48
Nevada	567	8.6 (7.6, 9.6)	5.7	8.3 (7.3, 9.3)	5.5	0.62
New Mexico	381	7.7 (7.0, 8.3)	5.7	7.2 (6.6, 7.8)	5.4	0.61
Texas	798	8.6 (8.0, 9.2)	6.0	7.3 (6.8, 7.7)	5.4	0.65
Wisconsin	1054	8.3 (7.9, 8.7)	6.4	7.4 (7.0, 7.7)	5.6	0.65
Wyoming	762	8.4 (7.8, 8.9)	5.9	7.9 (7.5, 8.4)	5.9	0.71

<sup>a</sup>Largest number of drinks consumed on any occasion during the past 30 days, among binge drinkers; data are from the BRFSS core section.

<sup>b</sup>Total number of drinks consumed in most recent binge drinking episode in the past 30 days; binge drinking was defined as consuming  $\geq 4$  drinks for women and  $\geq 5$  drinks for men per occasion in the past 30 days. Data are from the BRFSS binge drinking module.

<sup>c</sup>Correlation between maximum-drinks among binge drinkers and drinks-per-binge, within states; all *p*-values were significant at  $<0.001$ .

The present study affirms that binge drinkers generally drink at levels that are well above those used to define this behavior. Therefore, in addition to monitoring binge drinking prevalence and frequency, it is important to monitor binge intensity in states and nationwide, which routinely can be done with the maximum-drinks measure. This information can, in turn, be used to plan and evaluate strategies for preventing binge drinking and related harms, such as those recommended by the *Guide to Community Preventive Services* (e.g., increasing the price of alcoholic beverages and regulating alcohol outlet density).<sup>19–21</sup>

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