

## Binge Drinking and Alcohol Problems Among Moderate Average-Level Drinkers

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**Introduction:** A significant amount of binge drinking among adults escapes public health scrutiny because it occurs among individuals who drink at a moderate average level. This observational study examined the role of a binge pattern of drinking in predicting alcohol problems among moderate drinkers in a U.S. national sample of adults.

**Methods:** Participants were 1,229 current drinkers aged  $\geq 30$  years from 2 waves of the study of Midlife Development in the United States, with a 9-year time lag (2004–2015) (analyzed in 2021–2022). Negative binomial regression analyses were used to examine the number of alcohol problems, and binary logistic regression analyses were used to examine multiple ( $\geq 2$ ) alcohol problems.

**Results:** Independent of the average level of drinking, binge drinking was linked with an almost 3 times increase in the number of concurrent alcohol problems and a 40% increase in the number of alcohol problems prospectively 9 years later. Moderate average level drinkers accounted for most cases of binge drinking and multiple alcohol problems. Among moderate drinkers, binge drinking was linked with a close to 5 times increase in concurrent multiple alcohol problems and a  $>2$  times increase in multiple alcohol problems prospectively 9 years later.

**Conclusions:** These results substantially broaden an increasing recognition that binge drinking is a public health concern among adults. Moderate average-level drinkers should be included in efforts to reduce alcohol problems in adults. These findings are applicable to primary and secondary prevention of alcohol problems with the potential to advance population health.

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### INTRODUCTION

Although research on binge drinking ( $\geq 5$  drinks on the same occasion) has focused primarily on adolescents and college students, a pattern of binge drinking is prevalent across the adult lifespan. In fact, most binge drinking occurs among adults aged  $\geq 30$  years.<sup>1</sup> Moreover, the prevalence of binge drinking is increasing among adults, including adults aged  $\geq 50$  years.<sup>2,3</sup> Stressors associated with the coronavirus disease 2019 (COVID-19) pandemic are increasing excess daily drinking in adults.<sup>4</sup>

Adults who engage in a pattern of binge drinking have an increased risk of alcohol problems.<sup>5,6</sup> However, because a binge drinking pattern is confounded with an average level of consumption,<sup>7,8</sup> it is not clear how binge drinking uniquely contributes to alcohol problems, independent of the average level of drinking.<sup>9</sup> Focusing only

on moderate average consumption masks the divergent underlying patterns of drinking, from regular low consumption to irregular binge drinking.<sup>7</sup> In fact, most epidemiologic studies focus solely on average level of drinking, overlooking occasions of high consumption.<sup>7,8</sup> Similarly, mass media uncritically espouse the health advantages of moderate alcohol consumption.<sup>10</sup> Thus, many drinkers assume that moderate average consumption is safe, regardless of drinking pattern.

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Especially troubling, much binge drinking among adults escapes public health scrutiny because it occurs among individuals who drink at a moderate average level (average of not >1 drink a day for women and 2 drinks a day for men).<sup>11</sup> Drinking within U.S. National Institute on Alcohol Abuse and Alcoholism low-risk guidelines for average consumption (not >1 drink a day for women and 2 drinks a day for men) leaves sufficient opportunity for risky drinking on particular occasions.<sup>7</sup> Using data from the U.S. Behavioral Risk Factor Surveillance System, Naimi and colleagues<sup>11</sup> found that moderate drinkers accounted for half of the occasions of binge drinking. Furthermore, using data from the Canadian Institute for Health Information, Sherk et al.<sup>12</sup> found that individuals drinking within average consumption guidelines accounted for a substantial proportion of alcohol's social harms.

This study examined the role of a binge pattern of drinking in predicting alcohol problems among moderate average-level drinkers in a U.S. national sample of adults. Participants were 1,229 current drinkers aged  $\geq 30$  years from 2 waves of the study of Midlife Development in the United States (MIDUS) with a 9-year time lag.<sup>13</sup> Preliminary analyses examined the unique contribution of a regular versus binge pattern of drinking, independent of a moderate versus high average level of drinking, in predicting alcohol problems in the full sample of drinkers. Next, the association of a pattern of binge drinking with multiple alcohol problems was examined among moderate average drinkers. Each set of analyses included cross-sectional analyses and prospective analyses across 9 years.

## METHODS

### Study Sample

The MIDUS study investigated health and well-being in a U.S. national sample of non-institutionalized, English-speaking adults. The study was initiated by the MacArthur Midlife Research Network with later funding from the National Institute on Aging. Baseline data for the current analyses are from Wave 2 of the MIDUS study, which introduced the measure of binge drinking in the survey. Follow-up data are from Wave 3 of the MIDUS study, 9 years later. Baseline data were collected between 2004 and 2006, and follow-up data were collected between 2013 and 2015.

The MIDUS sample of U.S. adults was selected by a random-digit-dialing procedure with metropolitan oversampling.<sup>13</sup> Each wave of data collection used a phone interview followed by a self-administered questionnaire. Oral consent for participation was obtained by telephone at first contact. Participation rate (adjusted for mortality) was 75% at baseline and 77% at the 9-year follow-up.<sup>14,15</sup> Baseline participants in this study were 1,229 current drinkers who provided complete data on predictor variables and covariates. In this study, follow-up data on alcohol problems at 9 years (adjusted for mortality) were available for 70% (767/1,229)

of baseline participants. This study did not require IRB approval because it involved secondary analyses of a publicly available, fully deidentified data set.

### Measures

Alcohol consumption was measured at baseline. Initially, respondents were asked: *During the past month, have you had at least one drink of any alcoholic beverage such as beer, wine, wine coolers, or liquor?* Respondents answering *yes* were defined as current drinkers. Respondents answering *no* were defined as noncurrent drinkers and were excluded from this study. For other research using these MIDUS measures of alcohol consumption, see the studies by Goldwater and colleagues<sup>16</sup> and Richardson and Boutwell.<sup>17</sup>

To index a moderate versus high average level of alcohol consumption, respondents were first asked: *During the past month, how often did you drink any alcoholic beverages, on the average?* Responses were scaled to the average number of drinking days per week. Next, to measure the average number of drinks on a drinking day, respondents were asked: *On the days when you drank, about how many drinks did you drink on the average?* One drink was defined as "a bottle of beer, a wine cooler, a glass of wine, a shot of liquor, or a mixed drink." To derive a composite index of average daily level of drinking, average drinking days per week and average drinks on a drinking day were multiplied, and the product was divided by 7.

*Moderate drinking* was defined following the National Institute on Alcohol Abuse and Alcoholism cut off for low-risk drinking.<sup>18</sup> Specifically, *moderate drinking* (score=0) was defined as an average level of drinking  $\leq 1$  drink/day for women and  $\leq 2$  drinks/day for men; *high drinking* (score=1) was defined as an average daily level of drinking  $> 1$  drink per day for women and  $> 2$  drinks/day for men. This definition is commonly used in alcohol studies to define a group of moderate as well as low-to-moderate drinkers.<sup>19,20</sup>

A separate question indexed a regular versus binge pattern of drinking on one occasion. Participants were asked: *Considering all types of alcoholic beverages, how many times during the past month did you have 5 or more drinks on the same occasion?* An occasion was defined as "drinks in a row, or in a short period of time." For both women and men, the MIDUS surveys indexed a regular pattern of drinking as  $< 5$  drinks on the same occasion and binge drinking as  $\geq 5$  drinks on the same occasion. This is consistent with the definition used at the time in the U.S. National Survey on Drug Use and Health. Following previous research,<sup>9,16</sup> a binary measure was used to contrast no instances of binge drinking (score=0) with 1-or-more instances of binge drinking (score=1).

Alcohol problems in the past 12 months were indexed at baseline and at the 9-year follow-up by the alcohol Dependence scale of the Composite International Diagnostic Interview-Short Form.<sup>21</sup> The scale consists of 7 items: experiencing effects of alcohol in a situation that increased the chances of getting hurt; emotional or psychological problems from alcohol; a desire to use alcohol that you could not resist; a month or more when you spent a great deal of time using alcohol; having to use more alcohol to get the same effect; using much larger amounts of alcohol than intended; experiencing the effects of alcohol at work, school, or caring for children. Following Magidson et al.,<sup>22</sup> for each item, no problems was given a score of 0, and any problems was given a

**Table 1.** Baseline Sample Characteristics for the Total Sample and for Moderate and Heavy Average-Level Drinkers

Characteristics	Total sample (N=1,229)	Average level of drinking	
		Moderate (n=1,107)	Heavy (n=122)
Age	55.52 (12.35)	55.51 (12.37)	55.52 (12.28)
Sex			
Male	640 (52.1)	579 (52.3)	61 (50)
Female	589 (47.9)	528 (47.7)	61 (50)
Years of education	14.95 (2.57)	14.94 (2.58)	15.12 (2.45)
Household income (median)	65,500	66,500	60,875
White	1,134 (92.3)	1,020 (92.1)	114 (93.4)
Non-White	95 (7.7)	87 (7.9)	8 (6.6)
Marital status			
Not married	356 (29.0)	316 (28.5)	40 (32.8)
Married	873 (71.0)	791 (71.5)	82 (67.2)
Drinking pattern			
Regular	972 (79.1)	925 (83.6)	47 (38.5)
Binge <sup>a</sup>	257 (20.9)	182 (16.4)	75 (61.5)
Baseline multiple alcohol problems			
No	1,114 (90.6)	1,030 (93.0)	84 (68.9)
Yes <sup>a</sup>	115 (9.4)	77 (7.0)	38 (31.1)
9-year multiple alcohol problems			
No	666 (86.8)	606 (88.3)	60 (74.1)
Yes <sup>a</sup>	101 (13.2)	80 (11.7)	21 (25.9)

Note: Multiple alcohol problems are shown at baseline and 9 years; for multiple alcohol problems at 9 years,  $n=767$ . Means (with SDs in parentheses) are shown for continuous variables (age and years of education), except for household income, for which the median is reported. The number of participants (with the percentage in parentheses) is shown for categorical variables.

<sup>a</sup>Moderate average-level drinkers accounted for most total cases of binge drinking at baseline and most total cases of multiple alcohol problems at baseline and 9 years.

score of 1. The MIDUS surveys included 6 alcohol problems at baseline (use in hazardous situations was not included) and all 7 problems at follow-up. For other research using the MIDUS measure of alcohol problems, see the study by Magidson and colleagues<sup>22</sup> and Gleib and Weinstein.<sup>23</sup>

To increase construct validity, 2 measures of alcohol problems were developed. Following Magidson et al.,<sup>22</sup> a continuous measure indexed the total number of alcohol problems. Following Richardson and Boutwell<sup>17</sup> and Gleib and Weinstein,<sup>23</sup> a binary measure indexed multiple alcohol problems. To link our definition of multiple alcohol problems to diagnostic criteria for alcohol use disorder,<sup>24</sup> a cut off of 2 was used to index multiple alcohol problems, contrasting  $\leq 1$  problem (score=0) with  $\geq 2$  problems (score=1).

### Statistical Analysis

Analyses used Mplus, version 8.1.<sup>25</sup> Following previous research predicting alcohol problems,<sup>26–28</sup> negative binomial regression analyses were used to examine the association between binge drinking and the continuous measure of the number of alcohol problems, controlling for the average level of drinking. Binary logistic regression analyses were used to examine the association between binge drinking and the binary measure of multiple alcohol problems among moderate average-level drinkers. Following Goldwater and colleagues,<sup>16</sup> all analyses controlled for age, sex,

years of education, household income, White/non-White, and marital status at baseline. In statistical analyses, age was scaled in 10-year units, and household income was scaled in 10,000-dollar units to facilitate interpretation. The analyses followed the key recommendations for prospective designs: (1) alcohol consumption at baseline predicted subsequent alcohol problems, and (2) alcohol problems at baseline were controlled, ensuring that the predictive effect was independent of reverse effects and stability in alcohol problems.<sup>29</sup>

## RESULTS

Table 1 shows the sample characteristics for the total sample and for moderate and heavy average-level drinkers.

A negative binomial regression analysis was used to examine the association of average level of drinking and a binge pattern of drinking, controlling for one another, with the number of alcohol problems at baseline (Table 2). The analysis controlled for all sociodemographic covariates. A high compared with a moderate average level of drinking was independently and significantly associated with a 2.16 times increase in the number of alcohol problems. A binge compared with a

**Table 2.** Negative Binomial Regression Analyses With the Level and Pattern of Drinking Predicting the Number of Alcohol Problems

Predictors at baseline	Number of alcohol problems at baseline (n=1,229), OR (95% CI)	Number of alcohol problems at 9 years (n=767), OR (95% CI)
Age <sup>a</sup>	<b>0.75</b> (0.70, 0.82)	<b>0.81</b> (0.73, 0.90)
Sex (male=0, female=1)	<b>0.70</b> (0.56, 0.86)	<b>0.76</b> (0.58, 0.99)
Years of education	1.03 (0.99, 1.07)	1.03 (0.98, 1.08)
Household income <sup>b</sup>	1.01 (0.99, 1.02)	1.01 (0.99, 1.02)
Non-White (White=0, non-White=1)	1.25 (0.87, 1.68)	2.46 (0.64, 1.65)
Married (no=0, yes=1)	0.91 (0.73, 1.13)	1.08 (0.83, 1.45)
Baseline number of alcohol problems	—	<b>1.74</b> (1.53, 2.02)
Average level of drinking (moderate=0, high=1)	<b>2.16</b> (1.71, 2.71)	1.06 (0.71, 1.46)
Pattern of drinking (regular=0, binge=1)	<b>2.76</b> (2.19, 3.41)	<b>1.40</b> (1.05, 1.83)

Note: OR in boldface indicates statistical significance ( $p < 0.05$ ).

Analyses were unadjusted for covariates. At baseline, the OR for average drinking=**1.94** (95% CI=1.55, 2.41), and the OR for binge drinking=**3.70** (95% CI=3.06, 4.42). At 9 years, the OR for average drinking=0.90 (95% CI=0.61, 1.22), and the OR for binge drinking=**1.62** (95% CI=1.23, 2.07).

<sup>a</sup>In the analysis, age is scaled in 10-year units to facilitate interpretation.

<sup>b</sup>In the analysis, income is scaled in 10,000-dollar units to facilitate interpretation.

regular pattern of drinking was independently and significantly associated with a 2.76 times increase in the number of alcohol problems.

A negative binomial regression analysis was also used to examine the predictive association of average level of drinking and a binge pattern of drinking at baseline, controlling for one another, with the number of alcohol problems at the 9-year follow-up (Table 2). The analysis controlled for all sociodemographic covariates as well as for the number of alcohol problems at baseline. Prospectively, a binge compared with a regular pattern of drinking was independently and significantly associated with a 40% increase in the number of alcohol problems 9 years later. Average level of drinking was not prospectively associated with the number of alcohol problems 9 years later.

Although negative binomial regression is commonly used in predicting alcohol problems, binomial logistic regression provides an alternative procedure appropriate for count data with an upper bound.<sup>30</sup> To further validate these findings, binomial logistic regression was used to reexamine the models predicting the number of alcohol problems in Table 2. Results were similar to those reported in Table 2. At baseline, high average drinking (OR=2.58; 95% CI=1.90, 3.50) and binge drinking (OR=3.12; 95% CI=2.47, 4.05) significantly predicted the number of alcohol problems. Prospectively, only binge drinking (OR=1.43; 95% CI=1.03, 1.98) significantly predicted the number of alcohol problems.

Moderate drinkers accounted for 70.8% (182/257) of cases of binge drinking at baseline and 67.0% (77/115) and 79.2% (80/101) of cases of multiple alcohol problems at baseline and 9 years, respectively (Table 1). For

men, moderate drinkers accounted for 73.3% (143/195) of cases of binge drinking at baseline and 70.1% (54/77) and 84.9% (62/73) of cases of multiple alcohol problems at baseline and 9 years, respectively. For women, moderate drinkers accounted for 62.9% (39/62) of cases of binge drinking at baseline and 60.5% (23/38) and 64.3% (18/28) of cases of multiple alcohol problems at baseline and 9 years, respectively.

Among moderate average-level drinkers, a binary logistic regression analysis was conducted to examine the association of a binge pattern of drinking with multiple alcohol problems at baseline (Table 3). The analysis controlled for all sociodemographic covariates. At baseline, a binge compared with a regular pattern of drinking was independently and significantly associated with a 4.85 times increase in odds of multiple alcohol problems among moderate average-level drinkers.

Among moderate average-level drinkers, a binary logistic regression analysis was also conducted to examine the predictive association of a binge pattern of drinking at baseline with multiple alcohol problems at the 9-year follow-up (Table 3). The analysis controlled for all sociodemographic covariates as well as for multiple alcohol problems at baseline. Prospectively, a binge compared with a regular pattern of drinking was independently and significantly associated with a 2.11 times increase in the odds of multiple alcohol problems 9 years later.

Potential moderation of the binge drinking effect by sex and (separately) age was examined in each of the models mentioned earlier. The interaction of sex with a binge pattern of drinking was not significant ( $p > 0.05$ ) in predicting either the number of alcohol problems or,

**Table 3.** Logistic Regression Analyses Among Moderate Drinkers With Pattern of Drinking Predicting Multiple Alcohol Problems

Predictors at baseline	Multiple alcohol problems at baseline (n=1,107), OR (95% CI)	Multiple alcohol problems at 9 years (n=686), OR (95% CI)
Age <sup>a</sup>	<b>0.59</b> (0.46, 0.73)	<b>0.70</b> (0.53, 0.87)
Sex (male=0, female=1)	0.61 (0.34, 1.07)	<b>0.33</b> (0.16, 0.57)
Years of education	1.01 (0.90, 1.14)	1.05 (0.95, 1.17)
Household income <sup>b</sup>	1.03 (0.99, 1.07)	1.00 (0.96, 1.04)
Non-White (White=0, non-White=1)	1.33 (0.53, 2.57)	0.63 (0.12, 1.77)
Married (No=0, yes=1)	0.75 (0.43, 1.45)	0.75 (0.42, 1.45)
Baseline multiple alcohol problems	—	<b>5.72</b> (2.81, 12.73)
Pattern of drinking (regular=0, binge=1)	<b>4.85</b> (2.81, 8.86)	<b>2.11</b> (1.11, 4.01)

Note: OR in boldface indicates statistical significance ( $p < 0.05$ ).

Analyses were unadjusted for covariates: OR for binge drinking=**7.18** (95% CI=4.48, 11.80) at baseline and **3.06** (95% CI=1.62, 5.63) at 9 years.

<sup>a</sup>In the analysis, age is scaled in 10-year units to facilitate interpretation.

<sup>b</sup>In the analysis, income is scaled in 10,000-dollar units to facilitate interpretation.

among moderate average-level drinkers, multiple alcohol problems either at baseline or at the 9-year follow-up. Similarly, the interaction of age with a binge pattern of drinking was not significant ( $p > 0.05$ ) in predicting either the number of alcohol problems or multiple alcohol problems among moderate average-level drinkers either at baseline or the 9-year follow-up.

Potential moderation of the binge drinking effect by average level of drinking was also examined in the models in Table 2. The interaction of average level of drinking with a binge pattern of drinking in predicting the number of alcohol problems was significant ( $p < 0.05$ ) in cross-sectional analyses but not in prospective analyses ( $p > 0.05$ ). Cross-sectional analyses by drinking-level subgroups indicated that binge drinking significantly ( $p < 0.05$ ) predicted more alcohol problems among both moderate and high average-level drinkers, with the effect stronger for moderate drinkers.

Several baseline variables showed statistically significant ( $p < 0.05$ ), although small, correlations with 9-year attrition: age ( $r = 0.07$ ), years of education ( $r = -0.14$ ), household income ( $r = -0.13$ ), non-White ( $r = 0.12$ ), and number of alcohol problems ( $r = -0.09$ ). In a binary logistic regression with these variables controlling for one another, only non-White showed a noteworthy effect size (OR=2.34; 95% CI=1.47, 3.96) in predicting increased 9-year attrition.

In addition, the baseline models predicting alcohol problems described in Tables 2 and 3 were reexamined restricting the analyses to participants who provided complete data across both waves. Results were similar to those reported in Tables 2 and 3. High average drinking (OR=1.97; 95% CI=1.46, 2.52) and binge drinking (OR=2.60; 95% CI=2.04, 3.36) significantly predicted the

number of alcohol problems; among moderate drinkers, binge drinking (OR=5.39; 95% CI=2.83, 11.87) significantly predicted multiple alcohol problems.

## DISCUSSION

A binge compared with a regular pattern of drinking predicted the number of alcohol problems independent of the average level of drinking. Extending previous research,<sup>5,6,9</sup> this association persisted prospectively across 9 years and generalized to both women and men throughout the adult life span. Independent of a high average level of drinking, a pattern of binge drinking was uniquely linked with an almost 3 times increase in the number of concurrent alcohol problems and a 40% increase in the number of alcohol problems prospectively 9 years later. These findings underscore that average consumption by itself does not sufficiently reflect alcohol risk.<sup>31</sup> Alcohol research and policy need to address patterns as well as average level of consumption.

Extending previous research,<sup>11,12</sup> moderate average-level drinkers accounted for most cases of binge drinking at baseline and of multiple alcohol problems at baseline and follow-up. Moreover, binge drinking was linked to multiple alcohol problems among moderate average-level drinkers. This association persisted prospectively across 9 years and generalized to both women and men throughout the adult life span. Among moderate average-level drinkers, a binge pattern of drinking was associated with a close to 5 times increase in concurrent multiple alcohol problems and a  $>2$  times increase in multiple alcohol problems prospectively 9 years later.

The present results that moderate average-level drinkers accounted for many cases of binge drinking

and multiple alcohol problems have public health relevance.<sup>32</sup> These findings are consistent with the prevention paradox, which emphasizes the need for alcohol interventions targeting moderate average drinkers in addition to conventional strategies focusing on the higher-risk but smaller population of habitually high-level drinkers.<sup>33</sup> In a cross-sectional design, O'Dwyer et al.<sup>34</sup> addressed this issue among Irish adults with alcohol problems who were not alcohol dependent. Consistent with the present findings, the authors emphasized the role of binge drinking in alcohol problems among nonalcohol-dependent drinkers.

These results support including moderate average drinking adults in public health efforts to reduce binge drinking. Alcohol control policies focused on the price and availability of alcohol are especially effective in reducing binge drinking at a population level.<sup>35,36</sup> A significant contribution to such efforts can also come from primary care providers, who interact with a broad spectrum of adults who consume alcohol.<sup>37</sup> At present, binge drinking among moderate drinkers is largely undetected in primary care settings.<sup>38,39</sup>

### Limitations

The present findings are correlational and do not provide evidence of causality. In addition, the data were self-report and are subject to recall bias, common method variance, and social desirability. In addition, because the MIDUS sample underrepresented non-White participants and because non-White status was linked to increased 9-year attrition, caution is needed in generalizing these findings to minority populations. Furthermore, the MIDUS surveys indexed binge drinking as 5 or more drinks on an occasion for both women and men. Because binge drinking in women is now more commonly indexed as 4 or more drinks on an occasion, these findings may have underreported binge drinking in women.

### CONCLUSIONS

In a U.S. national sample of adults, moderate drinkers accounted for most cases of both binge drinking and multiple alcohol problems. Among moderate drinkers, binge drinking was predictively linked to multiple alcohol problems. These results substantially broaden an increasing recognition that binge drinking is a public health concern among adults.<sup>1</sup> Moderate average level drinkers should be included in efforts to reduce binge drinking and alcohol problems in adults. These findings are applicable to primary and secondary prevention of alcohol problems with the potential to advance population health.

### CREDIT AUTHOR STATEMENT

Charles J. Holahan: Conceptualization, Formal analysis, Methodology, Project administration, Writing - original draft, Writing - review and editing. Carole K. Holahan: Conceptualization, Methodology, Writing - review and editing. Rudolf H. Moos: Conceptualization, Methodology, Writing - review and editing.

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