American Journal of
Preventive Medicine

RESEARCH ARTICLE

Alcohol Use Among U.S. Adults by Weight Status and Weight Loss Attempt: NHANES, 2011–2016

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Introduction: Past research examining the relationship between alcohol use and weight status has not differentiated among classes of obesity. There is limited research investigating whether adults trying to lose weight consume less alcohol.

Methods: In 2018–2019, the authors analyzed 2011–2016 National Health and Nutrition Examination Survey data for nonpregnant adults aged ≥20 years with BMI ≥18.5 kg/m^2. Multinomial and binomial logistic regression and linear regression were used to test associations between (1) past-year alcohol use and current weight status, differentiating among Class 1, 2, and 3 obesity, and (2) past-year weight loss attempt and alcohol use, controlling for potential confounders. Analyses were stratified by sex.

Results: Male current drinkers versus nondrinkers had lower odds of Class 3 obesity versus healthy weight (AOR=0.62, 95% CI=0.42, 0.92); female current drinkers versus nondrinkers had lower odds of Class 1 (AOR=0.67, 95% CI=0.50, 0.90), Class 2 (AOR=0.62, 95% CI=0.46, 0.83), and Class 3 (AOR=0.66, 95% CI=0.49, 0.89) obesity versus healthy weight. Among current drinkers, less frequent alcohol use was associated with higher odds of Class 1–3 obesity versus healthy weight in both sexes (p<0.05), whereas higher continued volume (heavier drinking) was associated with higher odds of Class 1–3 obesity versus healthy weight in females (p=0.049). Females reporting a weight loss attempt had higher odds of current drinking and more frequent heavy drinking.

Conclusions: Lower frequency of alcohol use (both sexes) and higher continued volume (female adults only) are associated with higher odds of higher weight status. Female adults trying to lose weight drink more, despite guidelines suggesting reducing caloric intake for weight control.

Am J Prev Med 2019;57(2):220–230.

INTRODUCTION

Almost 80 million U.S. adults are obese, nearly 35 million of whom have Class 2 or 3 obesity.[1] Obesity, particularly Class 2 or 3, is associated with high morbidity and medical spending.[2,3]

One possible contributing factor to obesity is alcohol, an addictive and energy-dense macronutrient that reduces fat oxidation and increases fat storage,[4] and which may lead to weight gain and obesity.[5,6] Alcohol use also influences behaviors that may impact weight status. It may prompt individuals to eat more and exercise less[7,8] or, conversely, may lead to loss of interest in food[6] or decreased absorption and metabolism of nutrients, leading to lower weight.[9]

Two systematic reviews of studies examining the association between alcohol use and weight concluded that the association is unclear,[10,11] in part because most studies evaluated frequency or quantity of alcohol use alone.

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0749-3797/$36.00
https://doi.org/10.1016/j.amepre.2019.03.025

They noted that future research should examine alcohol use patterns that take both frequency and quantity into account.[10] The literature includes at least two additional limitations. First, most previous studies have made nondrinkers the reference group when evaluating associations with alcohol use, despite nondrinkers differing from current drinkers in more than alcohol use[12−14] (e.g., nondrinkers may have underlying health conditions that make them "sicker" than current drinkers). Thus, the potential for residual confounding is large. Second, most studies evaluating alcohol use and weight status have not differentiated between classes of obesity, despite differences in degree of excess adiposity, health status, and alcohol metabolism among individuals in the three groups. Evidence suggests that individuals with Class 2 and 3 obesity may need to consume larger quantities of alcohol to reach intoxicating levels than individuals with Class 1 obesity.[15,16] By contrast, alcohol use may more often be contraindicated among individuals with higher classes of obesity who have higher prevalence of comorbidities and associated medication use, which may lead to less alcohol use compared with those with lower classes of obesity.[17,18]

Clinical guidelines on the treatment of overweight and obesity recommend dieting to reduce caloric intake.[3] Because alcohol contains calories with limited nutritional value, limiting alcohol use is often a target for weight control.[11] However, it is unclear whether individuals who are trying to lose weight have different alcohol use patterns than those not trying to lose weight.

To address these limitations in the literature, this study examined associations between alcohol use, taking both frequency and quantity into account simultaneously, and weight status, differentiating between Class 1, 2, and 3 obesity, using 2011−2016 National Health and Nutrition Examination Survey (NHANES) data. Relationships between weight loss attempt and alcohol use were also examined.

METHODS

Study Sample

A cross-sectional, stratified, multistage probability sample of the civilian noninstitutionalized U.S. population, NHANES is designed to assess health status and behaviors of the population through interviews and physical examinations.[19,20] All participants gave informed consent and ethics approval was obtained from the National Center for Health Statistics Research Ethics Review Board. In 2018−2019, NHANES data from 2011 to 2016 for nonpregnant adults aged ≥20 years who had nonmissing BMI of ≥18.5 kg/m^2 (i.e., healthy weight or higher) and had completed at least one item on the Alcohol Use Questionnaire were analyzed. Participants with BMI <18.5 kg/m^2 were excluded from analysis because small sample size (n=261) precluded analysis in this subgroup.

Measures

Lifetime drinkers consumed ≥12 alcoholic drinks in their lifetime, whereas never drinkers consumed <12 drinks in their lifetime.[21,22] Among lifetime drinkers, current drinkers consumed one or more alcoholic drink in the past 12 months.[21,22] Frequency of any drinking days in the past 12 months was reported as number of days per week or per month and converted to total number of days in the past 12 months. Average quantity of drinks consumed per drinking day was reported as a whole number. Continued drinking volume, which represents the total number of drinks in the past year beyond one drink per drinking day, was defined as volume (frequency of any drinking days × average quantity of drinks consumed per drinking day) − frequency of any drinking days.[23−25] When examining frequency of any drinking days and continued volume simultaneously, frequency of any drinking days represents the number of days consuming one drink, whereas continued volume represents heavier drinking. Heavy drinking was defined as, in a day, consuming five or more drinks among males or four or more drinks among females.[21] Owing to the rarity of heavy drinking, frequency of heavy drinking days in the past 12 months was categorized into the following groups: none, once to monthly (i.e., one to 12 times), more than monthly to weekly (i.e., 13−52 times), and more than weekly (i.e., ≥53 times).

Anthropometric data, including height and weight, were measured by trained personnel using standardized procedures and calibrated equipment.[26] BMI was defined as weight in kg divided by height in m^2 and was categorized as healthy weight (BMI 18.5 to <25 kg/m^2); overweight (BMI 25 to <30 kg/m^2); and Class 1 (BMI 30 to <35 kg/m^2), Class 2 (BMI 35 to <40 kg/m^2), and Class 3 (BMI ≥40 kg/m^2) obesity.[3]

Individuals who reported that, in the past 12 months, they intentionally lost ≥10 pounds and those who reported trying to lose weight were defined as having a weight loss attempt.

Demographic variables were self-reported via questionnaire. Birthdate was reported by the participant and actual or imputed birthdate was used to calculate age in years. Ages ≥80 years were reported as 80 years.[27] Race/ethnicity was categorized into Hispanic (Mexican American and other Hispanic); white, non-Hispanic; black, non-Hispanic; and other race (including multiracial). Education level was defined as less than high school (< 9th grade and 9th−11th grade, including 12th grade with no diploma), high school graduate/GED or equivalent, some college or associate's degree, and college graduate or higher. Annual household income was categorized as <$35,000, $35,000−$64,999, $65,000−$99,999, and ≥$100,000. People who reported, in the past week, working at a job or business or with a job or business but not at work were considered employed.[28] Marital status was categorized as married or living with a partner; never married; or widowed, divorced, or separated. Smoking status was self-reported as current smoker (now smoking every day or some days), former smoker (smoked ≥100 cigarettes in lifetime but no current use), and never smoker (smoked <100 cigarettes in lifetime).[29] Definitions for comorbidities (i.e., depression symptoms, high cholesterol, hypertension, coronary heart disease, stroke, diabetes, and chronic obstructive pulmonary disease) and physical activity are described in the online Appendix.

Statistical Analysis

Nonresponse differences in the sample and the unequal probability of sample selection were accounted for using SAS, version 9.4 survey procedures. Respondents not included in the study population (i.e., had BMI <18.5 kg/m^2 or missing data on weight status or alcohol use) were included in SE computations to fully account for the complex sample design. Estimates with a relative SE >30% were suppressed.[30] All analyses were stratified by sex.

Descriptive statistics were used to report the distribution of the weighted sample across alcohol use variables by weight status and weight loss attempt categories.

Multinomial logistic regression was used to examine associations between current drinking and weight status among all adults (Model 1), as well as associations between alcohol use patterns (i.e., frequency of any drinking days and continued volume [Model 2] and frequency of heavy drinking days [Model 3]) and weight status among current drinkers. Adjusted models controlled for the following potential confounders: age, race/ethnicity, education, employment status, income, marital status, smoking status, depression symptoms, high cholesterol, hypertension, coronary heart disease, stroke, diabetes, chronic obstructive pulmonary disease, physical activity, and weight loss attempt.[6,11,21,22,31] Because the parallel assumption was not met in ordinal logistic regression models, multinomial logistic regression models were used to test the odds of higher weight categories versus healthy weight by level of alcohol use. The overall p-value from each model is reported, as well as the unadjusted and adjusted odds and 95% CIs of each weight category (overweight and Class 1, 2, and 3 obesity) versus healthy weight for higher versus the lowest levels of alcohol use. The null hypothesis for each model indicates that alcohol use is not associated with weight status. The overall p-value was used to assess the overall association, whereas comparisons of each weight category versus healthy weight were made by examining 95% CIs for the AORs.

Logistic regression was used to examine associations between weight loss attempt and current drinking among all adults (Model 4). Linear regression was used to examine associations between weight loss attempt and frequency of any drinking days (Model 5) and quantity of drinks consumed per drinking day (Model 6) among current drinkers. Multinomial logistic regression was used to examine associations between weight loss attempt and frequency of heavy drinking days (Model 7) among current drinkers; the unadjusted and adjusted odds and 95% CIs of each frequency category versus none are reported. Models were adjusted for potential confounders described previously, in addition to categorical weight status 1 year ago. Those who were underweight 1 year ago were excluded from analyses examining associations between weight loss attempt and alcohol use.

RESULTS

This report includes 14,095 of 16,323 eligible 2011–2016 NHANES participants aged ≥20 years, representing an estimated 202 million U.S. adults (Appendix Figure 1, available online). Among males, an estimated 22.8% (95% CI=21.1, 24.4) had Class 1 obesity, 8.0% (95% CI=7.5, 9.0) had Class 2 obesity, and 5.2% (95% CI=4.3, 6.2) had Class 3 obesity; 41.7% (95% CI=39.8, 43.6) attempted to lose weight in the past year (Table 1). The corresponding percentages in females were 20.1% (95% CI=18.8, 21.3), 11.2% (95% CI=10.4, 12.1), 9.4% (95% CI=8.5, 10.4), and 57.2% (95% CI=55.7, 58.7), respectively.

An estimated 78.1% (95% CI=76.0, 80.3) of males and 70.1% (95% CI=67.4, 72.8) of females were current drinkers (Table 1). The estimated proportion of current drinking ranged from 69.0% (95% CI=62.2, 75.9) among males with Class 3 obesity to 80.5% (95% CI=77.9, 83.2) among those with healthy weight, and from 64.0% (95% CI=59.3, 68.7) among females with Class 2 obesity to 76.5% (95% CI=72.9, 80.1) among those with healthy weight. Both frequency of any drinking days and continued volume appeared lowest among males with Class 2 and 3 obesity (Table 2). Frequency of any drinking days appeared lowest among females with Class 2 and 3 obesity; continued volume appeared lowest among females who were overweight (Table 2).

Compared with males who were not current drinkers, current drinkers had lower odds of Class 3 obesity versus healthy weight (AOR=0.62, 95% CI=0.42, 0.92) (Table 3, Model 1).

In unadjusted and adjusted models, among male current drinkers, lower frequency of any drinking days was associated with higher weight status versus healthy weight (Table 3, Model 2). For example, every 30 more days when one drink was consumed in the past year was associated with an AOR of 0.95 (95% CI=0.90, 1.00) for Class 1 obesity, 0.89 (95% CI=0.83, 0.96) for Class 2 obesity, and 0.90 (95% CI=0.82, 0.98) for Class 3 obesity versus healthy weight. After adjustment for frequency of drinking days and potential confounders, there was not a significant association between continued volume and weight status. There was not a significant association between frequency of heavy drinking days and weight status (Table 3, Model 3) in unadjusted or adjusted models.

Female current drinkers had lower odds of Class 1 (AOR=0.67, 95% CI=0.50, 0.90), Class 2 (AOR=0.62, 95% CI=0.46, 0.83), and Class 3 (AOR=0.66, 95% CI=0.49, 0.89) obesity versus healthy weight (Table 3, Model 1).

Among female current drinkers, lower frequency of any drinking days and higher continued volume (Model 2), as well as lower frequency of heavy drinking days (Model 3), were significantly associated with higher weight status versus healthy weight; for frequency of any drinking days, associations were more pronounced with greater obesity severity (Table 3). For example, every 30 more days in the past year when one drink was consumed was associated with an AOR of 0.90 (95% CI=0.85, 0.95) for Class 1 obesity, 0.73 (95% CI=0.64, 0.84) for Class 2 obesity, and 0.71 (95% CI=0.63, 0.81) for Class 3 obesity versus healthy weight. A continued

Table 1. Characteristics of U.S. Adults ≥20 Years With BMI ≥18.5 kg/m^2, 2011–2016 NHANES

	Total		Males		Females	
Characteristics	**Weighted N[a]**	**% (95% CI)[b]**	**Weighted N[a]**	**% (95% CI)[b]**	**Weighted N[a]**	**% (95% CI)[b]**
Age, years (median, Q1–Q3)	47.6	(33.2–60.8)	46.2	(32.0–59.4)	49.0	(34.8–62.4)
Race/ethnicity						
Hispanic	28,777	14.3 (11.3, 17.2)	14,927	14.9 (11.9, 17.9)	13,850	13.7 (10.8, 16.6)
White, non-Hispanic	135,363	67.1 (62.8, 71.4)	67,358	67.1 (62.8, 71.4)	68,004	67.1 (62.7, 71.5)
Black, non-Hispanic	21,943	10.9 (8.6, 13.1)	10,222	10.2 (8.1, 12.3)	11,721	11.6 (9.1, 14.1)
Other race	15,672	7.8 (6.6, 8.9)	7,896	7.9 (6.5, 9.2)	7,777	7.7 (6.6, 8.8)
Education						
Less than high school	29,944	14.8 (12.9, 16.8)	15,875	15.8 (13.6, 18.0)	14,070	13.9 (11.9, 15.8)
High school	42,398	21.0 (19.5, 22.5)	22,254	22.2 (20.4, 23.9)	20,144	19.9 (18.2, 21.6)
Some college	66,183	32.8 (31.2, 34.4)	30,311	30.2 (28.5, 31.9)	35,872	35.4 (33.5, 37.3)
College graduate or higher	63,181	31.3 (28.3, 34.3)	31,945	31.8 (28.5, 35.1)	31,236	30.8 (27.9, 33.8)
Employed	126,566	62.8 (60.8, 64.7)	69,917	69.7 (67.5, 71.9)	56,649	55.9 (53.7, 58.1)
Annual household income						
<$35,000	57,470	30.6 (27.6, 33.5)	25,698	27.6 (24.6, 30.5)	31,772	33.5 (30.4, 36.7)
$35,000–$64,999	46,659	24.8 (23.1, 26.5)	23,104	24.8 (22.9, 26.6)	23,555	24.8 (22.9, 26.8)
$65,000–$99,999	33,289	17.7 (16.3, 19.1)	17,672	18.9 (17.4, 20.5)	15,617	16.5 (14.9, 18.1)
≥$100,000	50,650	26.9 (23.4, 30.5)	26,795	28.7 (25.0, 32.5)	23,856	25.2 (21.7, 28.6)
Marital status						
Married or living with partner	126,670	62.8 (60.8, 64.8)	66,732	66.5 (64.2, 68.7)	59,938	59.1 (57.0, 61.3)
Never married	37,351	18.5 (16.5, 20.5)	21,040	21.0 (18.7, 23.2)	16,310	16.1 (14.1, 18.1)
Widowed, divorced, separated	37,705	18.7 (17.5, 19.8)	12,620	12.6 (11.2, 14.0)	25,085	24.8 (23.5, 26.1)
Smoking status						
Current	38,360	19.0 (17.7, 20.3)	21,587	21.5 (19.9, 23.2)	16,773	16.6 (15.0, 18.1)
Former	51,048	25.3 (23.8, 26.8)	29,417	29.3 (27.7, 31.0)	21,631	21.4 (19.3, 23.4)
Never	112,231	55.7 (54.0, 57.3)	49,350	49.2 (47.2, 51.2)	62,881	62.1 (60.1, 64.1)
Depression symptoms in past 2 weeks	15,975	8.0 (7.2, 8.7)	5,666	5.7 (4.9, 6.4)	10,309	10.2 (9.2, 11.3)
High cholesterol[c]	23,084	11.9 (10.9, 12.8)	9,908	10.3 (9.2, 11.3)	13,177	13.5 (12.2, 14.9)
Hypertension[c]	78,528	39.6 (38.0, 41.2)	38,606	39.0 (37.3, 40.8)	39,922	40.1 (38.2, 42.0)
Coronary heart disease[c]	14,114	7.0 (6.4, 7.6)	7,799	7.8 (7.0, 8.6)	6,315	6.2 (5.5, 7.0)
Stroke[c]	5,542	2.7 (2.5, 3.0)	2,587	2.6 (2.1, 3.0)	2,955	2.9 (2.5, 3.5)
Diabetes[c]	21,363	10.6 (9.8, 11.4)	10,994	11.0 (9.9, 11.9)	10,368	10.2 (9.3, 11.2)
Chronic obstructive pulmonary disease[c]	14,328	7.1 (6.4, 7.9)	5,285	5.3 (4.5, 6.1)	9,043	8.9 (7.9, 10.0)
Physical activity, MET-minutes per week (median, Q1–Q3)	1,422.5	(190.5–4,196.0)	1,995.7	(389.0–6,076.4)	922.5	(0.0–2,758.4)
BMI, kg/m^2 (median, Q1–Q3)	28.0	(24.4–32.7)	27.9	(24.8–31.9)	28.1	(23.9–33.6)

(*continued on next page*)

Table 1. Characteristics of U.S. Adults ≥20 Years With BMI ≥18.5 kg/m^2, 2011–2016 NHANES (*continued*)

Characteristics	Total		Males		Females	
	Weighted N[a]	% (95% CI)[b]	Weighted N[a]	% (95% CI)[b]	Weighted N[a]	% (95% CI)[b]
Weight status						
Healthy weight (BMI 18.5–<25 kg/m^2)	56,759	28.1 (26.6, 29.7)	25,534	25.4 (23.9, 27.0)	31,224	30.8 (28.8, 32.8)
Overweight (BMI 25–<30 kg/m^2)	67,243	33.3 (32.1, 34.6)	38,424	38.3 (36.5, 40.0)	28,819	28.4 (26.8, 30.1)
Class 1 obesity (BMI 30–<35 kg/m^2)	43,227	21.4 (20.4, 22.5)	22,875	22.8 (21.1, 24.4)	20,352	20.1 (18.8, 21.3)
Class 2 obesity (BMI 35–<40 kg/m^2)	19,691	9.8 (9.1, 10.4)	8,304	8.3 (7.5, 9.0)	11,387	11.2 (10.4, 12.1)
Class 3 obesity (BMI ≥40 kg/m^2)	14,836	7.4 (6.6, 8.1)	5,266	5.2 (4.3, 6.2)	9,570	9.4 (8.5, 10.4)
Weight loss attempt in past year	97,936	49.4 (48.1, 50.8)	41,424	41.7 (39.8, 43.6)	56,512	57.2 (55.7, 58.7)
Lifetime drinker	178,154	88.3 (86.8, 89.9)	92,984	92.6 (91.2, 94.1)	85,170	84.1 (82.2, 86.0)
Current drinker[d]	149,370	74.1 (71.9, 76.3)	78,413	78.1 (76.0, 80.3)	70,957	70.1 (67.4, 72.8)
Frequency of any drinking days[d,e] (median, Q1–Q3)	47.5	(11.1–103.7)	51.1	(11.8–152.9)	22.4	(5.4–101.2)
Average quantity of drinks per drinking day[d,e] (median, Q1–Q3)	1.5	(1.0–2.7)	1.9	(1.0–3.6)	1.2	(1.0–1.9)
Continued volume[d,e,f] (median, Q1–Q3)	22.8	(0.0–155.3)	54.8	(0.0–300.4)	3.4	(0.0–71.1)
Frequency of heavy drinking days[d,g]						
Nondrinker	52,189	25.9 (23.7, 28.1)	21,939	21.9 (19.8, 24.0)	30,250	29.9 (27.2, 32.6)
None	83,123	41.3 (39.4, 43.1)	37,237	37.2 (35.3, 39.0)	45,886	45.4 (43.1, 47.6)
Once to monthly	38,894	19.3 (18.1, 20.5)	21,615	21.6 (20.1, 23.0)	17,279	17.1 (15.6, 18.6)
>Monthly to weekly	15,063	7.5 (6.7, 8.2)	10,335	10.3 (9.3, 11.4)	4,729	4.7 (3.7, 5.7)
>Weekly	12,105	6.0 (5.3, 6.7)	9,079	9.1 (7.8, 10.3)	3,026	3.0 (2.5, 3.5)

[a]In thousands.
[b]Unless otherwise specified.
[c]In lifetime.
[d]In past year.
[e]Among current drinkers.
[f]Total number of drinks beyond one drink per drinking occasion, (frequency of any drinking days × average quantity of drinks consumed per drinking day) - frequency of any drinking days.
[g]Consumed ≥5 drinks in a single day in males and ≥4 drinks in a single day in females.
MET, metabolic equivalent of task; NHANES, National Health and Nutrition Examination Survey; Q1, quartile 1; Q3, quartile 3.

Table 2. Alcohol Use Among U.S. Adults ≥20 Years With BMI ≥18.5 kg/m^2, by Weight Status, 2011–2016 NHANES

	Weight status[a]									
	Healthy weight		Overweight		Class 1 obesity		Class 2 obesity		Class 3 obesity	
Alcohol use	Weighted N[b]	% (95% CI)[c]	Weighted N[b]	% (95% CI)[c]	Weighted N[b]	% (95% CI)[c]	Weighted N[b]	% (95% CI)[c]	Weighted N[b]	% (95% CI)[c]
Males										
Lifetime drinker	23,487	92.0 (90.2, 93.8)	35,697	92.9 (90.9, 95.0)	21,131	92.4 (90.6, 94.2)	7,833	94.3 (92.2, 96.5)	4,836	91.8 (87.9, 95.7)
Current drinker[d]	20,553	80.5 (77.9, 83.2)	30,186	78.6 (75.6, 81.6)	17,370	76.0 (72.8, 79.1)	6,668	80.3 (76.3, 84.4)	3,636	69.0 (62.2, 75.9)
Frequency of any drinking days[d,e] (median, Q1–Q3)	51.3	(11.9–152.4)	50.9	(13.9–152.5)	50.7	(11.5–150.9)	28.5	(10.1–103.0)	30.8	(98–101.5)
Average quantity of drinks per drinking day[d,e] (median, Q1–Q3)	1.9	(1.0–3.7)	1.8	(1.0–3.2)	2.0	(1.0–3.7)	2.0	(1.0–4.0)	2.2	(1.1–4.2)
Continued volume[d,e,f] (median, Q1–Q3)	68.7	(0.0–302.9)	69.0	(0.0–302.2)	51.8	(0.0–258.7)	45.0	(0.0–202.6)	47.0	(1.7–288.6)
Frequency of heavy drinking days[d,g]										
Nondrinker	4,966	19.5 (16.9, 22.2)	8,207	21.4 (18.4, 24.4)	5,500	24.1 (20.9, 27.3)	1,636	19.7 (15.7, 23.8)	1,630	31.0 (24.1, 37.8)
None	9,920	39.0 (35.7, 42.3)	13,946	36.3 (33.3, 39.4)	8,323	36.4 (33.3, 39.5)	3,320	40.1 (33.4, 46.7)	1,728	32.8 (26.1, 39.6)
Once to monthly	5,214	20.5 (18.0, 23.0)	8,915	23.2 (20.3, 26.2)	4,724	20.7 (18.4, 23.0)	1,735	20.9 (14.6, 27.3)	1,027	19.5 (13.6, 25.3)
>Monthly to weekly	2,635	10.4 (8.0, 12.7)	3,898	10.2 (8.8, 11.5)	2,304	10.1 (7.8, 12.4)	928	11.2 (6.8, 15.6)	570	10.8 (6.5, 15.2)
>Weekly	2,696	10.6 (8.3, 12.9)	3,411	8.9 (6.9, 10.9)	1,994	8.7 (6.4, 11.1)	668	8.1 (5.2, 10.9)	310	5.9 (2.6, 9.2)
Females										
Lifetime drinker	27,147	87.0 (84.4, 89.5)	23,764	82.5 (80.0, 85.0)	16,556	81.4 (78.5, 84.4)	9,512	83.6 (80.5, 86.6)	8,192	85.8 (83.2, 88.3)
Current drinker[d]	23,872	76.5 (72.9, 80.1)	19,987	69.4 (65.8, 73.0)	13,382	65.9 (62.0, 69.8)	7,271	64.0 (59.3, 68.7)	6,446	67.5 (62.9, 72.2)
Frequency of any drinking days[d,e] (median, Q1–Q3)	48.9	(10.7–103.7)	23.1	(7.4–101.0)	20.7	(4.6–54.8)	10.6	(3.4–33.8)	10.4	(3.1–31.3)
Average quantity of drinks per drinking day[d,e] (median, Q1–Q3)	1.2	(1.0–1.9)	1.0	(1.0–1.9)	1.2	(1.0–2.0)	1.2	(1.0–2.0)	1.2	(1.0–2.0)
Continued volume[d,e,f] (median, Q1–Q3)	9.8	(0.0–100.4)	0.4	(0.0–51.7)	4.5	(0.0–71.4)	2.0	(0.0–34.8)	3.0	(0.0–24.9)
Frequency of heavy drinking days[d,g]										
Nondrinker	7,335	23.5 (19.9, 27.1)	8,807	30.6 (27.0, 34.2)	6,921	34.1 (30.2, 38.0)	4,088	36.1 (31.4, 40.8)	3,099	32.5 (27.8, 37.2)
None	14,287	45.8 (41.8, 49.7)	13,082	45.4 (42.1, 48.8)	8,637	42.6 (38.7, 46.4)	5,364	47.4 (42.0, 52.8)	4,516	47.3 (41.5, 53.2)
Once to monthly	6,473	20.7 (17.8, 23.7)	4,746	16.5 (14.2, 18.8)	3,388	16.7 (13.2, 20.2)	1,299	11.5 (8.5, 14.5)	1,372	14.4 (10.8, 17.9)
>Monthly to weekly	2,114	6.8 (4.6, 9.0)	1,151	4.0 (2.7, 5.3)	737	3.6 (2.2, 5.1)	377	3.3 (1.8, 4.8)	349	3.7 (1.9, 5.4)
>Weekly	1,010	3.2 (2.2, 4.2)	1,008	3.5 (2.2, 4.8)	613	3.0 (1.7, 4.4)	191	[h]	204	2.1 (0.9, 3.4)

[a]Healthy weight (BMI 18.5–<25 kg/m^2), overweight (BMI 25–<30 kg/m^2), and Class 1 (BMI 30–<35 kg/m^2), Class 2 (BMI 35–<40 kg/m^2), and Class 3 (BMI ≥40.0 kg/m^2) obesity.
[b]In thousands.
[c]Unless otherwise specified.
[d]In past year.
[e]Among current drinkers.
[f]Total number of drinks beyond one drink per drinking occasion, (frequency of any drinking days × average quantity of drinks consumed per drinking day)–frequency of any drinking days.
[g]Consumed ≥5 drinks in a single day in males and ≥4 drinks in a single day in females.
[h]Estimate suppressed; relative SE >30%.
NHANES, National Health and Nutrition Examination Survey; Q1, quartile 1; Q3, quartile 3.

Table 3. Unadjusted and Adjusted Odds of Overweight and Obesity by Past-Year Alcohol Use, 2011–2016 NHANES

Alcohol use in past year	ORs/AORs of overweight and obesity vs healthy weight[a]				*p*-value
	Overweight[a]	Class 1 obesity[a]	Class 2 obesity[a]	Class 3 obesity[a]	
Among all males, unadjusted OR (95% CI)	0.89 (0.73, 1.08)	0.76 (0.62, 0.95)	0.99 (0.71, 1.36)	0.54 (0.39, 0.75)	**0.003**
Model 1, Current drinker (ref=no)					
Among male current drinkers, unadjusted OR (95% CI)					
Model 2					
Frequency of any drinking days (per 30 more days/year)	1.02 (0.98, 1.06)	0.97 (0.93, 1.00)	0.92 (0.87, 0.97)	0.88 (0.82, 0.93)	**<0.001**
Continued volume (per 30 more drinks/year)	0.99 (0.98, 1.00)	1.00 (0.99, 1.00)	1.00 (0.99, 1.01)	1.01 (1.00, 1.01)	**0.004**
Model 3					
Frequency of heavy drinking days[b] (ref=none)					0.73
Once to monthly	1.22 (0.94, 1.56)	1.08 (0.85, 1.37)	0.99 (0.65, 1.51)	1.13 (0.71, 1.80)	
>Monthly to weekly	1.05 (0.80, 1.39)	1.04 (0.71, 1.53)	1.05 (0.64, 1.72)	1.24 (0.74, 2.08)	
>Weekly	0.90 (0.64, 1.27)	0.88 (0.62, 1.25)	0.74 (0.48, 1.15)	0.66 (0.34, 1.29)	
Among all females, unadjusted OR (95% CI)					
Model 1					
Current drinker (ref=no)	0.70 (0.58, 0.84)	0.59 (0.48, 0.74)	0.55 (0.44, 0.68)	0.64 (0.49, 0.84)	**<0.001**
Among female current drinkers, unadjusted OR (95% CI)					
Model 2					
Frequency of any drinking days (per 30 more days/year)	0.97 (0.94, 1.01)	0.90 (0.85, 0.95)	0.72 (0.64, 0.81)	0.67 (0.60, 0.76)	**<0.001**
Continued volume (per 30 more drinks/year)	1.00 (0.99, 1.02)	1.03 (1.01, 1.05)	1.04 (1.02, 1.06)	1.05 (1.03, 1.08)	**0.001**
Model 3					
Frequency of heavy drinking days[c] (ref=none)					**0.01**
Once to monthly	0.80 (0.63, 1.02)	0.87 (0.63, 1.20)	0.54 (0.36, 0.80)	0.67 (0.48, 0.93)	
>Monthly to weekly	0.59 (0.37, 0.96)	0.58 (0.39, 0.87)	0.48 (0.25, 0.92)	0.52 (0.29, 0.95)	
>Weekly	1.09 (0.67, 1.76)	1.01 (0.56, 1.80)	0.50 (0.22, 1.14)	0.64 (0.34, 1.22)	
Among all males, AOR[b] (95% CI)					
Model 1					
Current drinker (ref=no)	0.93 (0.75, 1.16)	0.83 (0.65, 1.07)	1.12 (0.81, 1.55)	0.62 (0.42, 0.92)	**0.04**
Among male current drinkers, AOR[b] (95% CI)					
Model 2					
Frequency of any drinking days (per 30 more days/year)	1.00 (0.95, 1.04)	0.95 (0.90, 1.00)	0.89 (0.83, 0.96)	0.90 (0.82, 0.98)	**0.001**
Continued volume (per 30 more drinks/year)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.01 (1.00, 1.02)	1.01 (1.00, 1.02)	0.14
Model 3					
Frequency of heavy drinking days[b] (ref=none)					0.27
Once to monthly	1.45 (1.07, 1.97)	1.31 (1.00, 1.74)	1.21 (0.75, 1.96)	1.32 (0.77, 2.24)	
>Monthly to weekly	1.67 (1.15, 2.41)	1.60 (1.05, 2.44)	1.40 (0.78, 2.49)	1.75 (0.86, 3.55)	

(*continued on next page*)

Table 3. Unadjusted and Adjusted Odds of Overweight and Obesity by Past-Year Alcohol Use, 2011–2016 NHANES (*continued*)

Alcohol use in past year	ORs/AORs of overweight and obesity vs healthy weight[a]				*p*-value
	Overweight[a]	Class 1 obesity[a]	Class 2 obesity[a]	Class 3 obesity[a]	
>Weekly	1.37 (0.91, 2.07)	1.15 (0.76, 1.73)	0.95 (0.54, 1.67)	1.07 (0.52, 2.21)	
Among all females, AOR[b] (95% CI)					
Model 1					
Current drinker (ref=no)	0.81 (0.65, 1.01)	0.67 (0.50, 0.90)	0.62 (0.46, 0.83)	0.66 (0.49, 0.89)	**0.01**
Among female current drinkers, AOR[b] (95% CI)					
Model 2					
Frequency of any drinking days (per 30 more days/year)	0.97 (0.93, 1.01)	0.90 (0.85, 0.95)	0.73 (0.64, 0.84)	0.71 (0.63, 0.81)	**<0.001**
Continued volume (per 30 more drinks/year)	1.00 (0.98, 1.02)	1.02 (1.00, 1.04)	1.03 (1.01, 1.06)	1.03 (1.01, 1.06)	**0.049**
Model 3					
Frequency of heavy drinking days[c] (ref=none)					**0.002**
Once to monthly	0.87 (0.66, 1.14)	0.94 (0.64, 1.39)	0.54 (0.33, 0.89)	0.72 (0.50, 1.04)	
>Monthly to weekly	0.73 (0.42, 1.18)	0.70 (0.42, 1.20)	0.50 (0.24, 1.05)	0.52 (0.27, 0.99)	
>Weekly	1.12 (0.64, 1.95)	0.87 (0.47, 1.61)	0.36 (0.14, 0.93)	0.33 (0.16, 0.68)	

Note: Boldface indicates statistical significance ($p<0.05$).
[a]Healthy weight (BMI 18.5–<25 kg/m^2), overweight (BMI 25–<30 kg/m^2), and Class 1 (BMI 30–<35 kg/m^2), Class 2 (BMI 35–<40 kg/m^2), and Class 3 (BMI ≥40.0 kg/m^2) obesity.
[b]All models adjusted for age, race/ethnicity, education, employment status, annual household income, marital status, smoking status, depression symptoms, high cholesterol, hypertension, coronary heart disease, stroke, diabetes, chronic obstructive pulmonary disease, physical activity, and weight loss attempt.
[c]Consumed ≥5 drinks in a single day in males and ≥4 drinks in a single day in females.
NHANES, National Health and Nutrition Examination Survey.

volume of 30 drinks per year beyond one drink per drinking day was associated with an AOR of 1.02 (95% CI=1.00, 1.04) for Class 1 obesity, 1.03 (95% CI=1.01, 1.06) for Class 2 obesity, and 1.03 (95% CI=1.01, 1.06) for Class 3 obesity versus healthy weight. In general, any heavy drinking versus none was associated with lower odds of Class 2 or 3 obesity versus healthy weight (Table 3, Model 3). Results were similar between unadjusted and adjusted models.

The proportion of current drinkers was similar among males who did (78.2%, 95% CI=75.6, 80.9) and did not (78.7%, 95% CI=76.4, 81.0) attempt to lose weight, but higher among females who did (74.4%, 95% CI=71.4, 77.4) versus did not (66.1%, 95% CI=62.9, 69.2) attempt to lose weight (Appendix Table 1, available online). After adjusting for confounders, there were no significant associations between attempting to lose weight and any alcohol use variable among males (Table 4, Models 4–7). With adjusting for confounders, females who did versus did not attempt to lose weight had greater odds of current drinking (AOR=1.32, 95% CI=1.08, 1.61). Additionally, among female current drinkers, those who attempted to lose weight were more likely to have reported heavy drinking in the past year (once to monthly: AOR=1.51, 95% CI=1.18, 1.93; more than monthly to weekly: AOR=1.60, 95% CI=1.05, 2.42; more than weekly: AOR=1.58, 95% CI=0.87, 2.87) versus those who did not attempt to lose weight. However, associations between attempting to lose weight and frequency of any drinking or average quantity of drinks per drinking day were not significant after adjusting for confounders (Table 4, Models 5 and 6). In general, associations were stronger in the unadjusted models than the adjusted models except that, among female current drinkers, associations between weight loss attempt and frequency of heavy drinking days were stronger after adjustment for confounders.

DISCUSSION

Although prior work has reported an inverse association between frequency of alcohol use and obesity,[22] results of this nationally representative study are the first to demonstrate that the magnitude of the inverse association is stronger with higher levels of weight status. This is important because health status, on average, is substantially worse with each higher grade of obesity, and the prevalence of higher classes of obesity is increasing in the U.S.[32,33] Despite controlling for potential confounders, higher frequency of any drinking days may represent better health because drinking is often contraindicated among individuals with poorer health. This study also determined that greater continued volume, or how much

Table 4. Associations of Past-Year Weight Loss Attempt With Alcohol Use, 2011–2016 NHANES

	Weight loss attempt (ref=no attempt)							
	Unadjusted models				Adjusted models[a]			
Alcohol use in past year	Males	*p*-value	Females	*p*-value	Males	*p*-value	Females	*p*-value
Among all adults, OR/AOR[a] (95% CI)								
Model 4, Current drinker (ref=no)	1.04 (0.90, 1.21)	0.60	1.52 (1.33, 1.74)	**<0.001**	0.97 (0.81, 1.15)	0.71	1.32 (1.08, 1.61)	**0.01**
Among current drinkers								
Model 5, Frequency of any drinking days, β (95% CI)	−13.51 (−21.19, −5.84)	**<0.001**	−6.67 (−15.28, 1.94)	0.13	−9.14 (−19.82, 1.53)	0.09	5.37 (−3.75, 14.48)	0.24
Model 6, Average quantity of drinks per drinking day, β (95% CI)	−0.23 (−0.46, −0.001)	**0.049**	0.16 (0.04, 0.28)	**0.01**	−0.17 (−0.42, 0.08)	0.17	0.15 (−0.01, 0.30)	0.06
Model 7, Frequency of heavy drinking days[b] (ref=none), OR/AOR[a] (95% CI)		0.15		**<0.001**		0.85		**0.004**
Once to monthly	1.10 (0.92, 1.31)		1.45 (1.19, 1.77)		0.97 (0.77, 1.23)		1.51 (1.18, 1.93)	
>Monthly to weekly	0.90 (0.70, 1.17)		1.37 (0.94, 1.98)		0.86 (0.61, 1.22)		1.60 (1.05, 2.42)	
>Weekly	0.77 (0.55, 1.08)		1.18 (0.75, 1.85)		0.91 (0.60, 1.36)		1.58 (0.87, 2.87)	

Note: Boldface indicates statistical significance ($p<0.05$).
[a]AOR of alcohol use as described in the table, for those who attempted weight loss in the past year versus those who did not. All models adjusted for age, race/ethnicity, education, employment status, annual household income, marital status, smoking status, depression symptoms, high cholesterol, hypertension, coronary heart disease, stroke, diabetes, chronic obstructive pulmonary disease, physical activity, and weight status 1 year ago.
[b]Consumed ≥5 drinks in a single day in males and ≥4 drinks in a single day in females.
NHANES, National Health and Nutrition Examination Survey.

alcohol is consumed beyond one drink per drinking day, is associated with higher odds of Class 1–3 obesity among female adults. This association may reflect that continued volume is a marker of heavier drinking, which is correlated with higher calorie consumption from alcohol. Examining both frequency of any drinking days and continued volume simultaneously is important because someone who has one drink frequently is quite different than someone who drinks infrequently but consumes five or more drinks per drinking occasion. Although direct comparisons to previous research are impeded by differences in measurement of alcohol use, the current findings agree with those from previous research showing that the odds of obesity were higher among those with heavy drinking.[21,22]

Because alcohol use was examined among current drinkers, rather than among all adults, these findings address a prior weakness in the published literature, which used nondrinkers as their reference group.[21,22] Findings also build upon the previous literature by examining associations between alcohol use patterns (i.e., continued volume and frequency of heavy drinking days) and weight status, as suggested by a review article on the topic, rather than frequency or quantity of alcohol use alone.[10] Prior research not accounting for alcohol use patterns concluded that moderate drinking, or lower quantity of alcohol,[21,22] lowers the odds of obesity, findings that are inconsistent with those of this study.

In this study, after adjustment for potential confounders, there were no statistically significant associations between trying to lose weight and alcohol use among males. Females who were trying to lose weight had higher odds of being current drinkers and higher odds of heavy drinking at any frequency than females not trying to lose weight. It is unclear why this is the case but may reflect the cross-sectional nature of the study. For example, female current drinkers who also drink more heavily may be more likely to attempt weight loss than those who do not. It is important to note that alcohol use was measured over a 1-year period and not exclusively during the time of weight loss attempt. Future research should confirm these associations.

Limitations

Because of the cross-sectional design of this study, causality cannot be determined; it is possible that drinking patterns change after adults become obese or develop comorbidities. Prospective epidemiologic studies are needed to confirm the direction of these associations. In addition, some drinking patterns were rare, especially among females and among adults with Class 3 obesity, such that frequency of heavy drinking categories that might have slightly different effects were collapsed. Moreover, the authors did not control for calorie consumption from sources other than alcohol nor calorie consumption from alcohol directly or indirectly, such as increased calories consumed from food sources during intoxication. Finally, alcohol use in NHANES is self-reported, which may introduce bias. However, evidence suggests that self-reported alcohol use is a valid and reliable method for measuring alcohol consumption.[34] The strengths of this study are that it uses a large, nationally representative sample that allows for the examination of associations between alcohol use and weight status, differentiating Class 1–3 obesity, as well as weight loss attempt with alcohol use.

CONCLUSIONS

In this nationally representative sample of U.S. adults, among male and female current drinkers, higher frequency of days with alcohol use is associated with lower odds of obesity, whereas among female current drinkers higher continued volume (heavier drinking) is associated with higher odds of obesity. Male and female adults trying to lose weight do not drink less than those not trying to lose weight, and in fact, female adults trying to lose weight are more likely to drink at any or heavy levels. These findings should be confirmed in long-term prospective studies, particularly research that examines factors related to caloric intake from alcohol and other sources in a controlled setting and better characterizes individuals who are more likely to gain weight because of alcohol use. Because even modest weight loss can have profound health benefits at the population level, the effectiveness of limiting alcohol use on reducing caloric intake and achieving weight control should be investigated.

ACKNOWLEDGMENTS

All authors made substantial contribution to the conception and design of the study, wrote or revised the article for intellectual content, and read and approved the final version of the manuscript. Gretchen E. White was responsible for data analysis and interpretation. There was no funding for this manuscript.

Anita P. Courcoulas reports grants from NIH/National Institute of Diabetes and Digestive and Kidney Diseases/Patient-Centered Outcomes Research Institute, grants from Covidien/Ethicon, grants from Allurion, Inc., and project consulting for Apollo Endosurgery, outside the submitted work. No other financial disclosures were reported.

SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at https://doi.org/10.1016/j.amepre.2019.03.025.

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