Relationship Between Body Mass Index, Alcohol Use, and Alcohol Misuse in a Young Adult Female Twin Sample*

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ABSTRACT. Objective: The aim of this study was to examine the relationships between body mass index (BMI) and alcohol use and misuse in young adulthood in a sample of black and white female twins. **Method:** Cox proportional hazards and logistic regression models were used to examine the relationships between BMI category and first alcohol use, current weekly alcohol use, and current weekly heavy episodic drinking in 3,514 (14.06% black) young adult female twins. Analyses were conducted separately in black and white women. **Results:** After adjusting for relevant covariates, in white women obesity was protective against alcohol use (hazard ratio = 0.83; 95% confidence interval [CI]: 0.73-0.93) and against weekly drinking (odds ratio [OR] = 0.36; 95% CI: 0.24-0.53) and weekly heavy episodic drinking (OR = 0.51; 95% CI: 0.31-0.82) among ever drinkers compared with women of ideal weight. Overweight women living with their parents were less likely to be weekly drinkers (OR = 0.31; 95% CI: 0.16-0.61), whereas overweight women who were not living with their parents were less likely to be weekly heavy episodic drinkers (OR = 0.51; 95% CI: 0.31-0.82). Among black women, obesity was not associated with any of the drinking outcomes; however, black women who were overweight and who reported that the majority of their friends were not weekly drinkers had greater odds of reporting weekly drinking than those of ideal weight (OR = 2.91; 95% CI: 1.33-6.39). **Conclusions:** Obese white women were less likely to ever use alcohol, be weekly drinkers, or be weekly heavy episodic drinkers than their ideal-weight peers. Body weight may affect drinking behavior in young women, and this effect may differ by race. Future research is needed to identify mediators and moderators of this relationship as well as to explore racial differences in the effect of body weight on drinking behavior. (*J. Stud. Alcohol Drugs* **70:** 458-466, 2009)

THE PROPORTION OF AMERICAN WOMEN who are overweight or obese has increased dramatically in the past 50 years. According to recent data from the National Health and Nutrition Examination Survey 2003-2004, 22.8% of young women ages 20-39 years were overweight, and 28.9% were obese (Ogden et al., 2006). Obesity is a risk factor for many of the leading causes of death in American women, including cancer, heart disease, and diabetes mellitus (Calle et al., 2003; Li et al., 2006; Must et al., 1999) and is associated with shorter life expectancy, particularly among younger women (Fontaine et al., 2003).

Given that alcohol is relatively energy dense, with 7.1 kcal/g, compared with 4 kcal/g of protein or carbohydrates and 9 kcal/g of fat, it follows that higher consumption of alcohol should be associated with higher body weight. Findings from studies examining the relationship between alcohol consumption and weight have, however, been mixed (Suter, 2005). Some studies that have stratified by gender have found the association between body mass index (BMI; weight in kg/height in m²) and alcohol use to be greater in women than in men (Breslow and Smothers, 2005; Colditz et al., 1991; Wilsgaard et al., 2005), whereas others have found similar effects for both genders (Lahti-Koski et al., 2002; Tolstrup et al., 2005). Findings in women have still been somewhat heterogeneous, but, in general, BMI has been found to be negatively associated with frequency of alcohol consumption (Arif and Rohrer, 2005) and positively associated with the quantity of alcohol consumed (e.g., Breslow and Smothers, 2005; Tolstrup et al., 2005; Wilsgaard et al., 2005). Further confusing the issue are more consistent findings that abstinence from alcohol has been linked with greater BMI (Wilsgaard et al., 2005), higher likelihood of overweight and obesity (Breslow and Smothers, 2005; Lahti-Koski et al., 2002), and greater weight gain over time (Wilsgaard et al., 2005) in women. This suggests the possibility that a woman's weight may influence her drinking behavior in addition to her drinking behavior influencing her weight.

Many previously published studies on alcohol use and BMI in women have been conducted on samples containing women of a broad age range and consisting entirely of Caucasian women. Those studies that have included women of

different races/ethnicities have rarely addressed the possibility of racial differences in the relationship between alcohol use and BMI. If this relationship is explained by behavioral factors, there is the potential that the relationship between alcohol use and BMI differs by race and age. Therefore, the objective of the current study was to examine the relationship between BMI and alcohol use and misuse in a sample of young adult white and black women from a midwestern twin cohort. Although there have been other articles published using this dataset in which alcohol use was examined (Agrawal et al., 2006; Sartor et al., 2008), none have done so in the context of BMI categories, nor have they stratified by race.

Method

The Missouri Adolescent Female Twin Study (MOAFTS) is a study of female twin pairs born between 1975 and 1985 to parents residing in the state of Missouri. Parents of twins were identified and traced through birth records and contacted regarding participation (target n = 1,999 white and n = 370 black pairs representing all live-born pairs of Missouri resident parents; 95.9% of families located, n = 2,279). Participants reflect statewide demographics and include individuals of both African (black) and European (white) ancestry coming from rural and urban areas. Data collection from the twins began with the baseline interview in 1995-1999, when twins were of median age 15 (mean [SD] = 15.52 [2.42]; range: 12-23 years). Unless otherwise noted, data for the current study come from the Wave 4 data collection, which was conducted between 2000 and 2005, on average 5 years after the baseline assessment, when the twins were median age 22 (mean = 21.69 [2.76]; range: 18-29 years). Unlike for Waves 2 and 3, all women originally targeted at baseline were recontacted for the Wave 4 assessment unless they had previously been withdrawn from the study, because minors for whom parental consent was denied at baseline were of legal age of consent at Wave 4. Consequently the Wave 4 sample was larger than that for baseline (n = 3,787 vs n = 3,446). Seven percent (n = 273) of Wave 4 participants were excluded from the current analyses because of known pregnancy/postpartum status or because of missing data for height, weight, or alcohol-use variables, resulting in a final sample 3,514 (14.06% black) women. We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research. All protocols were approved by the institutional review board at the Washington University School of Medicine. Additional details regarding the sample are available elsewhere (Heath et al., 1999, 2002).

Study participants were interviewed with a telephone adaptation of the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA), a comprehensive structured psychiatric diagnostic instrument (Bucholz et al., 1994). Reliability data for individual diagnoses of the original SSAGA,

including alcohol dependence, other drug dependence, and depression have indicated good to excellent reliability, with κ exceeding .60 for most diagnoses studied (Bucholz et al., 1994; Hesselbrock et al., 1999). Unfortunately we do not have data on the reliability and validity of the single items from the alcohol section of the interview that were used in these analyses. Self-reported height and weight, elicited in the zygosity section of the interview, were used to compute BMI. Respondents were asked their co-twins' heights and weights in the zygosity section of the interview, and questions were sequenced (self-height, co-twin height, self-weight, co-twin weight) so that, at the time respondents were asked about their own weight, they could anticipate that their weight would also be reported by their twin sister. Respondents' BMI based on self-reported height and weight was highly correlated with that calculated based on their co-twins' reports at both time points (baseline r = .86 and follow-up r = .90). BMI categories were assigned based on standard adult BMI cutoffs: underweight (<18.5 kg/m^2), ideal weight (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), and obese (≥30 kg/m^2) (National Heart, Lung, and Blood Institute, 1998). Because only seven black women had BMIs in the underweight range, this category was eliminated for the analyses in black women, and underweight black women were instead combined with the ideal-weight category. Very few women in the sample met criteria for a strict Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV; American Psychiatric Association, 1994), lifetime diagnosis of eating disorder (19 with bulimia nervosa only, 20 with anorexia nervosa only, 3 with a history of both disorders, and 4 with a history of binge eating disorder). Unfortunately recency data for anorexic behaviors was not collected, and therefore it is not possible to determine the prevalence of eating disorders at the time of interview. However, one woman with a lifetime diagnosis of binge eating disorder and 15 women with bulimia nervosa reported binge eating in the past year at the time of interview.

Age at first alcohol use, current weekly drinking, and current weekly heavy episodic drinking outcomes were obtained from the alcohol-use disorder section of the interview, in which current alcohol use was queried extensively. Current weekly use was queried with the question: "During the past 12 months, on how many days have you had an alcoholic drink?" Heavy episodic drinking was assessed with the question, "In the past 12 months, on how many days did you have 5 (or more) drinks in a 24 hour period?" The 13 response options for both questions ranged from "every day" to "1 day/year." Women who indicated that they had consumed alcohol or had five or more drinks in a 24-hour period 1 day per week or more frequently in the past 12 months were coded positive for weekly drinking and weekly heavy episodic drinking, respectively.

Variables identified from the literature as being related to both BMI and alcohol use and available in the MOAFTS

datasets were selected as potential covariates. Age at interview (>22 vs ≤22 years), being currently in school, current employment status, living with parents, DSM-IV lifetime major depression, current smoking (women who had ever smoked at least once a week for 2 or more months and had smoked within the past 6 months), ever having had a romantic relationship, being involved in a current romantic relationship, marital status, having many friends, having a majority of friends who drink alcohol weekly, having a majority of friends who get drunk monthly, childhood sexual abuse (onset < 16 years), early menarche (<12 years), and weight shape concern (from the eating disorders diagnostic section; Duncan et al., 2007) were obtained from the twin interview. In addition, parental education (maternal and paternal education ≤ high school) was obtained from the parental (usually maternal) interview at baseline in which the parent completing the interview reported on their own and the other parent's educational achievement. Parental report data were not available for 528 white and 177 black women. Therefore maternal and paternal education variables were each included in multivariable models as a set of design variables (parental education ≤ high school or parental data missing, with parental education > high school as the referent). Maternal and paternal education less than or equal to high school were moderately correlated (tetrachoric correlation = .67).

Analyses were conducted separately in white and black women because of significant differences in the distribution of BMI by race. Black women were more likely than white women to be overweight and obese ($p < .001$). Statistical analyses were conducted using Stata Version 8 (StataCorp LP, College Station, TX), and standard errors were adjusted for the nonindependence of observations inherent in twin data using Huber-White robust variance estimation (StataCorp, 2003). Comparisons of alcohol-use variables and potential covariates across BMI categories were performed using chi-square. When omnibus tests proved statistically significant, post hoc tests were performed to determine which groups differed from one another. Because of the large number of statistical tests performed, the more stringent p value of .01 was adopted.

Since a portion of our sample was not through the age of risk for onset of alcohol use, a Cox proportional hazards model with time-dependent covariates was used to model time to onset of alcohol use (Cox, 1972). This statistical technique, a form of survival analysis, allows for censoring of individuals who have not yet developed the outcome (or may never develop the outcome), rather than assuming that those who have not experienced the outcome at the time of the analysis will never do so, as in logistic regression. Consequently, estimates of risk derived using survival analysis are thought to be more accurate. For the current analyses, data were transformed into a "person years" format with each individual having a row of data for each year of her life.

For a given time-dependent variable (childhood sexual abuse, menarche, major depression, regular smoking, ever had a romantic relationship), an individual was coded zero for each line of data until she reached the age at onset, after which the variable was coded one. Fixed covariates or covariates for which age at onset were not available were coded as time invariant (i.e., one on all rows of data for a given participant). Variables coded as time invariant included BMI categories, parental education, friends' weekly drinking, employment status, marital status, having many friends, and weight/shape concern. Once the final model was obtained, the proportional hazards assumption that risk remains constant over time was assessed using the Grambsch and Therneau test of the Schoenfeld residuals (Grambsch and Therneau, 1994). When a proportional hazards violation was identified, separate dummy variables were defined for different age periods for that variable based on which division(s) eliminated the proportional hazards violation (e.g., smoking before age 14, smoking between ages 14 and 16, and smoking after age 16), and separate hazards ratios were estimated for each period.

Current drinking outcomes (weekly drinking and weekly heavy episodic drinking in the past 12 months) were examined using logistic regression. These models, unlike the Cox regression models, were limited to women who had ever had a full drink of alcohol (white: $n = 2,635$; black: $n = 376$). For a given logistic or Cox regression model, potential confounders of the relationship between BMI category and the alcohol outcome were assessed by adding the variables into the base model one at a time. If the addition of the covariate caused the odds ratio (OR) or hazard ratio (HR) for any of the levels of the BMI category design variable to change by more than 10%, the variable was judged to be a confounder and was retained in the model. A change of less than 10% resulted in the variable being dropped from the model (Greenland, 1989). Interactions between the potential confounders and the BMI categories were also assessed.

Results

The ideal-weight category was the largest of the weight categories for both white and black women (66.99% and 43.93%, respectively; see Table 1). The prevalence of alcohol-use outcomes and potential covariates are shown by BMI category and race in Table 1. Among white women, those who were underweight had a lower prevalence of ever drinking than women in the other BMI categories, who did not differ from one another (omnibus $p = .006$), but women who had ever had a drink in the underweight and ideal-weight categories had significantly lower ages of onset than those in the obese category (omnibus $p < .001$). Obese white women had a lower prevalence of current weekly drinking than women in other BMI categories and a lower prevalence of weekly heavy episodic drinking than women of ideal weight (omnibus $p < .001$ for both).

TABLE 1. Characteristics of the 3,020 white and 494 black female twin participants in the Missouri Adolescent Female Twin Study by body mass index (BMI) category (all numbers are percentages unless otherwise noted)

Variable	BMI category				p
	Underweight	Ideal weight	Overweight	Obese	
Whites	($n = 235$)	($n = 2,023$)	($n = 460$)	($n = 302$)	
Ever had a drink	79.24[a]	87.99[b]	87.83[b]	88.12[b]	.006
Age at first drink, mean (SD)	16.16 (2.54)[a]	16.20 (2.32)[a]	16.38 (2.33)	16.80 (2.63)[b]	<.001
Current weekly drinking	21.28[a]	28.72[a]	23.48[a]	11.96[b]	<.001
Current weekly heavy episodic drinking	8.94	13.74[a]	10.43	5.96[b]	<.001
>22 years old	27.54[a]	34.35[a]	42.91[b]	53.53[c]	<.001
Maternal education ≤ high school	40.68	35.49[a]	43.48[b]	47.19[b]	<.001
Paternal education ≤ high school	42.37	36.93[a]	49.13[b]	54.46[b]	<.001
Parental education data missing	19.49	17.30	14.78	20.79	.249
Currently in school	52.12[a,b]	56.60[a]	43.91[b]	30.36[c]	<.001
Currently employed full time	32.63[a]	39.84[a,b]	50.65[c]	46.20[b,c]	<.001
Live with parents	34.32[a]	39.20[a]	45.00	51.49[b]	<.001
DSM-IV major depression	18.22[a]	18.44[a]	18.91[a]	31.68[b]	<.001
Current smoking	34.89	30.61[a]	36.09	40.07[b]	.006
Ever had romantic relationship	91.67	94.95	94.25	90.86	.021
Current romantic relationship	65.53	66.30	61.52	57.67	.024
Married or cohabiting	30.21[a]	28.03[a]	34.13	43.05[b]	<.001
Many friends	55.32[a]	57.09[a]	50.43	43.05[b]	<.001
Majority of friends drink weekly	37.93	47.42[a]	35.65[b]	29.35[b]	<.001
Majority of friends get drunk monthly	37.93	45.08[a]	35.00[b]	24.66[c]	<.001
Childhood sexual abuse	14.41[a,b]	10.23[a]	14.57[b]	24.09[c]	<.001
Early menarche (<12 years)	7.73[a]	14.96[b]	25.00[c]	28.81[c]	<.001
Weight/shape concern	13.62[a]	26.09[b]	31.59[b,c]	39.07[c]	<.001
Blacks		($n = 217$)*	($n = 139$)	($n = 139$)	
Ever had a drink	–	75.46	76.98	77.14	.922
Age at first drink, mean (SD)	–	17.63 (2.57)	17.42 (2.51)	17.08 (3.20)	.235
Current weekly drinking	–	11.11	15.83	13.67	.439
Current weekly heavy episodic drinking	–	4.63	2.16	4.32	.547
>22 years	–	35.19[a]	48.92	55.00[b]	.003
Maternal education ≤ high school	–	31.02	37.41	36.43	.469
Paternal education ≤ high school	–	40.28	46.76	45.71	.493
Parental education data missing	–	36.11	32.37	39.29	.568
Currently in school	–	51.85[a]	41.01	30.71	.001
Currently employed full time	–	33.49	41.01	41.73	.236
Live with parents	–	46.76	56.12	50.00	.285
DSM-IV major depression	–	21.30	28.06	32.86	.077
Current smoking	–	12.96	20.86	16.55	.174
Ever had romantic relationship	–	93.99	98.12	90.32	.038
Current romantic relationship	–	51.85	56.83	55.80	.608
Married or cohabiting	–	17.59	22.23	20.71	.546
Many friends	–	29.63	20.86	21.43	.145
Majority of friends drink weekly	–	22.07	28.57	26.12	.418
Majority of friends get drunk monthly	–	20.38	22.56	23.13	.807
Childhood sexual abuse	–	13.43[a]	23.02[b]	26.43[b]	.008
Early menarche (<12 years)	–	23.61[a]	33.33	39.86[b]	.008
Weight/shape concern	–	22.22[a]	36.69[b]	45.65[b]	<.001

Notes: DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition. Percentages with different superscripts differ significantly from one another ($p \leq .01$). *This group includes 7 underweight women.

There were statistically significant differences ($p < .01$) between BMI categories among white women on every potential covariate examined with the exception of missing parental data, ever having had a romantic relationship, and current romantic relationship. In contrast, there were no significant differences between BMI categories for drinking outcomes among black women, and only age older than 22 years, currently in school, childhood sexual abuse, menarche before age 12, and weight/shape concern differed by BMI category ($p \leq .008$ for all).

Results from the Cox proportional hazards models of time to first alcohol use in white and black women are presented in Table 2. In the unadjusted model for white women, being underweight, overweight, and obese were all associated with decreased likelihood of ever using alcohol. Smoking and having a majority of friends who drink weekly were identified as confounders, and both of these variables violated the proportional hazards assumption. To fix this violation, smoking was divided into three groups (before age 14, between ages 14 and 18, and age 19 and older), and majority

TABLE 2.   Cox proportional hazards models of body mass index (BMI) category predicting first alcohol use among white (*n* = 3,020) and black (*n* = 494) young adult women

Variable	Unadjusted model HR (95% CI)	Adjusted model HR (95% CI)
Whites		
BMI category*		
Underweight	**0.84 (0.72-0.97)**	–
Majority of friends drink		
weekly, <16 years	–	1.13 (0.86-1.49)
Majority of friends drink		
weekly, ≥16 years	–	**1.34 (1.12-1.60)**
Ideal weight	1.00	1.00
Overweight	**0.89 (0.80-1.00)**	0.95 (0.86-1.05)
Obese	**0.83 (0.73-0.93)**	**0.83 (0.73-0.93)**
Smoking, <14 years	–	
Smoking, 14-18 years	–	
Smoking, ≥19 years	–	
Majority of friends drink		
weekly, <16 years	–	**2.35 (2.06-2.67)**
Majority of friends drink		
weekly, ≥16 years	–	**1.75 (1.60-1.90)**
Blacks		
BMI category*		†
Ideal weight	1.00	–
Overweight	1.01 (0.81-1.27)	–
Obese, <16 years	1.44 (0.84-2.45)	–
Obese, ≥16 years	0.92 (0.72-1.18)	–

Notes: **Bold** indicates statistical significance. HR = hazard ratio; CI = confidence interval. *BMI category: underweight (<18.5), ideal weight (18.5-24.9), overweight (25.0-29.9), and obese (≥30); †no confounders were identified among blacks.

of friends drink weekly was divided into two groups (before age 16 and age 16 and older). In addition, there was an interaction between majority of friends drink weekly before age 16 and underweight. For ease of interpretation, rather than keeping the interaction term in the model, underweight was reparameterized by dividing it by the variable with which it interacted into two variables that, together with the overweight and obese categories, comprised a set of four design variables with the ideal-weight category as the referent. In the final adjusted model, obesity was still protective against ever drinking (HR = 0.83; 95% confidence interval [CI]: 0.73-0.94), but the effect for overweight was attenuated and no longer statistically significant. Being underweight and having a majority of friends who drink weekly was not significantly associated with alcohol-use onset before age 16; however, being underweight and having a majority of friends who drink weekly was positively associated with alcohol use for onset at age 16 or later (HR = 1.34; 95% CI: 1.12-1.60).

Among the black women, no confounders or interactions were identified and neither overweight nor obesity was significantly associated with the initiation of alcohol use.

Results from logistic regression models of BMI category on current weekly drinking in women who had ever used alcohol are shown in Table 3. In the unadjusted model, overweight and obesity were significantly negatively associated with current weekly drinking (OR = 0.75; 95% CI: 0.58-

0.96; and OR = 0.33, 95% CI: 0.22-0.47, respectively); however, the OR for underweight, although of similar magnitude to that for overweight, was not statistically significant (OR = 0.76, 95% CI: 0.54-1.06). A significant interaction was found between underweight and living with one's parents among white women; therefore the overweight category was stratified by living situation, resulting in four design variables for BMI category: underweight and living with parents, underweight and not living with parents, overweight and obese, and ideal weight (serving as the referent group). After adjusting for relevant confounders (current smoking, having a majority of friends who drink weekly) and the main effect of living with one's parents, obesity remained significantly associated with current weekly drinking (OR = 0.36; 95% CI: 0.24-0.53). Underweight was significantly associated with weekly drinking only for those women who lived with their parents (OR = 0.31, 95% CI: 0.16-0.61), and there was no longer a significant effect for overweight. Among black women, overweight and obesity were not significantly associated with current weekly drinking in the unadjusted model; however, after adjusting for relevant confounders (majority of friends weekly drinkers, current smoking, and weight/shape concern) and reparameterizing overweight to account for an interaction between overweight and having a majority of friends who are weekly drinkers, current weekly drinking was significantly associated with being overweight and having a majority of friends who were not weekly drinkers (OR

TABLE 3. The association between body mass index (BMI) category* and weekly drinking in white (*n* = 2,635) and black (*n* = 376) young adult women who had ever had a drink of alcohol

Variable	Unadjusted model HR (95% CI)	Adjusted model HR (95% CI)
Whites		
BMI category*		
Underweight	0.76 (0.54-1.06)	
Lives with parents	–	**0.31 (0.16-0.61)**
Does not live with parents	–	1.15 (0.71-1.86)
Ideal weight	1.00	1.00
Overweight	**0.75 (0.58-0.96)**	0.83 (0.62-1.10)
Obese	**0.33 (0.22-0.47)**	**0.36 (0.24-0.53)**
Lives with parents	–	1.11 (0.90-1.37)
Current smoking	–	**2.38 (1.93-2.92)**
Majority of friends weekly drinkers	–	**5.49 (4.47-6.73)**
Blacks		
BMI category		
Ideal weight	1.00	1.00
Overweight	1.50 (0.80-2.81)	–
Majority of friends weekly drinkers	–	0.49 (0.17-1.42)
Majority of friends not weekly drinkers	–	**2.91 (1.33-6.39)**
Obese	1.18 (0.60-2.35)	1.22 (0.56-2.65)
Majority of friends weekly drinkers	–	**4.11 (1.92-8.81)**
Current smoking	–	**3.01 (1.52-5.95)**
Weight/shape concern	–	0.66 (0.34-1.30)

Notes: **Bold** indicates statistical significance. HR = hazard ratio; CI = confidence interval. *BMI category: underweight (<18.5), ideal weight (18.5-24.9), overweight (25.0-29.9), and obese (≥30).

= 2.91; 95% CI: 1.33-6.39). The ORs for being overweight and having a majority of friends who drink weekly and for obesity were not statistically significant.

The results of logistic regression analyses for current weekly heavy episodic drinking among ever drinkers are presented in Table 4. In the unadjusted model, both overweight and obesity were significantly negatively associated with weekly heavy episodic drinking. After adjusting for confounders (living with one's parents, current smoking, majority of friends get drunk monthly) and taking into account the interaction between overweight and living with parents, underweight, overweight and living with parents, and obesity were significantly negatively associated with weekly heavy episodic drinking. There were too few black women who engaged in weekly heavy episodic drinking (*n* = 19) to build a multivariable model.

Discussion

Obesity was associated with a decreased likelihood of ever drinking and of being a current weekly drinker or current weekly heavy episodic drinker among white women

TABLE 4. The association of body mass index (BMI) category* with weekly heavy episodic drinking in white (*n* = 2,635) young adult women who had ever had a drink of alcohol

	Whites	
Variable	Unadjusted model OR (95% CI)	Adjusted model OR (95% CI)
BMI category*		
Underweight	0.69 (0.43-1.10)	**0.59 (0.35-1.00)**
Ideal weight	1.00	1.00
Overweight	0.71 (0.51-1.00)	–
Lives with parents	–	1.38 (0.82-2.34)
Does not live with parents	–	**0.51 (0.31-0.82)**
Obese	**0.39 (0.24-0.64)**	**0.54 (0.32-0.92)**
Lives with parents	–	**0.51 (0.38-0.69)**
Current smoking	–	**3.09 (2.37-4.05)**
Majority of friends get drunk monthly	–	**7.80 (5.61-10.85)**

Notes: **Bold** indicates statistical significance. OR = odds ratio; CI = confidence interval.*BMI category: underweight (<18.5), ideal weight (18.5-24.9), overweight (25.0-29.9), and obese (≥30).

who had ever used alcohol. Being underweight and having a majority of friends who drink weekly was associated with an increased likelihood of ever drinking after age 16; however, underweight in white women was associated with a decreased likelihood of weekly heavy episodic drinking and of weekly drinking in underweight women still living with their parents. Being overweight and not living with parents was associated with decreased odds of weekly heavy episodic drinking in white women. Although there was no association between BMI category and ever drinking among black women, obese black ever drinkers who reported that the majority of their friends were *not* weekly drinkers were more likely to be weekly drinkers themselves compared with black ever drinkers of ideal weight. Too few black women engaged in current weekly heavy episodic drinking to assess the relationship between BMI and heavy episodic drinking in a multivariate model.

The results presented here for ever using alcohol in white women are similar to those of several other studies that have found alcohol abstinence to be associated with weight gain and obesity in women and mixed gender samples of broad age ranges (Adams and Rini, 2007; Arif and Rohrer, 2005; Breslow and Smothers, 2005; Lahti-Koski et al., 2002; Wilsgaard et al., 2005). The findings that obesity was negatively associated with weekly drinking and weekly heavy episodic drinking in white women who had ever used alcohol were somewhat unexpected given the results of many previous studies and because a positive association between drinking and obesity is biologically plausible (e.g., increased levels of ghrelin have been implicated in both obesity and excessive alcohol use; Noguiras et al., 2008; Wurst et al., 2007). It is difficult, however, to compare the results presented here with those from other studies because of differences in alcohol-use definitions and sample characteristics. For example, some studies excluded individuals who had ever smoked (Arif and Rohrer, 2005; Breslow and Smothers, 2005) or included never drinkers in the analyses, sometimes using them as the comparison group (Arif and Rohrer, 2005; Duvigneaud et al., 2007; Wilsgaard et al., 2005).

There are at least two possible explanations for the protective relationship between obesity and alcohol use and misuse in young adult white women. First, the social lives of obese women may differ such that they associate with individuals who do not drink as frequently and heavily as the friends of women of ideal weight or do not engage in activities where alcohol use is common to the degree that young women of ideal weight do. Second, obese women may choose to drink less frequently because of increased concerns about weight gain. However, the inclusion of variables related to these possible explanations that were available in our data either did not alter the relationship between BMI and the respective alcohol-use outcome (e.g., current romantic relationship or weight/shape concern) or the effect for obesity remained significant even when the variable was included in the model

(e.g., half of friends drink weekly). Unfortunately we did not have information on the types of social activities engaged in by the respondents or the availability of alcohol at these events, nor did we have information on whether respondents ever avoided the consumption of alcohol for fear of weight gain or because they were trying to lose weight. Because the relationships between obesity and lower frequency and amount of alcohol consumption are not direct ones, there must be variables in the causal pathway that are as yet unmeasured.

The results of the interaction between overweight and friends weekly drinking in the black model of weekly drinking were counterintuitive, with overweight women who report that the majority of their friends are weekly drinkers having lower (although not statistically significant) odds of weekly drinking and those reporting that the majority of their friends are not weekly drinkers having significantly higher odds of being weekly drinkers. Given the relatively small sample of black ever drinkers (n = 376) and the low prevalence of weekly drinking among them (17%, n = 64), as evidenced by the large confidence intervals, it is possible that these point estimates in this model are unstable and should be interpreted with caution. With the exception of this interaction, and in contrast to results in white women, the HRs and ORs for BMI categories in the black models were not statistically significant and of modest magnitude. It is possible that whatever unmeasured factors account for the association between obesity and drinking outcomes in white women operate differently in black women. For example, although obesity can be a social liability, the effect is less strong among black women than among their white counterparts (Averett and Korenman, 1999; Strauss and Pollack, 2003). Therefore, white obese women may engage in fewer or different kinds of social activities than ideal-weight white women, although there may be no such differences between overweight/obese and ideal-weight black women. Likewise, differences in how white and black adolescent and young adult women view their body weight (Thompson et al., 2003) may result in greater concern about consuming the calories contained in alcoholic beverages among obese white women than among obese black women. Although our study does not support this hypothesis because the prevalence of weight/shape concern was similar among obese black (39.07%) and white (45.65%) women, the single question assessing weight/shape concern in the interview may have been inadequate to fully capture the nuances of this construct.

We have treated MOAFTS as a general population sample, ignoring the twin structure of the data, with the exception of using robust standard errors to account for the relatedness of our twin pairs. A substantial amount of literature has documented a moderately strong genetic contribution to variation in alcohol consumption levels (Heath, 1995). Given equally strong evidence for high heritability of BMI, including BMI assessed during young adulthood (Maes

et al., 1997; Schousboe et al., 2003), it is possible that BMI is a significant mediator of genetic effects on heaviness of alcohol consumption. However, in preliminary analyses we found little evidence for common genetic liability to BMI and alcohol use or misuse, implying that genetic analysis would not be useful. Genetic correlations with BMI were not significant for alcohol use (r = .10, 95% CI: −1.00-1.00), weekly alcohol use (r = .31, 95% CI: −1.00-1.00) or weekly heavy episodic drinking (r = .35, 95% CI: −1.00-1.00) among black women. Among white women, genetic correlations with BMI were not significant for alcohol use (r = .28, 95% CI: −.07-.59) and weekly heavy episodic drinking (r = −.19, 95% CI: −1.00-1.00). The genetic correlation between BMI and weekly drinking was statistically significant; however, the confidence interval was extremely wide (r = −.56; 95% CI: −1.00-−.10).

This study was not without limitations. First, these analyses were cross-sectional, and as such it is not possible to make causal inferences. Although longitudinal data were available, we chose to conduct our analyses using cross-sectional data because results of analyses on Wave 4 of MOAFTS are likely more generalizable than those from women who participated at both time points since the entire sample, including those whose parents had refused participation for them at baseline when they were minors, were retargeted at Wave 4. We have found that women who did not participate at baseline differ from baseline participants on several variables that are related to both BMI and drinking behavior (e.g., greater inclusion of women reporting a history of childhood sexual abuse). Furthermore, we also felt that current BMI was more relevant to current drinking behavior than past BMI. We did, however, repeat all analyses using prospective data with BMI category at baseline as the main predictor, including covariates from the baseline assessment and forcing drinking status at baseline into the logistic regression models (weekly drinking or weekly heavy episodic drinking at baseline, depending on the outcome). Results were similar with regard to the association between obesity and drinking outcomes, with the exception that the point estimate for obesity in the model of heavy episodic drinking for white women, although more extreme than that for the cross-sectional model, was not statistically significant (OR = 0.47; 95% CI: 0.20-1.09). There were, however, differences in associations between underweight and overweight at baseline and Wave 4 drinking outcomes among white women. There were no statistically significant interactions. Underweight was protective against alcohol use and was not significantly predictive of weekly drinking or weekly heavy episodic drinking, and overweight was not significantly associated with weekly heavy episodic drinking.

A second limitation was that BMI was computed using self-reported height and weight, which have been found to correspond highly with actual height and weight in young women (Brunner Huber, 2007; Goodman et al., 2000), but

with a bias toward underreporting weight observed in adolescents (Elgar et al., 2005; Goodman et al., 2000). This weight underestimation has been found to result in more false negatives (low sensitivity) when categorizing BMI (Elgar et al., 2005; Goodman et al., 2000). Because we do not have measured heights and weights for MOAFTS participants, it was not possible to determine the effect misestimation may have on the results presented here. Finally, because of the large number of statistical tests performed, it is possible that some of the statistically significant associations may be spurious because of Type I error (erroneously rejecting the null hypothesis). Wherever possible, specific p values were given so that the reader may adopt a more stringent p value when evaluating these results.

Conclusions

Among white young adult women, obesity is associated with a decrease in the likelihood of initiating alcohol use and with lower odds of any current drinking and current heavy episodic drinking on a weekly basis among alcohol users. In contrast, among black women younger than age 16, obesity was associated with an increased likelihood of alcohol use, and BMI category was not associated with weekly drinking among drinkers. No additional factors were identified that fully mediated these relationships. Future research is needed to identify mediators and moderators to better understand the relationship between body weight and drinking in young women of different racial backgrounds.

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