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Alcohol Consumption and Metabolic Syndrome Among Hispanics/Latinos: The Hispanic Community Health Study/Study of Latinos

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Abstract

Background: The association between alcohol consumption and metabolic syndrome (MetS) among Hispanic/Latino populations has not been studied in great detail. Our study examined the relationship between alcohol consumption and MetS among U.S. Hispanics/Latinos and explored whether this relationship varied by age, body mass index, gender, and Hispanic/Latino backgrounds.
Methods: The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) is a multisite, prospective, population-based, cohort study of Hispanics/Latinos, ages 18–74 years from four U.S. communities. Participants were categorized into never, former, occasional, low, moderate, and high alcohol consumption categories. A cross-sectional analysis of 15,905 participants with complete data was conducted. Survey design appropriate chi-squared and logistic regression models were run to detect significant associations between alcohol consumption categories and cases of MetS.
Results: Almost half (47.4%) of the sample was classified as occasional, low, moderate, or heavy drinkers. Low and moderate alcohol consumers had lower odds of MetS than never drinkers. Low and heavy drinkers had higher odds of presenting with elevated central obesity, while occasional, low, moderate, and heavy drinkers had higher odds of having low high-density lipoprotein cholesterol levels compared to never drinkers. Low and moderate wine drinkers had lower odds of MetS compared to never drinkers. There were no significant findings among beer or liquor drinkers, or with binge drinking after model adjustments.
Conclusions: Our findings suggest that low and moderate alcohol consumption may lower the odds of MetS in a sample of Hispanic/Latino adults, but that the relationship of alcohol consumption varies with the individual components of MetS.

Introduction

Previous studies have established evidence for a protective role of light-to-moderate levels of alcohol consumption in the development of coronary heart disease,[1] stroke,[2] and mortality.[3] Conversely, low-to-moderate levels of alcohol consumption have been associated with liver disease, peptic ulcers, certain types of cancers, and brain damage[4]; more than 90,000 U.S. deaths are attributed to alcohol misuse annually.[5] These relationships among alcohol consumption, morbidity, and mortality are of particular importance given that alcohol consumption is prevalent in more than half of the U.S. population.[6]

Although the prevalence of alcohol consumption has remained relatively stable over the past decade (51.0% in 2002 vs. 52.1% in 2012),[6,7] patterns of alcohol consumption

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differ among race/ethnic groups.[8,9] In the 2012 National Survey on Drug Use and Health, Hispanics/Latinos reported less current alcohol consumption compared to other race/ethnicities; yet, among those who did consume alcohol, the prevalence of binge and heavy alcohol consumption was significantly higher in Hispanics/Latinos.[6] Aside from higher rates of binge drinking and heavy consumption, Hispanics/Latinos also experience more severe consequences from drinking. Specifically, Hispanics/Latinos have a higher risk for liver disease and death from cirrhosis of the liver compared to non-Hispanic whites.[8,10,11] Given the popularity of alcohol and its varied effects across race/ethnic groups,[8,10,11] it is essential to obtain a clearer understanding of its association on other health outcomes in the United States.

Metabolic syndrome (MetS), a cluster of abnormalities that includes central obesity, low high-density lipoprotein (HDL) cholesterol, high fasting blood glucose, high triglycerides (TG), and elevated blood pressure (BP),[12] is a major public health challenge, especially among Hispanics/Latinos.[13,14] This combination of cardiometabolic risk factors has received an increasing level of attention due to its association with the development of diabetes and increased risk of cardiovascular morbidity and mortality.[15] The age-adjusted prevalence of MetS among Hispanics/Latinos in the United States (31.9%) is higher when compared to non-Hispanic whites (21.8%) and non-Hispanic blacks (22.7%).[14] Stratified by gender, the prevalence of MetS among Hispanics/Latinos has been reported at 36% and 34% among Hispanic/Latino women and men, respectively.[16] There is an urgent need to obtain a greater understanding of modifiable factors that may mitigate the progression of events leading toward the development of MetS.

Existing literature on the association between alcohol consumption and MetS is conflicting. Most studies show that alcohol has a protective effect,[17,18] while some report the opposite.[19] A recent review determined that low levels of consumption were significantly protective against MetS, but all other levels were not.[20] Furthermore, little work has been done to examine this relationship among Hispanic/Latino populations in the United States. Therefore, the purpose of our study was to examine the relationship between the patterns of alcohol consumption and MetS among U.S. Hispanics/Latinos and to explore whether this relationship differs by age, gender, body mass index (BMI), and Hispanic/Latino background.

Materials and Methods

Study population

The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) is a prospective, population-based, cohort study designed to examine chronic disease risk and protective factors among U.S. Hispanic/Latino 18–74-year olds. At baseline (2008–2011), participants were recruited from U.S. communities (Bronx, NY; Miami, FL; Chicago, IL; San Diego, CA) representing various self-identified Hispanic/Latino backgrounds. The HCHS/SOL recruited 16,415 participants through a two-stage area household probability design and probability sampling method within census-drawn geographical tracts in predefined communities. Specific details regarding the HCHS/SOL are described elsewhere.[21,22]

Participants completed a baseline examination that included a questionnaire, physical and clinical examinations, and a 24-hr dietary recall. They received a follow-up telephone call within 6 weeks to complete a second 24-hr dietary recall. Dietary intake was obtained with two interviewer-administered 24-hr recalls using the Nutrition Data System for Research software developed by the University of Minnesota. Clinical examinations were conducted by centrally trained and certified study staff. Weight, height, abdominal and hip girth were measured with participants wearing light clothing. Three seated BP measurements were obtained after a 5-min rest using an oscillometric automated sphygmomanometer. Serum samples were obtained following a standardized protocol and shipped daily to the HCHS/SOL Central Laboratory.[16,22] Protocols were approved by the institutional review board at the participating institutions, and all participants provided informed consent.

Metabolic syndrome

The primary outcome, MetS, was defined using the standardized guidelines.[15] An individual was defined as having MetS if they presented with abnormal/elevated cutoff values for at least three of the following: (1) waist circumference (WC) ≥102 cm for males or ≥88 cm for females; (2) systolic BP ≥130 mmHg and/or diastolic BP ≥85 mmHg, and/or report of current hypertensive medication use; (3) HDL cholesterol <50 mg/dL for females, <40 mg/dL for males; (4) serum TG levels ≥150 mg/dL; and (5) fasting blood glucose concentrations ≥100 mg/dL, and/or report of antidiabetic medication use.

Alcohol consumption

Alcohol consumption was obtained through a self-report questionnaire adapted for use in Hispanic/Latino adults.[23] Questions were asked about lifetime and current use of alcoholic beverages, the frequency of use per week, and type of alcohol consumed. Participants who reported alcohol consumption were also asked about binge drinking frequency. Binge drinking was assessed based on a question that asked whether four or more alcoholic drinks (for females) or five or more drinks (for males) were consumed within a 2-hr period.

Covariates

Gender, age, Hispanic/Latino background, BMI, cigarette smoking status, education level, physical activity level, and total daily caloric consumption were included as covariates *a priori*. Participants reported being male or female, their age in years, and their Hispanic/Latino background as Dominican, Central American, Cuban, Mexican, Puerto Rican, South American, or more than one heritage. BMI was defined as normal weight (BMI ≤24.9 kg/m^2), overweight (25.0 kg/m^2 ≤ BMI ≤29.9 kg/m^2), and obese (BMI >30.0 kg/m^2). Individuals self-reported their cigarette smoking status as never, former, or current smoker. Education level was defined as having no high school diploma, at least a high school diploma, and greater than a high school diploma. Physical activity levels were represented by the total physical activity min/day as self-reported in the Global Physical Activity Questionnaire (GPAQ). Total daily caloric consumption was derived based on 24-hr dietary recalls conducted at the initial examination and again within the following 6 weeks.

Statistical analysis

Participants were excluded from the current study sample if they did not complete the alcohol consumption frequency questionnaire ($n = 70$), were missing data used to calculate MetS ($n = 20$), or were missing any of the covariate data ($n = 420$). Missing covariate data were less than 5.0% of the study sample, and sensitivity analyses confirmed no significant differences in demographic, predictor, or outcome variables between those with missing data and those with complete data. Thus, this cross-sectional analysis was based on 15,905 participants.

Individual alcohol consumption was categorized as former (lifetime consumption of at least one drink, but not a current consumer), occasional (lifetime consumption of at least one drink, current consumer of <1 drink/week), low (females: 1–3 drinks/week; males: 1–7 drinks/week), moderate (females: 3–7 drinks/week; males: 7–14 drinks/week), and heavy (females: >7 drinks/week; males: >14 drinks/week) drinkers. Never drinkers were defined as participants who reported no lifetime alcohol consumption. Each alcohol type (beer, wine, and liquor) was categorized into low, moderate, and heavy drinkers following the aforementioned definitions for analysis purposes. Categories of binge drinking were collapsed into the following: (1) ≤1 day a month; (2) 2–3 days a month; (3) 1–2 days a week; (4) ≥3 days a week; and (5) never.

The sample was analyzed using survey design methods in Statistical Analytic Software (SAS) version 9.3 (SAS Institute, Inc., Cary, NC). Subsample weights, clusters, and strata were incorporated in all analyses in accordance with analytical guidelines for the two-stage probability sampling design. Domains were created to represent the analysis sample (domain = 1) and those excluded due to missing variables (domain = 0). Survey frequencies and chi-squared tests were used to compare descriptive characteristics, as well as prevalence of alcohol consumption patterns, and each individual component of MetS.

Logistic regression models were fit with MetS factors as a binary outcome (Yes: ≥3 abnormal factors; No: ≤3 abnormal factors) and alcohol consumption (former, occasional, low, moderate, and heavy) as the predictor, with never drinkers serving as the reference group. A second model was adjusted for age, gender, BMI, smoking status, education level, and Hispanic/Latino background. The final model was adjusted for all variables from model two, plus physical activity level and total daily caloric consumption. Logistic regression analyses were repeated with each individual MetS component in binary form based on standardized cutoff values (0 = normal, 1 = abnormal), adjusted for the same variables as in the final model above. A *post hoc* analysis was done using the International Diabetes Federation cutoff point for waist circumference (80 cm for women, 90 cm for men) within the definition of MetS to examine whether using ethnic-based cutoffs for waist circumference impacted the results. These procedures were then repeated with binge drinking as the predictor variable. Finally, stratification of the logistic regression analysis was performed for alcohol beverage type (beer, wine, and liquor), age, gender, BMI, and Hispanic/Latino background. Adjusted odds ratios (AOR) were reported with corresponding 95% confidence intervals and P values with an alpha set to 0.05.

Results

Sample characteristics

Table 1 describes characteristics of the sample. Almost one-half (47.4%) of the sample was categorized as occasional, low, moderate, or heavy drinkers. One-third (32.9%) were former drinkers and 19.7% reported never drinking. Females represented the majority among each category of noncurrent alcohol consumption (never, former, and occasional). Conversely, there was a higher prevalence of males in all active alcohol consumption categories. Among all categories of current drinkers, beer was reported as the most common beverage of choice. MetS was present in 32.0% of the overall sample (Table 1). Never drinkers had the highest prevalence (37.2%) of MetS within an all alcohol consumption category. Among current alcohol consumers, the prevalence of MetS within an alcohol category was the highest among heavy drinkers (31.6%).

Alcohol consumption and metabolic syndrome

The relationship between each category of alcohol consumption and MetS is illustrated in Table 2. There were no significant relationships found between former or heavy drinkers and MetS in any of the models when compared to never drinkers. Consistent across the unadjusted and adjusted models, low and moderate drinkers had lower odds of presenting with MetS than never drinkers. Specifically, in the fully adjusted model, low drinkers had 0 · 81 (95% CI 0.67–0.97) and moderate drinkers had 0.77 (95% CI 0.62–0.96), the odds of presenting with MetS when compared to never drinkers. Results remained consistent across all alcohol consumption categories in *post hoc* analyses using the International Diabetes Federation WC cutoff values for men and women.

Individual risk factors of metabolic syndrome. Table 3 presents the prevalence of each component of MetS across alcohol consumption categories. There were no significant differences in the prevalence of elevated TG levels among drinkers compared to never drinkers. The majority of never drinkers (61.5%) presented with elevated WC, which was significantly higher than low (44.4%), moderate (43.6%), and heavy (51.2%) drinkers ($P < 0.0001$). Similarly, never drinkers had a higher prevalence of low HDL (49.8%), elevated BP (37.1%), and elevated fasting glucose (32.9%) compared to most other current alcohol consumption categories (all $P \leq 0.02$).

Table 4 details the results for the individual components of MetS across alcohol consumption categories. Low and heavy drinkers presented with higher odds of elevated WC than never drinkers (low AOR: 1.37, 95% CI 1.07–1.74; heavy AOR: 1.82, 95% CI 1.31–2.52). Former drinkers had lower odds of elevated TG levels (AOR: 0.84, 95% CI 0.71–0.99) than never drinkers. Occasional, low, moderate, and heavy drinkers had higher odds of low HDL than never drinkers (occasional AOR: 1.24, 95% CI 1.05–1.47; low AOR: 1.42, 95% CI 1.21–1.67; moderate AOR: 1.88, 95% CI 1.53–2.31; heavy AOR: 1.82, 95% CI 1.44–2.32). Finally, heavy drinkers had higher odds of presenting with elevated BP (AOR: 1.55, 95% CI 1.20–2.01) when compared to never drinkers. There were no significant relationships between alcohol consumption and high fasting glucose levels.

Table 1. Demographic and Clinical Characteristics of the Sample ($N = 15,905$)

	Overall sample (N = 15,905), N *(%)*	*Never drinkers (N = 3139),* n *(%)*	*Former drinkers (N = 5230),* n *(%)*	*Occasional drinkers (N = 2633),* n *(%)*	*Low drinker (N = 2834),* n *(%)*	*Moderate drinker (N = 1270),* n *(%)*	*Heavy drinker (N = 799),* n *(%)*	P[a]
Gender								<0.0001
Female	9542 (52.3)	2569 (73.7)	3372 (57.6)	1766 (59.9)	1024 (32.3)	539 (37.0)	272 (30.9)	
Male	6363 (47.7)	570 (26.3)	1858 (42.4)	867 (40.1)	1810 (67.7)	731 (63.0)	527 (69.1)	
Age								<0.0001
18–24	1617 (17.0)	261 (15.1)	403 (13.5)	280 (17.3)	375 (20.1)	168 (19.8)	130 (24.1)	
25–44	4885 (42.8)	789 (35.1)	1513 (41.8)	821 (43.4)	1016 (47.0)	455 (48.8)	291 (46.9)	
45–64	8115 (31.7)	1715 (34.8)	2820 (34.8)	1359 (32.9)	1294 (27.4)	584 (26.7)	343 (25.3)	
≥ 65	1288 (8.5)	374 (15.0)	494 (9.9)	173 (6.4)	149 (5.5)	63 (4.7)	35 (3.7)	
BMI								<0.0001
Underweight (BMI <18.5)	129 (1.2)	28 (1.1)	41 (1.3)	16 (1.1)	31 (1.2)	9 (1.1)	4 (0.9)	
Normal (18.5 < BMI <25)	3105 (22.2)	614 (23.5)	877 (18.9)	510 (21.2)	626 (25.0)	294 (25.2)	184 (22.5)	
Overweight (25 ≤ BMI <30)	5962 (37.3)	1168 (36.3)	1867 (36.2)	992 (37.9)	1134 (38.9)	486 (38.9)	315 (36.7)	
Obese (BMI ≥30)	6709 (39.4)	1329 (39.1)	2445 (43.6)	1115 (39.8)	1043 (34.9)	481 (34.8)	296 (39.9)	
Smoking status								<0.0001
Never	9679 (61.4)	2468 (78.6)	3167 (62.7)	1632 (63.3)	1532 (56.5)	582 (46.7)	298 (37.3)	
Former	3147 (17.2)	358 (10.5)	1229 (20.7)	541 (17.1)	616 (18.8)	238 (16.3)	165 (16.0)	
Current	3079 (21.4)	313 (10.9)	834 (16.6)	460 (19.6)	686 (24.7)	450 (37.0)	336 (46.7)	
Education level								<0.0001
No high school diploma/GED	6051 (32.2)	1256 (33.9)	2277 (36.7)	892 (28.6)	897 (28.4)	447 (30.2)	282 (31.4)	
At least a high school diploma/GED	4071 (28.4)	806 (29.7)	1293 (28.6)	649 (26.4)	756 (27.8)	354 (29.0)	213 (29.0)	
Greater than a high school diploma/GED	5783 (39.4)	1077 (36.4)	1660 (34.7)	1092 (45.0)	1181 (43.9)	469 (40.8)	304 (39.6)	
Hispanic background								<0.0001
Dominican	1454 (10.1)	191 (5.5)	518 (11.6)	252 (10.9)	289 (11.2)	129 (10.0)	75 (10.6)	
Central American	1704 (7.5)	526 (11.7)	500 (6.9)	238 (6.6)	233 (5.6)	132 (7.3)	75 (6.2)	
Cuban	2330 (20.4)	819 (37.5)	458 (12.9)	355 (18.8)	383 (17.6)	178 (18.7)	137 (20.6)	
Mexican	6182 (36.6)	926 (25.5)	2246 (39.9)	1052 (37.4)	1191 (40.9)	472 (38.8)	295 (36.6)	
Puerto Rican	2673 (16.2)	373 (11.3)	1052 (20.3)	427 (15.0)	431 (14.8)	237 (16.3)	153 (17.4)	
South American	1059 (5.0)	232 (5.4)	320 (5.0)	211 (6.3)	194 (4.9)	73 (4.1)	29 (2.5)	
> One heritage	495 (4.2)	70 (3.1)	135 (3.4)	97 (5.0)	111 (5.0)	49 (4.8)	33 (6.1)	
Alcohol type								<0.0001
Beer	3656 (75.2)	—	—	—	1908 (67.5)	1036 (81.8)	712 (90.7)	
Red/white wine	765 (14.5)	—	—	—	557 (18.4)	158 (11.9)	50 (5.3)	
Liquor	482 (10.3)	—	—	—	369 (14.1)	76 (6.3)	37 (3.9)	
Metabolic syndrome[b]								<0.0001
Yes	5971 (32.0)	1352 (37.2)	2181 (35.2)	928 (30.8)	857 (26.6)	388 (25.4)	265 (31.6)	
No	9934 (68.0)	1787 (62.8)	3049 (64.8)	1705 (69.2)	1977 (73.4)	882 (74.6)	534 (68.4)	

[a]Differences across all alcohol use categories were examined by chi-squared tests.
[b]Prevalence within each drinking category.
BMI, body mass index.

Table 2. Odds Ratios of Metabolic Syndrome Across Categories of Alcohol Consumption

	Alcohol consumption (drinks/week)					
	Never drinkers	*Former drinkers*	*Occasional drinker*	*Low drinker*	*Moderate drinker*	*Heavy drinker*
Percent of individuals in each category[a]	18.5	29.9	15.9	20.2	9.3	6.1
Percent of individuals with metabolic syndrome in each category[b]	21.5	32.9	15.3	16.8	7.4	6.0
OR (CI)						
Model 1	1.00 (referent)	0.92 (0.80–1.05)	**0.75 (0.65–0.88)**	**0.61 (0.52–0.72)**	**0.58 (0.48–0.69)**	0.78 (0.62–1.00)
Model 2[c]	1.00 (referent)	0.85 (0.72–1.00)	0.85 (0.71–1.00)	**0.80 (0.66–0.96)**	**0.76 (0.61–0.95)**	1.04 (0.80–1.35)
Model 3[d]	1.00 (referent)	0.86 (0.73–1.01)	0.85 (0.71–1.02)	**0.81 (0.67–0.97)**	**0.77 (0.62–0.96)**	1.05 (0.81–1.37)

Bolded values indicate significant odds ratios.
[a]Percent for each alcohol consumption category based on weighted analyses across all categories.
[b]Percent of cases based on weighted analyses across all categories.
[c]Adjusted for age, gender, BMI, smoking status, education level, Hispanic background, and field center.
[d]Further adjusted for physical activity level and total caloric consumption.
CI, 95% confidence interval; OD, odds ratio.

Table 3. Prevalence of the Individual Components of the Metabolic Syndrome Across Categories of Alcohol Consumption

	Alcohol consumption (drinks/week)						
	Never drinkers (N = 3139)	*Former drinkers (N = 5230)*	*Occasional drinkers (N = 2633)*	*Low drinker (N = 2834)*	*Moderate drinker (N = 1270)*	*Heavy drinker (N = 799)*	P[a]
Central obesity[b]	2124 (61.5)	3425 (59.5)	1656 (57.7)	1378 (44.4)	637 (43.6)	402 (51.2)	<0.0001
High triglyceride[c]	1023 (29.6)	1665 (28.3)	758 (26.9)	884 (29.0)	427 (29.9)	248 (30.3)	0.58
Low HDL[d]	1593 (49.8)	2622 (51.0)	1200 (45.8)	1106 (39.5)	441 (35.1)	268 (37.5)	<0.0001
High blood pressure[e]	1352 (37.1)	2083 (33.5)	897 (28.5)	936 (28.3)	460 (27.8)	335 (35.1)	<0.0001
High fasting glucose[f]	1156 (32.9)	2022 (33.4)	857 (28.7)	986 (31.5)	412 (27.5)	298 (31.7)	0.02

[a]Chi-squared analyses comparing nondrinkers to alcohol consumption categories.
[b]Defined as a waist circumference ≥102 cm (men) or ≥88 cm (women).
[c]Defined as serum triglycerides ≥150 mg/dL.
[d]Defined as ≤40 mg/dL (men) or ≤50 mg/dL (women).
[e]Defined as systolic blood pressure ≥130 mm Hg, a diastolic blood pressure ≥85 mm Hg, or current use of medication for hypertension.
[f]Defined as ≥100 mg/dL or current use of medication for diabetes.
HDL, high-density lipoprotein.

TABLE 4. ODDS RATIOS OF THE INDIVIDUAL COMPONENTS OF THE METABOLIC SYNDROME ACROSS CATEGORIES OF ALCOHOL CONSUMPTION

		Alcohol Consumption (drinks/week)[a]				
	Cases (%)[b]	*Never drinkers (N = 3139)*	*Former drinkers (N = 5230)*	*Occasional drinker (N = 2633)*	*Low drinker (N = 2834)*	*Moderate drinker (N = 1270)*	*Heavy drinker (N = 799)*
Central obesity[c]							
Multivariate ORs	54.5	1.00 (referent)	1.19 (0.95–1.49)	1.30 (0.99–1.71)	**1.37 (1.07–1.74)**	1.32 (0.98–1.78)	**1.82 (1.31–2.52)**
High triglyceride[d]							
Multivariate ORs	28.7	1.00 (referent)	**0.84 (0.71–0.99)**	0.89 (0.75–1.05)	0.88 (0.73–1.07)	0.96 (0.77–1.21)	0.89 (0.69–1.14)
Low HDL[e]							
Multivariate ORs	45.3	1.00 (referent)	0.99 (0.85–1.14)	**1.24 (1.05–1.47)**	**1.42 (1.21–1.67)**	**1.88 (1.53–2.31)**	**1.82 (1.44–2.32)**
High blood pressure[f]							
Multivariate ORs	31.9	1.00 (referent)	0.83 (0.71–0.97)	0.83 (0.68–1.00)	0.90 (0.74–1.09)	0.96 (0.77–1.20)	**1.55 (1.20–2.01)**
High fasting glucose[g]							
Multivariate ORs	31.6	1.00 (referent)	0.93 (0.78–1.10)	0.92 (0.75–1.12)	1.01 (0.83–1.24)	0.87 (0.69–1.11)	1.05 (0.81–1.35)

Bolded values indicate significant odds ratios.
[a]Adjusted for age, gender, BMI, smoking status, education level, Hispanic background, field center, physical activity level, and total caloric consumption.
[b]Percent of cases on overall sample based on weighted analyses.
[c]Defined as a waist circumference ≥102 cm (men) or ≥88 cm (women).
[d]Defined as serum triglycerides ≥150 mg/dL.
[e]Defined as ≤40 mg/dL (men) or ≤50 mg/dL (women).
[f]Defined as systolic blood pressure ≥130 mm Hg, a diastolic blood pressure ≥85 mm Hg, or current use of medication for hypertension.
[g]Defined as ≥100 mg/dL or current use of medication for diabetes.

Age, gender, BMI, and Hispanic/Latino background. Interactions between alcohol consumption and age, gender, BMI, and Hispanic/Latino background were assessed with respect to MetS. There were no statistically significant interactions found; therefore, stratified analyses were not conducted.

Binge drinking and type of alcoholic beverage. The prevalence of binge drinking within each alcohol consumption category is described in Table 5. The prevalence of MetS across binge drinking categories and the relationships between binge drinking and MetS are depicted in Table 6. Slightly more than half of the current alcohol consumers (57.2%) reported binge drinking. The highest prevalence of MetS was among nonbinge drinkers (47.3%), followed by those who engaged in binge drinking ≤1 day a month (25.5%). Participants who engaged in binge drinking ≤1 day a month and 2–3 days a month had lower odds of presenting with MetS compared to nonbinge drinkers in the unadjusted model (OR 0.77, 95% CI 0.65–0.91; OR: 0.62, 95% CI 0.47–0.82, respectively). However, in the adjusted models, there were no significant relationships between frequency of binge drinking and presenting with MetS.

Table 7 presents the relationship between MetS and alcohol consumption based on the type of alcoholic beverage. Among wine drinkers, low and moderate drinkers were found to have lower odds of presenting with MetS compared to never drinkers (AOR: 0.72, 95% CI 0.55–0.96, AOR: 0.43, 95% CI 0.21–0.87, respectively). Beer and liquor consumption was not related to significant changes in the prevalence of MetS across any of the alcohol consumption categories or odds of MetS.

Discussion

This study is one of the first to examine the relationship between alcohol consumption and MetS in a large study of Hispanic/Latino adults of diverse backgrounds living in the United States. Our findings suggest that low and moderate alcohol consumption is associated with lower odds of MetS. This finding is consistent with current literature that suggests low-to-moderate alcohol consumption is protective against MetS.[18,20,24,25] A novel finding from our study is the use of an occasional drinking category among Hispanics/Latinos. In most of the current literature, the lowest consumption category is light drinking, which is often defined as ≤3 drinks per week. Future studies should consider including occasional drinking as the lowest consumption category.

The association between alcohol consumption and individual components of MetS varied in the current study. Consistent with others, we found that low levels of wine consumption, but not beer or liquor, were related to lower odds of MetS.[26] Our results were similar to current literature in the general U.S. population, except for WC and HDL cholesterol.[18,24–28] In contrast to our findings of increased odds of elevated WC among low and heavy drinkers, previous work found decreased odds of elevated WC as the number of alcoholic beverages increased[20]; however, this was a population-based study consisting of only 5.6% Hispanics/Latinos, who were primarily of Mexican American background. Our finding of increased odds of low HDL with greater alcohol consumption is unique to the literature. Previous studies, none in Hispanic/Latino populations, have found that greater alcohol consumption leads to decreased

Table 5. Prevalence of Binge Drinking Across Categories of Current Alcohol Consumption

	Alcohol consumption (drinks/week)			
	Occasional drinkers (N = 2633); n *(%)*[a]	*Low drinker (N = 2834);* n *(%)*[a]	*Moderate drinker (N = 1270);* n *(%)*[a]	*Heavy drinker (N = 799);* n *(%)*[a]
Never binge drinker	1590 (57.4)	1349 (44.0)	436 (29.7)	198 (20.5)
≤1 Day a month	886 (35.2)	830 (30.3)	271 (21.9)	83 (9.8)
2–3 Days a month	109 (5.8)	293 (11.8)	158 (13.1)	75 (8.2)
1–2 Days a week	32 (1.2)	308 (11.8)	347 (30.9)	293 (39.7)
≥3 Days a week	11 (0.4)	50 (2.1)	56 (4.4)	145 (21.8)

[a]Percent in each alcohol consumption category based on weighted analyses.

odds of low HDL.[29] Although low and moderate drinkers had lower odds of presenting with MetS, similar relationships were not observed among any of the individual components of the MetS leaving unanswered the source of the protective benefit of alcohol consumption on MetS. It is recommended that future investigations examine these relationships and underlying mechanisms more closely among Hispanics/Latinos.

The second aim of this study was to explore whether the relationship between alcohol consumption and MetS differed by age, gender, BMI, and Hispanic/Latino background. We observed no statistically significant interactions when analyzing within the context of our full model. Although we did not continue with subanalyses based on the lack of significant interaction terms, there is literature that suggests lower risk of coronary heart disease among older adults who engage in moderate alcohol consumption.[30] There is also literature from the general U.S. population that suggests a reduction of the odds of MetS among women who engage in moderate levels of alcohol consumption.[18] Previous studies have only reported on Mexican Americans or a general Hispanic/Latino category, not the diverse Hispanic/Latino backgrounds found in our study. Our study contributes to the literature by suggesting no significant interaction between BMI and alcohol consumption in relation to MetS. Although no interaction was found, future studies may want to look at this relationship more closely. In regard to the relationship between MetS and alcohol consumption by Hispanic/Latino background, no significant interaction was found in the current study. The sample sizes among each Hispanic/Latino background category may contribute toward the lack of significance found; however, our study is unique in that it includes diverse Hispanic/Latino backgrounds compared to the current literature that only reported on Mexican Americans or a general Hispanic/Latino category.[18]

Strengths of the current study include the population-based sampling frame of HCHS/SOL, which increases its representative nature in targeted geographic regions. Second, the data collection methodology used across sites was standardized for alcohol consumption, MetS and its individual components, along with centralized sample processing. Despite these strengths, the study is not without limitations. First, the cross-sectional nature limits our ability to examine temporal or causal relationships. Second, alcohol use was self-reported, which can lead to recall bias; however, this was partly addressed by adding specific time frames (*i.e.*, the week) as a reference point. Finally, as noted previously,[31] inferences about Hispanic/Latino individuals beyond the targeted areas covered by the study sites may not be completely appropriate.

Conclusion

In this study of alcohol consumption and MetS among U.S. Hispanics/Latinos, we found that low and moderate levels of alcohol consumption lowered the odds of presenting with MetS. Furthermore, results suggest that the relationships vary among alcohol consumption categories and the individual components of MetS. Caution should be used considering known deleterious effects of alcohol consumption such as liver disease.

Table 6. ORs of Metabolic Syndrome Across Frequency of Binge Drinking

	Frequency of binge drinking[a]				
	Never binge drinkers	*≤1 Day a month*	*2–3 Days a month*	*1–2 Days a week*	*≥3 Days a week*
Binge drinkers (%)[b]	42.8	27.9	9.8	15.2	4.3
Metabolic syndrome cases (%)[c]	47.3	25.5	7.6	14.6	5.0
OR (CI)					
Model 1	1.00 (referent)	**0.77 (0.65–0.91)**	**0.62 (0.47–0.82)**	0.82 (0.67–1.00)	1.11 (0.74–1.65)
Model 2[d]	1.00 (referent)	0.90 (0.73–1.10)	0.92 (0.68–1.26)	1.10 (0.86–1.39)	1.25 (0.77–2.03)
Model 3[e]	1.00 (referent)	0.90 (0.73–1.10)	0.95 (0.70–1.29)	1.10 (0.87–1.41)	1.25 (0.76–2.05)

Bolded values indicates significant odds ratios.
[a]Defined as consuming 4+ (women) and 5+ (men) drinks within a 2-hr period.
[b]Percent of binge drinkers based on weighted analyses.
[c]Percent of cases based on weighted analyses.
[d]Adjusted for age, gender, BMI, smoking status, education level, Hispanic background, and field center.
[e]Further adjusted for physical activity level and total caloric consumption.

Table 7. ORs of Metabolic Syndrome Among Current Alcohol Consumers Stratified by Type of Alcohol Beverage

	Alcohol consumption (drinks/week)			
	Never drinkers	*Low drinker*	*Moderate drinker*	*Heavy drinker*
Alcohol type				
Beer ($n=3656$)	1.00 (referent)	0.84 (0.65–1.07)	0.87 (0.64–1.19)	1.39 (0.99–1.95)
Wine ($n=765$)	1.00 (referent)	**0.72 (0.54–0.96)**	**0.43 (0.21–0.87)**	1.16 (0.43–3.16)
Liquor ($n=482$)	1.00 (referent)	0.87 (0.62–1.23)	0.93 (0.57–1.53)	1.07 (0.39–2.93)

Bolded values indicates significant odds ratios.
Adjusted for age, gender, BMI, smoking status, education level, Hispanic background, field center, physical activity level, total caloric consumption, and alcohol type (except within its own stratification).

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Author Contributions

D.C.V. contributed toward the literature search, data analysis, data interpretation, figures, and writing. M.S., K.A., and Y.T. contributed toward the data analysis, data interpretation, figures, and writing. M.G. contributed toward the study design, data collection, data interpretation, and writing. M.L.D., H.M.G., G.T., C.R.I., G.H., and N.S. contributed toward the study design, data collection, and writing.

Author Disclosure Statement

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