ORIGINAL ARTICLE

Alcoholic beverage preference and characteristics of drinkers and nondrinkers in western New York (United States)

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Abstract

Background and Aim: *Dietary and lifestyle characteristics may differ for drinkers of specific alcoholic beverages and nondrinkers which would have important implications for studies of alcohol and disease. Our aim in this study was to describe differences in dietary and lifestyle characteristics associated with alcoholic beverage preference in a population-based sample of healthy study participants.*

Methods and Results: *Data were collected as part of a series of case-control studies of alcohol use, myocardial infarction, and lung, breast and prostate cancer in western New York from 1846 men and 1910 women aged 35 to 79, randomly selected from the general population of Erie and Niagara Counties. Beverage preference was defined for non-current* vs *current drinkers, and drinkers of beer, wine, liquor, and mixed beverages. Generalized linear models for continuous variables and Cochran-Mantel-Haenszel statistics for categorical variables were computed for the entire sample and stratified by gender. Participant characteristics differed by alcoholic beverage preference and drinking status. In general, wine drinkers had higher education and household incomes, lower prevalence of current smoking, higher intakes of dietary fiber, potassium, vitamin E, and total carotenoids, lower total fat intakes and higher amounts of fruits, vegetables, and grain products than consumers of other beverages. Conversely, beer and liquor drinkers had somewhat lower education and household incomes, higher rates of current smoking, higher energy and total fat intakes and consumed lower amounts of fruits, vegetables, and grain products. Finally, current nondrinkers were more likely to be older, less educated, have lower household incomes, and consume diets less consistent with dietary guidelines than current drinkers.*

Conclusions: *These results suggest that usual beverage preference may encompass other health-related behaviors and underline the importance of accurate exposure measurement and use of statistical methods to accommodate these interrelationships.*

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Introduction

The association between alcohol intake and chronic disease is complex. In general, alcohol intake has been positively associated with cancers of several sites (1-8), and negatively associated with cardiovascular outcomes such as myocardial infarction (9-12). Many studies have examined total alcohol intake regardless of beverage type. When beverage type is considered, a number of studies indicate that specific alcoholic beverages may have differential effects on health, *ie*, the protective effects observed for cardiovascular disease appear to be limited to wine consumption, and, to a lesser extent, spirits, rather than beer (13-19). Beer, wine, and liquor differ somewhat nutritionally, and could affect chronic disease differentially. However, habitual consumption of a specific type of alcoholic beverage may also be related to other lifestyle char-

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acteristics possibly obscuring the true relationship between alcoholic beverage type and chronic disease.

The literature investigating the relationship between drinking patterns and subject characteristics is limited mostly to overall alcohol intake. Light to moderate alcohol consumption has been associated with higher intakes of vitamins C, E, B1, iron, calcium, and energy (20). Similarly, consumption of fruits and vegetables were reportedly lowest among subjects reporting sedentary behavior, heavy smoking, and heavy drinking (21). In a study conducted in France and Ireland, wine and beer consumption was negatively related to socioeconomic status and education in France, but in Ireland wine consumption was positively related to these factors (22). In a Danish study of 48763 men and women, higher wine intake compared to other alcoholic beverages was associated with higher intakes of fruit, fish, cooked vegetables, salad, and olive oil (23). On the other hand, a study in Italy found that wine consumption was not associated with a healthy diet (24).

Given the likely multidimensional nature of alcoholic beverage preference, a thorough description of the associations between specific beverages and subject characteristics would provide valuable insight into studies of alcohol consumption and chronic disease. Furthermore, the majority of studies investigating subject characteristics and alcohol consumption have been conducted abroad; few data of this kind are available for the United States. The aim of this study was to describe the association between usual alcohol beverage type and demographic, personal and dietary characteristics in a population-based sample of adult men and women (aged 35-79 years), residents of two counties in western New York.

Methods

We conducted a series of case-control studies of alcohol use, myocardial infarction, and lung, breast, and prostate cancer in western New York between 1996 and 2001 with one joint control group. These analyses utilized data from the control subjects only and are limited to the 1846 men and 1910 women with complete dietary data and excluding lifetime alcohol abstainers. Participants were healthy individuals aged 35 to 79, randomly selected from the general population of Erie and Niagara County residents using driver's license bureau lists for residents under 65 years of age and Health Care Finance Administration lists for residents aged 65 and older. The study protocol was approved by the Institutional Review Board of the University at Buffalo, and informed consent was obtained from all subjects.

TABLE 1
Descriptive characteristics of healthy participants of the Center for Preventive Medicine.

	Overall (n=3756)	**Men (n=1846)**	**Women (n=1910)**
	Mean (SD)		
Age, years	58.8 (12.0)	60.3 (12.1)	57.4 (11 8)
Education, years	13 5 (2.5)	13 6 (2.6)	13.4 (2 4)
Body mass index	28.2 (5.5)	28.3 (4 6)	28 2 (6 3)
Waist/hip ratio	0 89 (0.09)	0 96 (0.06)	0.83 (0 08)
Lifetime vigorous physical activity, hours per week	5 1 (1 8)	5.3 (1 8)	5 0 (1.8)
	Number (%)		
Race			
Caucasian	3452 (91.9)	1696 (91 9)	1756 (91.9)
African American	258 (6 9)	131 (7.1)	127 (6.7)
Other	46 (1 2)	19 (1 0)	27 (1 4)
Total household income			
<30,000	1248 (33.2)	568 (30.8)	680 (35.6)
30,001-50,000	929 (24.7)	500 (27.1)	429 (22 5)
50,001-70,000	641 (17 1)	330 (17.9)	311 (16 3)
>70,000	691 (18.4)	359 (19 5)	332 (17 4)
Unknown	122 (3 3)	41 (2.2)	81 (4.2)
Refused	125 (3 3)	48 (2 6)	77 (4.0)
Cigarette smoking			
Never	1505 (40 1)	620 (33 6)	885 (46 3)
Former	1686 (44 9)	963 (52 2)	723 (37.9)
Current	565 (15 0)	263 (14 3)	302 (15 8)
Vitamin supplement use			
No	1317 (35.1)	758 (41.1)	559 (29 3)
Yes	2439 (64.9)	1088 (58 9)	1351 (70.7)

Data on demographics, smoking history, alcohol consumption, and other study variables were collected by trained interviewers during in-person computer assisted interviews. Height, weight, waist and hip circumferences were measured by trained technicians using a standardized protocol. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters (kg/m^2). Waist/hip ratio (WHR) was calculated as waist circumference divided by hip circumference.

Alcohol consumption was assessed with a detailed, computer-assisted interview querying intake during the 12 to 24 months prior to interview. As part of the interview, each participant was asked which of the four broad types of alcoholic beverages (beer, wine, wine cooler, liquor) were consumed during this time period. Usual beverage consumption was defined as follows: current nondrinkers (less than one drink per month during the 12 to 24 months prior to interview), drinkers of beer, wine, or liquor (consumption of that beverage at least 75% of all drinking occasions), and mixed beverage consumption (no single beverage consumed at least 75% of all drinking occasions). As wine coolers were rarely consumed, they were included in the wine categories.

Dietary intake in the year 12 to 24 months prior to the interview was collected using a self-administered modified version of the Health Habits and History food frequency questionnaire developed by researchers at the National Cancer Institute (23). Individual mean daily nutrient intake was calculated using the DietSys (version 3.7) nutrient analysis software developed specifically for that questionnaire (24). All nutrient calculation methods were based on food composition data available from the United States Department of Agriculture (USDA). Individual nutrient intake was calculated as the product of the food specific portion size (g), nutrient content (per g) and frequency, summed across all foods. Nutrient intakes were expressed as daily consumption. We also examined monthly frequency of consumption of the major food groups (fruit, vegetables, grains, meats, desserts, and dairy) calculated as the sum of the monthly frequency of use of the foods belonging to each group.

All analyses involving beverage type were stratified by gender and conducted separately for current drinkers *vs* nondrinkers, and across beverage types (excluding current nondrinkers). The following descriptive characteristics were examined as continuous variables: age, education, BMI, WHR, and vigorous physical activity (average hours per week over the lifetime). Categorical variables considered were race, total household income, cigarette smoking, and vitamin supplement use. Differences in education, BMI, WHR, and physical activity across categories of alcoholic beverage type were assessed with generalized linear models adjusting for age and total alcohol intake. Differences in categorical variables by beverage type were assessed with Cochran-Mantel-Haenszel statistics adjusting for age and total alcohol intake.

Differences in mean nutrient and food group intakes across different categories of beverages were assessed with generalized linear models. All generalized linear models included the continuous food or nutrient variable as the dependent variable and drinking status or beverage type as the categorical fixed factor. Crude and adjusted mean

TABLE 2
Distribution of consumption of specific beverages by healthy participants, Center for Preventive Medicine.

	Overall (n=3756)	Men (n=1846)	Women (n=1910)
	Number (%)		
Current non-drinkers	1214 (32 3)	505 (27 4)	709 (37.1)
Beer	735 (19.6)	568 (30 8)	167 (8 7)
Wine	595 (15 8)	190 (10.3)	405 (21 2)
Liquor	363 (9 7)	194 (10 5)	169 (8.9)
Mixed	849 (22 6)	389 (21.1)	460 (24.1)

Current non-drinkers defined as less than one drink per month during the 12 to 24 months prior to interview, beer, wine, and liquor defined as consumption of that beverage at least 75% of all beverages consumed, mixed beverage choice defined as no single beverage consumed at least 75% of the time, $p<0$ 01, χ^2 for categorical differences between men and women

TABLE 3
Demographic characteristics by usual alcoholic beverage type of healthy participants of the Center for Preventive Medicine, men (n=1846).

	Current non-drinkers[1] (n=505)		Current drinkers (n=1341)		Beer[2] (n=568)		Wine (n=190)		Liquor (n=194)		Mixed (n=389)	
	Mean (SE)				Mean (SE)							
Age, years	**62.2**[3]	**(0.5)**	59.5	(0.3)	*56 2*[3]	*(0.5)*	62 8	(0 9)	**64.6**	**(0.8)**	60.2	(0.6)
Education, years	13.0[3]	(0 1)	**13.8**	**(0.1)**	*13.2*[3]	*(0 1)*	**14.7**	**(0.2)**	13.7	(0 2)	14.4	(0.1)
Body mass index	**29.0**[3]	**(0.2)**	28.0	(0 1)	28.0	(0 2)	*27.8*	*(0.3)*	**28.7**	**(0.3)**	*27.8*	*(0.2)*
Waist/hip ratio	**0.96**[3]	**(0.003)**	0.95	(0 002)	0.95	(0 003)	0.95	(0.004)	0.96	(0.004)	0.95	(0.003)
Lifetime vigorous physical activity, hours per week	5.2	(0.1)	5 3	(0 1)	5.4	(0.1)	5 1	(0 1)	5.2	(0 1)	5.3	(0.1)
	Number (%)				Number (%)							
Race												
Caucasian	460[3]	(83.8)	**1236**	**(95.3)**	**554**[3]	**(97.5)**	179	(94.2)	*173*	*(89.2)*	330	(95.7)
African American	**75**	**(13.7)**	56	(4.3)	*12*	*(2 1)*	11	(5.8)	**20**	**(10.3)**	13	(3 8)
Other	**14**	**(2.6)**	5	(0 4)	2	(0.4)	0	(0 0)	1	(0.5)	2	(0 6)
Total household income												
<30,000	**228**[3]	**(41.5)**	340	(26.2)	**173**[3]	**(30.5)**	45	(23.7)	56	(28 9)	66	(19 1)
30,001-50,000	141	(25.7)	**359**	**(27.7)**	153	(26 9)	50	(26 3)	50	(25.8)	**106**	**(30.7)**
50,001-70,000	71	(12.9)	259	(20 0)	119	(21 0)	**42**	**(22.1)**	42	(21 7)	56	(16 2)
>70,000	78	(14.2)	281	(21 7)	106	(18 7)	40	(21 1)	34	(17 5)	**101**	**(29.3)**
Unknown	17	(3.1)	24	(1 9)	9	(1 6)	5	(2.6)	4	(2 1)	6	(1.7)
Refused	14	(2.6)	34	(2 6)	8	(1 4)	8	(4 2)	8	(4.1)	10	(2.9)
Cigarette smoking												
Never	182	(33 2)	438	(33 8)	194[3]	(34 2)	**80**	**(42.1)**	*48*	*(24 7)*	116	(33.6)
Former	293	(53.4)	670	(51.7)	283	(49.8)	*94*	*(49.5)*	**107**	**(55.2)**	186	(53.9)
Current	74	(13 5)	189	(14 6)	91	(16 0)	*16*	*(8.4)*	**39**	**(20.1)**	43	(12.5)
Vitamin supplement use												
No	235	(42 8)	523	(40 3)	262[3]	(46.1)	62	(32 6)	77	(39 7)	122	(35 4)
Yes	314	(57.2)	774	(59.7)	*306*	*(53.9)*	**128**	**(67.4)**	117	(60.3)	223	(64.6)

Differences in continuous variables between different categories of beverage consumption assessed using generalized linear models for current non-drinkers compared to current drinkers[1] and across beverage types[2], analyses across beverage type adjusted for age and total alcohol intake, differences in categorical variables assessed with Cochran-Mantel-Haenszel statistics adjusting for age and total alcohol intake, [3]$p<0.01$ among significant differences, highest values appear in bold, lowest in italics

nutrient and food intakes for each beverage category were calculated using generalized linear models with age, education, cigarette smoking status, race, total energy (except in the case of total energy), and total alcohol intake as covariates. These covariates were chosen because they are behaviors most likely to be related to both diet and chronic disease. Finally, as there were few differences observed between crude and adjusted values for any of the comparisons performed, only the adjusted values are presented here.

Results

The descriptive characteristics of the study participants are shown in Table 1. Mean age of the participants was 58.8±12.0 years; men were slightly older than women (60.3±12.1 years *vs* 57.4±11.8, respectively). Participants, in general, were well educated (mean years education 13.5±2.5) and more than one-third had total household incomes above $50,000 per year. Although almost 50% of participants were former smokers, the prevalence of current smoking (15.0%) in this sample

was somewhat lower than the national prevalence of current smoking (21.6%) as estimated by the Behavioral Risk Factor Survey (25). Finally, use of vitamin supplements was fairly high in this sample; 64.9% of participants reported using supplements during the 12 to 24 months before interview.

The distribution of consumption of specific alcoholic beverages by study participants is shown in Table 2. Approximately one-third of participants were current non-drinkers (27.4% and 37.1%, men and women, respectively). Whereas men were more likely than women to be beer drinkers (30.8% *vs* 8.7%), the reverse was observed for wine drinking (10.3% *vs* 21.2%). Men were only slightly more likely than women to be liquor drinkers (10.5% *vs* 8.9%) or to have no single beverage preference (21.1% *vs* 24.1%).

Differences in demographic and personal characteristics by usual alcoholic beverage type among men and women are shown in Table 3 and Table 4. For the majority of characteristics examined, patterns were similar for both genders.

TABLE 4

Demographic characteristics by usual alcoholic beverage type of healthy participants of the Center for Preventive Medicine, women (n=1910).

	Current non-drinkers[1] (n=709)		**Current drinkers (n=1201)**		**Beer[2] (n=167)**		**Wine (n=405)**		**Liquor (n=169)**		**Mixed (n=460)**	
	Mean (SE)				**Mean (SE)**							
Age, years	**58.4[3]**	**(0.4)**	56 5	(0 4)	*54.9[4]*	*(0.9)*	57 3	(0 6)	**57.8**	**(0.9)**	55.4	(0 7)
Education, years	13 0[3]	(0.1)	**13.7**	**(0.1)**	13 2[3]	(0 2)	**14.1**	**(0.1)**	*13 2*	*(0.2)*	13 9	(0 1)
Body mass index	**29.4[3]**	**(0.2)**	27 1	(0.2)	27 1[3]	(0 4)	*26.4*	*(0.3)*	**28.4**	**(0.4)**	27 3	(0 3)
Waist/hip ratio	**0.84[3]**	**(0.002)**	0 82	(0 003)	0 83[3]	(0 006)	*0 81*	*(0 004)*	**0.84**	**(0.006)**	0 82	(0.005)
Lifetime vigorous physical activity, hours per week	5 0	(0 1)	5 0	(0 1)	**5.2[4]**	**(0.1)**	*4 9*	*(0.1)*	5.2	(0 1)	*4.9*	*(0 1)*
	Number (%)				**Number (%)**							
Race												
Caucasian	807[3]	(88.3)	**949**	**(95.3)**	155[3]	(92 8)	**393**	**(97.0)**	*153*	*(90 5)*	248	(97 3)
African American	**92**	**(10.1)**	35	(3.5)	11	(6 6)	8	(2.0)	**14**	**(8.3)**	*2*	*(0.8)*
Other	15	(1 6)	12	(1.2)	1	(0 6)	4	(1 0)	2	(1 2)	5	(2.0)
Total household income												
<30,000	**388[3]**	**(42.5)**	292	(29 3)	51[3]	(30 5)	112	(27 7)	**60**	**(35.5)**	*69*	*(27 1)*
30,001-50,000	201	(22.0)	228	(22.9)	**53**	**(31.7)**	*76*	*(18.8)*	43	(25 4)	56	(22 0)
50,001-70,000	137	(15.0)	*174*	*(17 5)*	*22*	*(13.2)*	70	(17.3)	28	(16.6)	**54**	**(21.2)**
>70,000	106	(11 6)	226	(22 7)	29	(17.4)	**116**	**(28.6)**	25	(14.8)	56	(22.0)
Unknown	49	(5.4)	32	(3 2)	6	(3 6)	11	(2 7)	8	(4.7)	7	(2 8)
Refused	33	(3.6)	44	(4 4)	6	(3 6)	20	(4 9)	5	(3 0)	13	(5 1)
Cigarette smoking												
Never	**467[3]**	**(51.1)**	418	(42 0)	*52[3]*	*(31.1)*	**203**	**(50.1)**	62	(36 7)	101	(39.6)
Former	313	(34.3)	**410**	**(41.2)**	68	(40 7)	167	(41.2)	*62*	*(36 7)*	**113**	**(44.3)**
Current	134	(14.7)	**168**	**(16.9)**	47	(28 1)	*35*	*(8 6)*	45	(26 6)	41	(16 1)
Vitamin supplement use												
No	285	(31 2)	274	(27.5)	54	(32 3)	95	(23.5)	55	(32 5)	70	(27 5)
Yes	629	(68 8)	722	(72.5)	113	(67 7)	310	(76.5)	114	(67 5)	185	(72 6)

Differences in continuous variables between different categories of beverage consumption assessed using generalized linear models for current non-drinkers compared to current drinkers[1] and across beverage types[2], analyses across beverage type adjusted for age and total alcohol intake, differences in categorical variables assessed with Cochran-Mantel-Haenszel statistics adjusting for age and total alcohol intake, [3]$p<0.01$, [4]$p<0.05$, among significant differences, highest values appear in bold, lowest in italics

Among both men and women, current nondrinkers tended to be older, slightly less educated, and have lower total household incomes than current drinkers. Although the number of non-white participants was small in this study, African Americans were more likely to be current nondrinkers than current drinkers (13.7% *vs* 4.3%). Nondrinkers also had higher BMI and greater WHR than current drinkers. Few significant differences were observed between nondrinkers and drinkers for lifetime vigorous physical activity, prevalence of current cigarette smoking, or use of vitamin supplements; however, women nondrinkers were more likely than drinkers to be never smokers.

Across beverage types for both men and women, beer drinkers tended to be younger, less educated, and have lower total household incomes than drinkers of other beverages (Tables 3 and 4, men and women, respectively). Although not statistically significant among men, beer drinkers also had slightly higher BMI but also higher levels of lifetime vigorous physical activity. Men and women wine drinkers and mixed drinkers, on the other hand, had higher levels of education and somewhat higher household incomes. Both men and women in these categories were also more likely to have lower BMI, higher vitamin supplement use, and were more likely to be never or former smokers than drinkers of other beverages. Men and women who preferred liquor were older, less educated, more likely to be African American, and had somewhat lower total household income than those in the other beverage categories. Liquor drinkers also tended to have higher BMI and WHR, and were more likely to be current smokers than those who preferred other beverages.

Differences in nutrient intakes between drinkers and nondrinkers and categories of alcoholic beverages for men and women are shown in Tables 5 and 6, respectively. Among men, compared to current drinkers, nondrinkers had significantly higher intakes of carbohydrates, total fat, protein, cholesterol, dietary fiber, and potassium, and slightly higher intakes of saturated and monounsaturated fats, folate, and vitamins C and E (Table 5). Similarly, women nondrinkers tended to have higher carbohydrate and total fat intakes,

TABLE 5

Adjusted mean[1] (SE) daily intake of selected nutrients by usual alcoholic beverage type of healthy participants of the Center for Preventive Medicine, men (n=1846)

	Current non-drinkers[2] (n=505)		**Current drinkers (n=1341)**		**Beer[3] (n=568)**		**Wine (n=190)**		**Liquor (n=194)**		**Mixed (n=389)**	
	Mean (SE)				**Mean (SE)**							
Energy (MJ)	7 7	(0.1)	8 0	(0 1)	8 1	(0 1)	8 1	(0 2)	7.8	(0 2)	8.3	(0.2)
Carbohydrates (% energy)	**46.6[4]**	**(0.3)**	44.7	(0 2)	44 4[4]	(0 3)	**46.7**	**(0.5)**	44 3	(0 5)	*44 2*	*(0.4)*
Protein (% energy)	**16.5[4]**	**(0.1)**	16.0	(0 1)	15 9[4]	(0 1)	**16.5**	**(0.2)**	16 1	(0 2)	*15.7*	*(0.1)*
Total fat (% energy)	**37.6[4]**	**(0.3)**	35.5	(0 2)	36 1[4]	(0 3)	*33 4*	*(0 5)*	**36.5**	**(0.5)**	35 0	(0 4)
Saturated fat (% fat)	36.0	(0 1)	35 8	(0 1)	35 9	(0.1)	35 4	(0.3)	36 2	(0.3)	35 9	(0 2)
Monounsaturated fat (% fat)	37.2	(0 1)	37.0	(0 1)	37 1	(0 1)	36 7	(0.2)	37 2	(0 2)	36 9	(0.1)
Polyunsaturated fat (% fat)	16 4	(0 1)	16 5	(0 1)	16.8	(0 2)	16.4	(0 3)	16 4	(0.3)	16 3	(0.2)
Alcohol (g)	----		15 0	(0 5)	14 0[4]	(1 0)	*10.5*	*(1 7)*	**24.0**	**(1.7)**	14.3	(1.2)
Cholesterol (mg)	**315.6[5]**	**(5.8)**	298 2	(3 7)	304 9	(5 6)	300.7	(9 6)	304 2	(9 6)	292 3	(7.0)
Dietary fiber (g)	**14.5[4]**	**(0.2)**	13 7	(0.1)	13.6[4]	(0 2)	**15.4**	**(0.4)**	*13.2*	*(0 4)*	14.0	(0 3)
Potassium (mg)	**2984.0[5]**	**(25.0)**	2908.1	(16 1)	2935.6[4]	(24.7)	**3141.6**	**(42.3)**	*2899.9*	*(42.3)*	2918 1	(30.9)
Folate (mcg)	333 9	(7 0)	327.2	(4 5)	326 6	(6.7)	350 5	(11 5)	322 3	(11.5)	332.5	(8 4)
Vitamin C (mg)	135 5	(3 0)	130 9	(1 9)	*125.3[4]*	*(2.8)*	**145.9**	**(4.8)**	134 0	(4 8)	135.0	(3 5)
Vitamin E (mg)	11 2	(0.3)	10 7	(0.2)	10 8	(0 3)	10 9	(0 5)	11 1	(0 5)	10 9	(0 3)
Carotenoids (mcg)	**3918.5[5]**	**(110.3)**	3608 2	(71 1)	*3461 6[5]*	*(107.0)*	**4029.4**	**(183.1)**	3496 7	(183.2)	3728 9	(133 9)

[1]Energy intake adjusted for age, education, race, smoking status, and alcohol, remaining nutrients further adjusted for total energy, differences in mean nutrient intake between different categories of beverage consumption assessed using generalized linear models for current non-drinkers compared to current drinkers[2] and across beverage types[3], [4]$p<0$ 01, [5]$p<0$ 05, among significant differences, highest values appear in bold, lowest in italics

TABLE 6
Adjusted mean[1] (SE) daily intake of selected nutrients by usual alcoholic beverage type of healthy participants of the Center for Preventive Medicine, women (n=1910).

	Current non-drinkers[2] (n=709)		Current drinkers (n=1201)		Beer[3] (n=167)		Wine (n=405)		Liquor (n=169)		Mixed (n=460)	
	Mean (SE)				Mean (SE)							
Energy (MJ)	6 0	(0.1)	6.1	(0.1)	6.2	(0.2)	6.0	(0.1)	6.2	(0.2)	6.4	(0 1)
Carbohydrates (% energy)	**48.1[4]**	**(0.2)**	46.6	(0.2)	45.0[4]	(0.6)	**48.1**	**(0.4)**	*44.7*	*(0 6)*	46 9	(0 5)
Protein (% energy)	16 4	(0 1)	16 1	(0 1)	*15.7[5]*	*(0.2)*	**16.5**	**(0.1)**	16 2	(0 2)	16 1	(0.2)
Total fat (% energy)	**36.3[4]**	**(0.3)**	34 8	(0.2)	36 4[4]	(0 6)	*33.5*	*(0 4)*	**36.7**	**(0.6)**	34 0	(0.5)
Saturated fat (% fat)	35.9	(0.1)	35.6	(0.1)	35 7	(0.3)	35.5	(0.2)	35.9	(0.3)	35 8	(0 2)
Monounsaturated fat (% fat)	**36.6[4]**	**(0.1)**	36.1	(0 1)	**36.6[5]**	**(0.2)**	*35.9*	*(0 1)*	36 0	(0 2)	36 0	(0.2)
Polyunsaturated fat (% fat)	16.6	(0 1)	16.8	(0 1)	17 1	(0.3)	16 4	(0 2)	17 1	(0 3)	16.9	(0.3)
Alcohol (g)	----		7 8	(0 4)	8 6	(1 2)	7 8	(0 8)	8.2	(1 2)	7.0	(1 0)
Cholesterol (mg)	216 9	(2 8)	215.4	(2.7)	217 7	(6 7)	215 8	(4 3)	227 5	(6.7)	213.8	(5.4)
Dietary fiber (g)	11 5	(0.1)	11 7	(0 1)	10 6[4]	(0 4)	**12.6**	**(0.2)**	*10.3*	*(0.4)*	12.3	(0 3)
Potassium (mg)	2409.2[5]	(17.2)	**2457.7**	**(16.4)**	*2370 1[4]*	*(40.3)*	**2574.5**	**(25.9)**	2383.3	(40 0)	2539.5	(32 3)
Folate (mcg)	260 8	(3 9)	269.4	(3 8)	253.3[4]	(9.6)	**288.5**	**(6.2)**	*250.8*	*(9.5)*	275.8	(7.7)
Vitamin C (mg)	118 3	(2.1)	123 7	(2 0)	113.8[4]	(4 9)	**132.5**	**(3.1)**	*112.5*	*(4 8)*	129.2	(3 9)
Vitamin E (mg)	8 7	(0 2)	8.8	(0.2)	8.5	(0.4)	9.2	(0 2)	8.5	(0.4)	8.8	(0 3)
Carotenoids (mcg)	3129 7	(72 7)	3306 6	(69.6)	2945.1[4]	(179.3)	**3605.8**	**(115.3)**	*2767.4*	*(178.0)*	**3606.9**	**(143.7)**

[1]Energy intake adjusted for age, education, race, smoking status, and alcohol, remaining nutrients further adjusted for total energy, differences in mean nutrient intake between different categories of beverage consumption assessed using generalized linear models for current non-drinkers compared to current drinkers[2] and across beverage types[3], [4]$p<0.01$, [5]$p<0.05$, among significant differences, highest values appear in bold, lowest in italics

but lower potassium intakes. Although not statistically significant, women nondrinkers tended to have slightly higher intakes of protein, saturated fat, cholesterol, folate, vitamins C and E, and total carotenoids (Table 6).

Across beverage types among men (Table 5), beer drinkers had significantly lower intakes of vitamins C and E and total carotenoids than drinkers of other beverages. On the other hand, men wine drinkers had higher intakes of carbohydrates, protein, dietary fiber, potassium, vitamin C, and carotenoids, and lower intakes of total fat and alcohol than other drinkers. Men who preferred liquor tended to have the highest intakes of total, saturated, and monounsaturated fats, and alcohol, but lower dietary fiber and potassium intakes. Few remarkable differences in nutrient intakes were observed for mixed drinkers among men.

Across beverage types among women (Table 6), beer drinkers had the highest alcohol intakes, and lower intakes of potassium and carotenoids. Conversely, women wine drinkers had slightly lower energy intakes, higher intakes of carbohydrate, protein, dietary fiber, potassium, folate, and vitamin C, and lower fat intakes compared to other drinkers. Finally, women liquor drinkers tended to have lower intakes of carbohydrates, dietary fiber, folate, and vitamin C, and higher fat intakes. As observed among men, few differences in nutrient intakes were observed for women with no single beverage preference.

We observed some differences in intakes of specific food groups by alcoholic beverage preference among both men and women (Table 7). Among men, nondrinkers compared to drinkers tended to have somewhat higher intakes of all food groups, especially of fruits and desserts. Women nondrinkers, on the other hand, were more likely to have lower intake of fruits, vegetables, and dairy, but higher intakes of meats, grains, and desserts. For both men and women, however, most of the observed differences were somewhat small and not statistically significant.

Notable differences in food group intake by beverage type among men and women were limited, and, as for non-

drinkers compared with drinkers, most were not statistically significant (Table 7). For both men and women, beer drinkers had lower intakes, but wine drinkers had higher intakes, of fruits and vegetables. Wine drinkers also had slightly higher grain intakes, and, among men, lower meat intakes. Although men liquor drinkers had higher meat intakes, the reverse was seen among women liquor drinkers. Few differences in food groups were observed for men or women mixed drinkers.

Discussion

Identification of the attributes of alcohol consumption which might contribute to the etiology of chronic disease has been the subject of many scientific inquiries. Our results suggest that preference for a specific alcoholic beverage, or avoidance of any alcohol consumption, may be related to important differences in the characteristics of the consumer. Many of these characteristics, such as diet, cigarette smoking, physical activity, and body size are also chronic disease risk factors. Correlations of these factors with consumption of specific beverages may confound the estimation of risk associated with that beverage.

Our results highlight the importance of lifestyle characteristics associated with consumption of specific beverages. Previous studies have suggested that the protective effect on cardiovascular disease by alcohol may be limited to wine (28), and several studies have implicated a positive association between beer and cancer of several sites (1). Although there may be nutritional factors associated with specific beverages, we have shown that there are important lifestyle differences as well. Wine drinkers in our study tended to have more education, higher household incomes, were less likely to be current smokers, and had lower BMI than consumers of other beverages, and, in some cases, even of non-

TABLE 7

Adjusted mean[1] (SE) monthly frequency of consumption of selected food groups by usual alcoholic beverage type of healthy participants of the Center for Preventive Medicine.

	Current non-drinkers[2]		Current drinkers		Beer[3]		Wine		Liquor		Mixed	
	Mean (SE)				Mean (SE)							
	Men											
	(n=505)		(n=1341)		(n=568)		(n=190)		(n=194)		(n=389)	
Fruits and juices	**109.4[5]**	**(2.6)**	102.5	(1 7)	*97.6[5]*	*(2.5)*	**110.6**	**(4.3)**	106 7	(4 3)	102.9	(3.1)
Vegetables	136.7	(2.9)	131 6	(1 9)	128 5	(2.8)	142 4	(4 8)	132 8	(4 8)	131 7	(3.5)
Meats	70 9	(1.5)	69.9	(1.0)	70 7	(1 5)	68 2	(2 5)	73.0	(2.5)	67 2	(1 8)
Grains	97.6	(1.6)	94.2	(1 0)	91.8	(1.5)	98 2	(2 6)	95 7	(2 6)	97.0	(1.9)
Dairy	34.8	(1.0)	33 8	(0 7)	33 7[4]	(1.0)	35 3	(1 8)	**39.7**	**(1.8)**	*32.3*	*(1.3)*
Desserts	**40.4[4]**	**(1.2)**	35.7	(0 8)	35 9	(1.2)	33.0	(2 0)	35 8	(2 0)	37 8	(1 4)
	Women											
	(n=709)		(n=1201)		(n=167)		(n=405)		(n=169)		(n=460)	
Fruits and juices	114 8	(2.0)	116.1	(1 9)	*103 0[4]*	*(4.6)*	**122.6**	**(3.7)**	103.3	(4 5)	**122.6**	**(2.9)**
Vegetables	139 5[5]	(2 3)	**146.9**	**(2.2)**	*132.8[4]*	*(5.2)*	**157.7**	**(3.3)**	133 3	(5.1)	149 1	(4 1)
Meats	57.3	(1 1)	54 9	(1 0)	55 9	(2 3)	55 0	(1.5)	53 8	(2 3)	54 6	(1 9)
Grains	**98.0[5]**	**(1.1)**	94 5	(1 1)	88 2[4]	(2 7)	**100.4**	**(1.8)**	*87.9*	*(2.7)*	95 3	(2 2)
Dairy	36 5[5]	(0 9)	**38.9**	**(0.8)**	37 8	(2 0)	40 9	(1 3)	39 5	(2 0)	39.8	(1 6)
Desserts	37 7	(0 9)	35.9	(0 9)	35 2	(2 1)	37 7	(1 3)	36 0	(2 1)	35 4	(1 7)

[1]Adjusted for age, education, smoking status, race, and total energy, across beverage types further adjusted for alcohol intake, differences in mean frequency of food consumption between different categories of beverage consumption assessed using generalized linear models for current non-drinkers compared to current drinkers[2] and across beverage types[3], [4]$p<0.01$, [5]$p<0.05$, among significant differences, highest values appear in bold, lowest in italics

drinkers. Marques-Vidal *et al* (22) reported that in France wine and beer consumption was negatively related to socioeconomic status and education, whereas in Northern Ireland a positive association was observed. Gronbaek *et al* (14) reported that beer drinkers were more likely to drink more frequently, but observed no differences in total alcohol intake for different beverages. Finally, Mortensen *et al* (29) reported that wine drinking was associated with higher IQ, higher parental education level and higher socioeconomic status. Our findings are consistent with the limited literature to date that has described subject characteristics and alcohol beverage type.

The relationship between alcohol drinking and chronic disease appears complex. Given the evidence suggesting that at least some portion of the protective effect of wine consumption compared to other alcoholic beverages may be attributed to the personal characteristics and behaviors of the wine consumer (28), the current study provides additional evidence that individuals differ in health-related behaviors by the types of beverages they habitually consume, or whether they drink at all. In our study, wine drinkers tended to have diets more consistent with recommendations to reduce chronic disease, whereas beer and liquor drinkers had patterns less consistent with these guidelines (1, 30-32).

The beneficial dietary profile of wine consumers may explain, in part, previously reported associations of the protective effect on cardiovascular disease by wine (28), and similarly, reported positive associations between beer and liquor and cancers of several sites (1). The literature is fairly consistent in supporting recommendations for increasing fruit and vegetable intakes and limiting meat and fat intakes for reducing chronic disease risk (30-32). In our study, wine drinkers tended to consume more fruits, vegetables, and grains, and somewhat lower amounts of meats. These results, in conjunction with that of others (22, 23), suggest that wine drinkers may be more likely to have healthier lifestyles, and that lifestyle patterns may be more important predictors of disease than a specific behavior. These findings emphasize the importance of using analytic methods which can take these correlated behaviors into account. Furthermore, because dietary and personal characteristics appear to be distributed differentially by beverage type, an accurate assessment of both diet and alcohol use is crucial for reducing misclassification of exposures associated with chronic disease.

We also had the opportunity in these data to compare characteristics of current nondrinkers with current drinkers. Interestingly, abstinence from alcohol in these data was not associated with a healthier profile. In fact, in our study, current nondrinkers were more likely to be older, less educated, have lower household incomes, and consume diets less consistent with dietary guidelines than current drinkers. It is possible that individuals who have ceased drinking alcohol differ from drinkers in some aspects, or have health conditions which resulted in cessation of alcohol drinking. This finding suggests that participant characteristics may be important in discerning alcohol-related differences in mortality and morbidity between nonconsumers and consumers.

Our results underline the complexity of the relationship between drinking patterns and disease etiology. A simple examination of total alcohol intake related to disease risk may be insufficient as it appears that beverage type may encompass a constellation of important risk factors. Diet is clearly an important component in the development of many chronic diseases, and alcoholic beverage choice may be an important determinant of dietary quality. Failure to incorporate both dietary and drinking patterns into etiologic research could reduce our ability to draw clear conclusions about the role alcohol plays in disease etiology. Our challenge is to accurately ascertain these exposures with detail sufficient to appropriately characterize patterns of behavior that impact the development of chronic disease. Future investigations may also need to consider more sophisticated statistical methods which incorporate correlated variables, or at least consider beverage type as an important factor related to disease etiology.

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