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Alcohol Intake, Type of Beverage, and the Risk of Cerebral Infarction in Young Women

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Background and Purpose—The relationship between alcohol consumption and cerebral infarction remains uncertain, and few studies have investigated whether the relationship varies by alcohol type or is present in young adults. We examined the relationship between alcohol consumption, beverage type, and ischemic stroke in the Stroke Prevention in Young Women Study.

Methods—All 59 hospitals in the greater Baltimore-Washington area participated in a population-based case-control study of stroke in young women. Case patients (n=224) were aged 15 to 44 years with a first cerebral infarction, and control subjects (n=392), identified by random-digit dialing, were frequency matched by age and region of residence. The interview assessed lifetime alcohol consumption and consumption and beverage type in the previous year, week, and day. ORs were obtained from logistic regression models controlling for age, race, education, and smoking status, with never drinkers as the referent.

Results—Alcohol consumption, up to 24 g/d, in the past year was associated with fewer ischemic strokes (<12 g/d: OR 0.57, 95% CI 0.38 to 0.86; 12 to 24 g/d: OR 0.38, 95% CI 0.17 to 0.86; >24 g/d: OR 0.95, 95% CI 0.43 to 2.10) in comparison to never drinking. Analyses of beverage type (beer, wine, liquor) indicated a protective effect for wine consumption in the previous year (<12 g/wk: OR 0.58, 95% CI 0.35 to 0.97; 12 g/wk to <12 g/d: OR 0.55, 95% CI 0.28 to 1.10; ≥12 g/d: OR 0.92, 95% CI 0.23 to 3.64).

Conclusions—Light to moderate alcohol consumption appears to be associated with a reduced risk of ischemic stroke in young women. (*Stroke*. 2001;32:77-83.)

Key Words: alcohol drinking ■ cerebral infarction ■ young adults

The relationship between alcohol consumption and cerebral infarction is controversial, with some studies reporting a J-shaped relationship and others no association.¹⁻⁵ Among those that have reported a J-shaped relationship, the majority observed a negative association for average intakes of up to 2 drinks per day and a positive association for intakes of 6 to 7 drinks per day or more.¹⁻⁵ Only a few studies that have examined the association of alcohol consumption with ischemic stroke have assessed whether the relationship varies by beverage type.^{3,4} It has been hypothesized that wine consumption, in particular, may be protective for both heart disease and ischemic stroke.⁶

In general, these relationships have not been explored among young adults, who are likely to have different patterns

of alcohol consumption and etiologies of stroke and may have a different relationship between alcohol intake and stroke than older adults. Therefore, we undertook the current study to examine the relationship between alcohol consumption, type of beverage, and ischemic stroke among women 15 to 44 years of age who participated in the Stroke Prevention in Young Women Study.

Subjects and Methods

The Stroke Prevention in Young Women Study is a population-based case-control study that examines risk factors for ischemic stroke in young women. Case patients and control subjects were recruited to the study between February 26, 1992, and January 1, 1996. Case patients were women aged 15 to 44 years with a first cerebral

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TABLE 1. Distribution of Demographic Characteristics and Ischemic Stroke Risk Factors Among Case Patients and Control Subjects

Characteristic	Cases		Controls		P*
	%	(n)	%	(n)	
Age \geq 40 y	36.2	(81)	34.7	(136)	0.71
Black	45.1	(101)	34.2	(134)	<0.01
Less than high-school education	14.9	(35)	12.5	(49)	0.41
Current smoker	48.0	(107)	29.8	(117)	<0.01
BMI \geq 27.2	48.6	(108)	37.6	(146)	<0.01
Total cholesterol $>$ 240 mg/dL	26.5	(48)	13.0	(45)	<0.01
HDL cholesterol $<$ 35 mg/dL	31.2	(70)	14.8	(58)	<0.01
Medical history					
Hypertension	29.2	(65)	12.5	(49)	<0.01
Diabetes	12.5	(28)	2.3	(9)	<0.01
Coronary heart disease	15.6	(35)	3.1	(12)	<0.01
Alcohol use in past year†					
Current Drinker	51.3	(115)	58.9	(231)	0.07
Beer drinker‡	72.8	(83)	68.7	(158)	0.43
Wine drinker‡	62.0	(70)	76.6	(177)	<0.01
Hard-liquor drinker‡	77.4	(89)	76.6	(177)	0.87

*From χ^2 test.

†Year prior to date of stroke for case patients and year prior to date of interview for controls.

‡Percentage of current drinkers who reported any intake of this type of alcohol.

infarction, identified by discharge surveillance at all hospitals (n=59) in Maryland (excluding the far western panhandle); Washington, DC; and the southern portions of both Pennsylvania and Delaware. The methods for discharge surveillance, chart abstraction, case adjudication, and assignment of probable and possible underlying causes have been described previously.⁷⁻⁹ Recruitment within 1 year of stroke was required for participation. Of 291 case patients who were both eligible and identified within the 1-year time window, 227 (78%) could be contacted and agreed to participate. Of these, 3 were excluded because information on alcohol intake in the past year was not available. Twenty-eight percent of case patients completed the interview within 1 month after stroke and 58% completed the interview within 6 months after stroke. Controls were women without a history of stroke, frequency matched by age and geographic region of residence to the cases, and identified by random-digit dialing. Of 450 eligible controls, 392 agreed to participate.

Face-to-face interviews were conducted with both case patients and controls (or a proxy if the participant was unable to answer; n=22) to assess demographic (age, race, and educational level), medical (history of hypertension, diabetes, angina, and myocardial infarction), and lifestyle (current smoking status and alcohol use) characteristics. Blood samples were obtained at the conclusion of the interview.

The questionnaire asked about lifetime alcohol use (Have you had more than 12 drinks of any kind of alcoholic beverage in any 1 year of your lifetime?) and alcohol use in the previous year (During the year prior to your stroke [or day of interview, for controls], did you drink any wine, beer, or drinks like vodka, whiskey, or gin?). Participants who reported never consuming more than 12 alcoholic drinks in any 1 year were classified as never drinkers. Former drinkers were those who reported ever drinking more than 12 alcoholic drinks in a year but who had not used alcohol in the past year. Current drinkers were defined as those who used alcohol in the past year.

Among current drinkers, average alcohol intake in the past year was estimated from responses to separate questions on frequency (ie, "How often did you usually drink beer?" recorded as number of

times per day, week, month, or year) and quantity of drinks per occasion of light beer (bottles/cans), beer (bottles/cans), wine (glasses), or hard liquor (shots) (ie, "On each occasion that you drank beer, how much did you usually have?"). Separate questions for each type of alcohol assessed the number of drinks consumed in the past week and in the past 24 hours (ie, "In the week before your stroke how much beer did you have?"). To estimate average alcohol intake in grams per day, we assumed that 1 bottle/can of light beer contained 11.3 g of alcohol, 1 bottle/can of beer contained 12.8 g, 1 glass of wine contained 9.6 g, and 1 shot of hard liquor contained 15.1 g.¹⁰ Average amount of alcohol intake in the past year and past week were categorized as $<$ 12 g/d, 12 to 24 g/d, and $>$ 24 g/d. These categories reflect current recommendations on alcohol consumption and coronary heart disease and stroke.^{11,12}

Hypertension, diabetes mellitus, angina, and myocardial infarction were determined by asking if the participant had ever been told by a physician that she had the condition. Body mass index (BMI) was also based on self-report and calculated as the weight in kilograms divided by the square of the height in meters. Total cholesterol and HDL cholesterol were measured according to standard practices.^{13,14} Total cholesterol was considered high at \geq 240 mg/dL. HDL cholesterol was considered low at \leq 35 mg/dL.

χ^2 tests were used to test for differences in the distributions of the demographic, medical, and lifestyle characteristics between cases and controls. The relationship between alcohol use and ischemic stroke was examined by estimating ORs from logistic regression models for current, former, and never drinkers, and, among current drinkers, for the amount of alcohol use in the past year and the past week, and any use in the past 24 hours. For the logistic regression analyses, three models were estimated; model 1 included only alcohol use; model 2, in addition to alcohol use, included age, race, educational level (less than high school versus greater than high school education), and smoking status (current versus noncurrent); and model 3 included all of the variables in model 2 as well as BMI, total cholesterol, HDL cholesterol, history of hypertension, history of diabetes, and history of coronary heart disease. The variables contained in model 2 have been identified in other analyses as

TABLE 2. Crude and Adjusted ORs for the Relationship Between Alcohol Consumption and Ischemic Stroke

	Cases, n	Controls, n	Model 1		Model 2*		Model 3†	
			OR	95% CI	OR	95% CI	OR	95% CI
Drinking status								
Never	83	125	1.00	Referent	1.00	Referent	1.00	Referent
Former	26	36	1.09	0.61–1.93	0.87	0.48–1.59	0.78	0.39–1.55
Current	115	231	0.75	0.52–1.07	0.62	0.42–0.91	0.80	0.51–1.26
Amount in past year, g/d								
Never drinker	83	125	1.00	Referent	1.00	Referent	1.00	Referent
<12	80	186	0.65	0.44–0.95	0.57	0.38–0.86	0.77	0.48–1.25
12–24	10	52	0.52	0.24–1.12	0.38	0.17–0.86	0.44	0.16–1.24
>24	18	16	1.69	0.82–3.51	0.95	0.43–2.10	1.14	0.44–2.94
Amount in past week, g/d								
Never drinker	83	125	1.00	Referent	1.00	Referent	1.00	Referent
None	52	88	0.82	0.54–1.24	0.76	0.49–1.17	0.91	0.54–1.51
<12	40	121	0.46	0.30–0.71	0.42	0.27–0.67	0.63	0.37–1.06
12–24	10	15	0.92	0.40–2.13	0.64	0.27–1.54	0.89	0.33–2.38
>24	6	7	1.19	0.39–3.63	0.87	0.27–2.76	2.00	0.51–7.85
Intake in past 24 h‡								
Never	83	125	1.00	Referent	1.00	Referent	1.00	Referent
None in past week	51	87	0.88	0.57–1.38	0.75	0.47–1.21	0.89	0.51–1.56
None in past 24 h	34	94	0.54	0.34–0.88	0.42	0.25–0.71	0.65	0.36–1.18
Drank in past 24 h	23	49	0.71	0.40–1.24	0.51	0.28–0.94	0.77	0.36–1.62

*Controlling for age, race, education, and smoking.

†Controlling for age, race, education, smoking, BMI, total cholesterol, HDL cholesterol, history of hypertension, history of coronary heart disease, and history of diabetes. ‡All models also controlled for average alcohol intake in the past year.

important confounders of the relationship between alcohol consumption and stroke.² The additional variables in model 3 include potential mediators of the causal association between alcohol and stroke. Never drinkers served as the referent category for all logistic regression models.

The effects of type of alcohol used in the past year and in the past week on ischemic stroke were also examined. To determine the effect of any use, 3 variables were created for any beer, wine, and hard liquor consumption. For these analyses, all logistic regression models also contained average daily alcohol consumption (in grams per day) and average daily alcohol consumption squared.

For alcohol intake in the past year, the relationship between the average amount of each type of beverage consumed and stroke was also examined. For each type of beverage, 3 dummy variables for average intake (<12 g/wk, 12 g/wk to <12 g/d, ≥12 g/d) were included in the logistic regression models. Few women reported an average consumption of each beverage of 12 to 24 g/d or >24 g/d; therefore, the above categories were selected to reflect their lower levels of intake.

Results

Among the 224 stroke patients, over half (51.3%) were current drinkers, 11.6% were former drinkers, and 37.0% were never drinkers. The prevalence of current drinking was slightly higher among the controls (58.9%); 9.2% of the controls were former drinkers, and 31.8% were never drinkers. Among current drinkers, stroke patients were less likely to be wine drinkers than were controls (Table 1). The 2 groups did not differ on use of beer or hard liquor. Stroke patients were more likely than the controls to be black. Stroke patients had a higher prevalence of cardiovascular disease

risk factors (current smoking, obesity, hypertension, hypercholesterolemia, low HDL cholesterol, and diabetes) and of coronary heart disease (Table 1).

Among the controls, current drinkers were more likely than never drinkers to be 40 years of age or older, to have less than a high school education, and to be current smokers ($P < 0.01$ for all 3 χ^2 tests). Current drinkers were less likely than never drinkers to be black ($P < 0.001$). When type of beverage among current drinkers was examined, differences in the other risk factors for stroke primarily existed between wine drinkers and nonwine drinkers. Women who drank wine were less likely than nonwine drinkers to have less than a high school education (6.2% versus 22.2%, $P < 0.01$), to be current smokers (27.1% versus 55.6%, $P < 0.01$), or to have a high cholesterol level (9.5% versus 21.3%, $P = 0.03$). Women who consumed hard liquor in the past year were more likely to be current smokers than those who did not drink hard liquor (38.9% versus 16.7%, $P < 0.01$).

For most of the comparisons, the results of logistic regression analyses controlling for age, race, education, and smoking status (model 2) were similar to the results of unadjusted analyses (model 1) (Table 2). Overall, current drinkers had an almost 40% lower risk of stroke than never drinkers (model 2 OR 0.62, 95% CI 0.42 to 0.91). Former drinking was not related to stroke among these young women. ORs indicated that women who drank, on average, ≤24 g of alcohol per day during the past year had a lower risk of stroke than never drinkers (model 2 OR 0.57 for

TABLE 3. Crude and Adjusted ORs for the Relationship Between Type of Alcohol Consumption and Ischemic Stroke

	Cases, n	Controls, n	Model 1*		Model 2†		Model 3‡	
			OR	95% CI	OR	95% CI	OR	95% CI
Type of alcoholic beverage in past year								
Never	83	125	1.00	Referent	1.00	Referent	1.00	Referent
Any beer	83	158	0.91	0.58–1.44	0.93	0.58–1.50	0.92	0.53–1.61
Any wine	70	177	0.50	0.32–0.78	0.57	0.36–0.91	0.55	0.31–0.98
Any liquor	89	177	1.00	0.63–1.59	0.81	0.50–1.33	1.35	0.73–2.49
Amount of alcoholic beverage in past year§								
Never	83	125	1.00	Referent	1.00	Referent	1.00	Referent
Beer								
<12 g/wk	29	88	0.75	0.44–1.30	0.79	0.45–1.37	0.75	0.39–1.44
12 g/wk to <12 g/d	32	49	1.40	0.80–2.47	1.33	0.75–2.38	1.67	0.86–3.24
≥12 g/d	18	21	1.29	0.61–2.72	0.90	0.41–1.98	0.73	0.29–1.84
Wine								
<12 g/wk	46	129	0.52	0.32–0.86	0.58	0.35–0.97	0.56	0.30–1.04
12 g/wk to <12 g/d	17	41	0.51	0.26–1.00	0.55	0.28–1.10	0.57	0.25–1.29
≥12 g/d	4	7	0.82	0.21–3.15	0.92	0.23–3.64	1.85	0.31–10.94
Liquor								
<12 g/wk	46	131	0.84	0.51–1.40	0.70	0.41–1.19	1.04	0.55–1.98
12 g/wk to <12 g/d	29	34	1.70	0.92–3.15	1.31	0.69–2.50	2.53	1.15–5.57
≥12 g/d	13	12	2.04	0.83–5.02	1.47	0.57–3.78	2.18	0.68–7.04
Type of alcoholic beverage in past week								
Never	83	125	1.00	Referent	1.00	Referent	1.00	Referent
Any beer	31	72	0.59	0.32–1.09	0.56	0.30–1.08	0.59	0.28–1.25
Any wine	19	59	0.51	0.28–0.93	0.60	0.32–1.13	0.65	0.32–1.33
Any liquor	24	56	0.65	0.65–1.23	0.57	0.30–1.12	0.85	0.39–1.86

*Controlling for average alcohol consumption; †controlling for average alcohol consumption, age, race, education, and smoking; ‡controlling for average alcohol consumption, age, race, education, smoking, BMI, total cholesterol, HDL cholesterol, history of hypertension, history of coronary heart disease, and history of diabetes.

§Average alcohol consumption was not included.

<12 g/d, 95% CI 0.38 to 0.86; model 2 OR 0.38 for 12 to 24 g/d, 95% CI 0.17 to 0.86).

The beneficial effect on the risk of stroke of drinking <24 g of alcohol per day was confirmed when weekly intake was examined. Women who drank in the past week and whose average intake for the week was <12 g of alcohol per day had an almost 60% lower stroke risk than never drinkers (model 2 OR 0.42, 95% CI 0.27 to 0.67). Women who drank 12 to 24 g/d, on average, during the past week also had a lower risk than never drinkers, but this comparison was not statistically significant (model 2 OR 0.64, 95% CI 0.27 to 1.54). Drinking alcohol in the past 24 hours was not related to stroke. Among women who drank alcohol in the past week, both those who drank in the past 24 hours (model 2 OR 0.51, 95% CI 0.28 to 0.94) and those who did not drink in the past 24 hours (model 2 OR 0.42, 95% CI 0.25 to 0.71) had a lower risk of stroke than never drinkers.

Adjustment for BMI, total cholesterol, HDL cholesterol, and history of hypertension, diabetes, and coronary heart disease increased the ORs for the majority of categories of alcohol intake, and the confidence intervals overlapped 1.0. For example, the ORs from the fully adjusted model (model 3) for women who drank alcohol in the past week and whose

intake was <12 g of alcohol per day was 0.63 (95% CI 0.37 to 1.06). Overall, these risk factors explained almost half (47%) of the relationship between current drinking and stroke.

ORs from logistic regression analyses that included type of alcoholic beverage consumed, in addition to average amount consumed, indicated a negative association for wine drinking (Table 3). For consumption in the past year, women who reported consuming wine had almost one-half the risk of stroke compared with never drinkers across all three logistic regression models (ie, model 3 OR 0.55, 95% CI 0.31 to 0.98). Any beer and hard liquor consumption in the past year was not statistically significantly associated with ischemic stroke.

When type of beverage in the past year was stratified by amount of intake, a negative association for wine intake was observed among women whose average wine consumption was <12 g/d. The OR for an average wine consumption of <12 g/wk during the past year was statistically significant in the model adjusting for age, race, education, and smoking status (model 2 OR 0.58, 95% CI 0.35 to 0.97). The corresponding OR comparing women who drank between 12 g/wk and <12 g/d to never drinkers was 0.55 (95% CI 0.28

to 1.10). The relationship between beer consumption and stroke was inconsistent, and none of the ORs were statistically significant. ORs for hard liquor consumption indicated that women whose average consumption was ≥ 12 g/wk had a higher risk of stroke than never drinkers; however, the ORs from model 2 were not statistically significant (OR for 12 g/wk to < 12 g/d: 1.31, 95% CI 0.69 to 2.50; OR for ≥ 12 g/d: 1.47, 95% CI 0.57 to 3.78). Further adjustment for BMI, total cholesterol, HDL cholesterol, and history of hypertension, coronary heart disease, and diabetes did not substantially modify the ORs for wine consumption (ie, model 3 OR for wine consumption of < 12 g/wk: 0.56, 95% CI 0.30 to 1.04); ORs for liquor consumption increased and became statistically significant for intake of 12 g/wk to < 12 g/d (model 3 OR 2.53, 95% CI 1.15 to 5.57).

When type of beverage in the past week was examined, ORs indicated a negative association with all types of beverages, although these were generally nonsignificant.

Discussion

In this large, population-based study among young black and white women, we found a negative association between light to moderate alcohol consumption and ischemic stroke. Light to moderate drinkers had a 40% to 60% lower risk of ischemic stroke than never drinkers. Regarding type of alcoholic beverage, light to moderate wine drinking appeared to have a beneficial effect on stroke risk in this population.

The negative association between light to moderate alcohol consumption and ischemic stroke has also been observed in studies of older adults.¹⁻⁵ The ORs from this study were similar to those from a case-control study of ischemic stroke among a multiethnic elderly population (mean age of stroke patients was 70 years) in Manhattan, NY.³ In that study, the OR for persons with an average alcohol consumption of ≤ 2 drinks/d in the past year compared with nondrinkers was 0.55 (95% CI 0.42 to 0.72) for the total population and 0.44 (95% CI 0.26 to 0.75) for those aged < 65 years, after adjusting for age, sex, race/ethnicity, hypertension, diabetes mellitus, cardiac disease, cigarette smoking, and education. Similarly, a case-control study of men and women aged 40 to 85 years in Asturias, Spain, reported an OR of 0.53 for cerebral infarction among those consuming < 30 g/d compared with nondrinkers, after adjusting for age, smoking, hypertension, hypercholesterolemia, diabetes, and cardiac disease.⁵ In summarizing the literature, Camargo^{1,2} observed that the risk of ischemic stroke appeared to be 50% to 70% lower among light to moderate drinkers from the United States, but that studies in Japanese populations had uniformly observed no association between alcohol consumption and ischemic stroke.² He speculated that effect modification with race/ethnicity might be occurring because of racial/ethnic differences in cultural practices associated with drinking, diet (ie, the low intake of animal fat among the Japanese), or other risk factors. The distribution of cerebral atherosclerosis may also differ; the small intracranial arteries may be more affected among the Japanese while the large extracranial neck arteries may be more affected among whites.^{15,16} However, no difference in the relationship between alcohol consumption and cerebrovascular hospitalizations was found for blacks and whites in

California,¹⁷ and alcohol consumption among blacks, Hispanics, and whites showed similar relationships with ischemic stroke in the Manhattan case-control study.³ In our study there were no statistically significant interactions between race (black versus white) and alcohol use. We could not assess whether the relationship with alcohol intake varied by ischemic stroke subtype due to limited numbers; however, excluding lacunar strokes ($n=22$) from the analysis did not substantially modify the ORs.

The majority of studies have found that heavy drinking, using several definitions (≥ 42 U/wk, ≥ 7 drinks/d, ≥ 140 g/d), is a risk factor for ischemic stroke.¹⁻⁵ The lack of association with drinking > 24 g/d in our study is probably due to the low levels of intake among women; for example, only 8 women consumed on average ≥ 60 g/d. Drinking in the past 24 hours was also not related to stroke risk. As expected from their reports of past-year intake, only 7 case patients and 2 controls reported drinking ≥ 5 drinks in the past 24 hours; therefore, recent heavy intake could not be assessed. Recent heavy alcohol intake has been shown to be a risk factor for stroke in several studies.¹⁻²

In logistic regression models controlling for total intake, wine consumption was negatively associated with stroke whereas beer and liquor were not strongly related to stroke. Similar relationships were reported in a cohort study of men and women aged 45 to 84 years in Copenhagen, Denmark.⁴ In contrast, the Manhattan study reported negative associations for all beverage types when monthly drinkers were classified by predominant beverage type.³ Although some studies have found an additional negative association between wine consumption and coronary heart disease risk, the majority of studies have not supported a strong role of beverage choice in risk of heart disease.^{18,19}

Alcohol consumption increases HDL cholesterol, prostacyclin-thromboxane ratios, and tissue insulin sensitivity and decreases platelet aggregation and fibrinogen levels.^{20,21} Alcohol may also reduce cardiovascular risk by decreasing vascular muscle cell proliferation during the postprandial phase.²² In contrast, alcohol can lead to increased stroke risk through increased blood pressure, alcohol-induced cardiomyopathy, atrial fibrillation, and cerebral vasoconstriction and spasm.^{23,24} Apart from the effects of total alcohol consumption, wine may have additional benefits for ischemic stroke due to the presence of antioxidant flavonoids.^{6,24,25} In our study, the association between wine intake and ischemic risk was only slightly modified by the inclusion in the logistic regression models of HDL cholesterol and history of hypertension or other coronary disease, which suggests that the measured variables were not responsible for the effect of wine. As in all observational studies, it remains possible that the protective association of wine drinking with ischemic stroke is due to other unmeasured factors associated with wine drinking. Because wine drinking may occur more frequently with meals, it is unclear whether the protective effect for ischemic stroke risk is due to specific components in wine or whether it is related to the timing of wine consumption. Future research is needed to determine the mechanisms of wine's effects and whether fruit and fruit juice consumption produces similar effects.

This study has several limitations. Our definition of never drinkers (ie, women who never consumed >12 drinks per year in their lives) most likely includes some women who were infrequent drinkers. The inclusion of infrequent drinkers in the never drinker category would cause the ORs for moderate alcohol intake to be underestimated.

Although the 1-year time period for reporting alcohol consumption is not long, recall bias may have occurred. The time period for recalling alcohol intake was longer among case patients than among controls, since case patients were asked to recall intake 1 year, 1 week, and 1 day before their stroke and were interviewed, on average, 5 months (and up to 1 year) after their stroke. Controls were asked about their alcohol intake relative to the date of their interview. Case patients may have altered their drinking habits after their stroke. It is unclear whether women who experienced a stroke would be more likely to underreport or overreport their prior intake compared with the controls. However, when we limited the logistic regression analysis to case patients who completed their interviews within 5 months after their stroke, we observed little change in the ORs for both amount of alcohol intake (ORs for average intake of >24 g/d were lower but remained nonsignificant) and type of alcohol consumed (except the OR for average beer intake of 12 g/wk to <12 g/d increased across all 3 models and became statistically significant in model 3: OR 2.39, 95% CI 1.09 to 5.24). Information bias may also be present. The Danish MONICA study²⁶ reported good overall agreement between usual intakes of beer, wine, and liquor from a frequency questionnaire and a detailed dietary history; however, correlations between the instruments were lower for women than men, leading the authors to suggest that women may be uncomfortable answering questions about alcohol intake in an in-person interview.

Most of the major confounders of the alcohol-ischemic stroke relationship were controlled for in this analysis except for physical activity, which was not assessed in this study.² Cholesterol levels were measured after the stroke, and therefore may explain more of the relationship between alcohol and stroke than indicated in this study. Residual confounding may still have occurred due to measurement error; this effect would be most pronounced in comparisons involving wine drinkers who had a higher socioeconomic status and more favorable cardiovascular risk factor profile than nonwine drinkers. Abstainers are a unique population, and they may differ from alcohol users in other risk factors for stroke that were not controlled for in this analysis. Similarly, important unmeasured differences may also exist between wine, beer, and liquor drinkers. The effect of drinking pattern was also not assessed. For example, among women classified as drinking on average between 12 and 24 g of alcohol per day, 18% reported daily intake of wine, beer, or liquor, while the remainder reported a weekly intake of wine, beer, or liquor of 1 to 5 times per week. At similar levels of intake, Palomaki and Kaste²⁷ observed a stronger negative association between alcohol consumption and ischemic stroke among regular drinkers than among infrequent drinkers. Our study was limited to women; however, other studies have found no difference between the sexes in the alcohol-ischemic stroke relationship.^{2,3}

Findings from this study indicate that the National Stroke Association's Stroke Prevention Guidelines on alcohol use¹¹ apply to young adults; drinking in moderation (up to 2 drinks per day) can be recommended for those who drink alcohol and who have no health contraindications. Alcohol use should not be encouraged for those who do not already drink because of the devastating morbidity and mortality associated with heavy use. Further research is needed to determine whether wine consumption has an additional beneficial effect for ischemic stroke and to clarify the biological mechanisms involved.

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