Alcohol and Stroke
A Case-Control Study of Drinking Habits Past and Present
Helen Rodgers, MRCP; Philip D. Aitken, FRACP; Joyce M. French, BSc; Richard H. Curless, MRCP; David Bates, FRCP; Oliver F.W. James, FRCP

Background and Purpose: Previous studies have reported a U-shaped relation between alcohol consumption and stroke. Those studies have been criticized for failing to distinguish between lifelong abstainers from alcohol and those who have given up drinking.

Methods: We examined current and previous drinking habits of 364 cases of acute stroke and 364 community-based control subjects matched for age, sex, and family practitioner.

Results: Stroke patients were more likely to have been lifelong abstainers from alcohol than were the control subjects. The odds ratio (OR) of lifelong abstainers versus those who had ever drunk regularly was 2.36 (95% confidence interval [CI], 1.67 to 3.37). No relation was found between stroke and current nondrinkers. Current male heavy drinkers also had an increased risk of stroke (OR, 2.88; 95% CI, 1.08 to 2.31).

Conclusions: Lifelong abstinence from alcohol is associated with an increased risk of stroke. Moderate alcohol consumption may protect against cerebrovascular disease. (Stroke. 1993;24:1473-1477.)

KEY WORDS • alcohol drinking • cerebrovascular disorders • risk factors

Alcohol was first implicated as a possible risk factor for stroke in 1725.1 Several epidemiological studies now suggest a U-shaped association between alcohol intake and stroke.2 The explanation of this possible relation (similarly seen in coronary heart disease) remains the subject of much discussion, and the potentially protective role of moderate alcohol consumption remains controversial.2-6 Previous studies have been criticized for not differentiating between nondrinkers who were lifelong abstainers and those who had given up drinking.3,7 By asking specifically about previous regular drinking habits we have been able to distinguish between the two groups. The level of alcohol consumption at which this possible protective effect is lost and alcohol becomes a risk factor for stroke are unknown.

We report the findings of a case-control study that examines the contribution of alcohol to the risk of stroke in moderate and heavy drinkers (both currently and previously), lifelong abstainers (those who have never drunk alcohol), and current abstainers (those who had formerly been regular drinkers but who currently do not drink alcohol), using validated measures of alcohol consumption.

Subjects and Methods
Cases
Three hundred sixty-four consecutive patients hospitalized for acute stroke in Newcastle upon Tyne between August 1989 and July 1990 formed the study population. No patient refused to take part in the study. Patients were identified by daily contact with the resident medical officer and completeness of case ascertainment was checked with data from the medical records department at each of the three participating hospitals (Freeman Hospital, Royal Victoria Infirmary, and Newcastle General Hospital). Stroke was defined as rapidly developing clinical signs of focal or global disturbance of brain function lasting for more than 24 hours with no apparent cause other than vascular.8 Patients with primary subarachnoid hemorrhage were excluded.

Controls
Three hundred sixty-four community control subjects were matched for age (±2 years), sex, and family doctor. Control subjects were the next unrelated matching individual to the propositus in the family doctor register. Control subjects with a previous history of stroke were excluded. Permission was then sought from the general practitioner to invite the control subject by letter to participate in the study. They were contacted a week later by telephone to arrange an appointment. Control subjects who did not have a telephone were visited at home to obtain consent. Two hundred ninety-six (81%) control subjects who were initially approached agreed to take part in the study. When the “first choice” control refused consent or could not be contacted, another subject was approached. Reasons for exclusion were patient refused (27), general practitioner advised against contact (16), or unable to contact (25).

Collection of Data
Patients (with a close relative or significant other when possible) were interviewed and examined by H.R.
(79%) or P.D.A. within 48 hours of hospitalization. Control subjects were interviewed in their homes by H.R. (also with a relative or significant other when possible). Interobserver validation studies between the two interviewers were carried out. The proportion of agreement between two observers, \( \kappa \), was 0.68.

Details about current and previous alcohol consumption using the “typical occasion method” were collected using a verbally administered structured questionnaire. Patients and control subjects completed the same questionnaire. The possible relation of alcohol to stroke was not mentioned, and dummy questions about consumption of tea and coffee were included. When possible, information was confirmed by a significant other. Respondents were asked how often they drank alcohol, how much they typically drank, and what type of alcoholic drink was consumed. They were then questioned about previous drinking habits; the frequency, quantity, and type of alcohol consumed, in addition to the duration of abstinence or heavy drinking, were recorded. To enable comparison between different types of drink, the amount of alcohol drunk regularly per week was converted to standard units. One unit is equivalent to one standard measure of spirit (1/6 gill), one standard glass of wine, or half a pint of beer. On average, a standard unit contains 8.5 g alcohol.

Ethical approval was granted by Newcastle District Joint Ethical Committee and the Local Medical Committees of the surrounding districts.

### Analysis

Drinking frequency was recorded as a categorical variable, whereas past and present amounts of alcohol consumption, duration of abstinence, and heavy drinking were recorded as continuous variables. Data were transferred to Northumbrian University’s Multiple Access Computer (NUMAC). Following verification procedures to ensure accurate transcription, data were analyzed using SPSS-X (SPSS-X Batch System, SPSS Inc, Chicago, Ill).

The Mann-Whitney U test was used for between group analyses of nonparametric data, the standard \( \chi^2 \) test when appropriate for discrete variables, and McNemar’s \( \chi^2 \) test to compare discordant pairs. The odds ratio (OR) with 95% confidence intervals (CIs) was used as an estimate of risk. Log linear analysis was used to calculate the adjusted odds ratio for potential confounding variables.

### Results

Details of current and previous drinking habits were complete in 309 matched pairs. Fifty-five pairs (15%) were excluded from the analysis because of inadequate information about previous drinking habits. In 53 patients this was due to dysphasia, coma, or death before complete information could be obtained; dementia prevented two controls from giving details about previous consumption. In all of these cases it was not possible to obtain the relevant information from a significant other. Table 1 shows the demographic features of the study population.

### Frequency of Drinking

Fig 1 shows the frequency of current regular drinking habits in patients and control subjects. Patterns of current drinking varied between men and women, with a larger proportion of women abstaining from alcohol in both groups; 40 (29%) male versus 119 (69%) female patients \( (P<.0001) \) were current abstainers, as were 18 (13%) male versus 73 (42%) female controls \( (P<.0001) \). Twenty-three of 40 (58%) male patients who were current abstainers had formerly drunk alcohol compared with 10 of 18 (56%) male controls (not significant). Only 14 of 119 (11%) female patients who were current abstainers had previously drunk alcohol compared with 14 of 73 (19%) female controls \( (P=.05) \). The

### Table 1. Characteristics of the Study Population

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Men</th>
<th></th>
<th></th>
<th>Women</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Patients</td>
<td>Controls</td>
<td>Patients</td>
<td>Controls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age group</td>
<td>No.</td>
<td>(%)</td>
<td>No.</td>
<td>(%)</td>
<td>No.</td>
<td>(%)</td>
</tr>
<tr>
<td>&lt;65 years</td>
<td>49</td>
<td>(36)</td>
<td>...</td>
<td>...</td>
<td>18</td>
<td>(10)</td>
</tr>
<tr>
<td>65-74 years</td>
<td>46</td>
<td>(33)</td>
<td>...</td>
<td>...</td>
<td>41</td>
<td>(24)</td>
</tr>
<tr>
<td>75+ years</td>
<td>42</td>
<td>(31)</td>
<td>...</td>
<td>...</td>
<td>113</td>
<td>(66)</td>
</tr>
<tr>
<td>Smoking habits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never smoked</td>
<td>17</td>
<td>(12)</td>
<td>24</td>
<td>(17)</td>
<td>92</td>
<td>(53)</td>
</tr>
<tr>
<td>Former smoker</td>
<td>61</td>
<td>(45)</td>
<td>56</td>
<td>(41)</td>
<td>48</td>
<td>(30)</td>
</tr>
<tr>
<td>Current smoker</td>
<td>59</td>
<td>(43)</td>
<td>57</td>
<td>(42)</td>
<td>32</td>
<td>(18)</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Socioeconomic group</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>17</td>
<td>(12)</td>
<td>25</td>
<td>(18)</td>
<td>15</td>
<td>(9)</td>
</tr>
<tr>
<td>Middle</td>
<td>52</td>
<td>(38)</td>
<td>38</td>
<td>(28)</td>
<td>64</td>
<td>(37)</td>
</tr>
<tr>
<td>Low</td>
<td>63</td>
<td>(46)</td>
<td>71</td>
<td>(52)</td>
<td>73</td>
<td>(42)</td>
</tr>
<tr>
<td>Uncertain</td>
<td>5</td>
<td>(4)</td>
<td>3</td>
<td>(2)</td>
<td>20</td>
<td>(12)</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
OR of stroke in current abstainers versus current drinkers was 2.54 (95% CI, 1.84 to 3.56). This relation was seen both in men (OR, 2.73; 95% CI, 1.53 to 5.09) and women (OR, 3.04; 95% CI, 1.98 to 4.81). Stroke patients were not only more likely to be current abstainers than the control subjects but were also more likely to be lifelong abstainers. The OR of lifelong abstinence from alcohol versus those who have ever drunk regularly was 2.36 (95% CI, 1.67 to 3.37). This relation was seen in both men (OR, 2.28; 95% CI, 1.02 to 5.54) and women (OR, 3.0; 95% CI, 1.96 to 4.73).

**Alcohol Consumption Past and Present**

Alcohol consumption was categorized according to current recommended sensible drinking levels\(^{10}\) (Table 2). In each category levels of consumption for women are 70% of those for men. Table 3 shows the current weekly alcohol consumption of patients and control subjects. Reported amounts of alcohol consumption varied from 0 to 2860 g per week. In male patients who were current drinkers the mean current weekly consumption of alcohol was 166 g (SD, 190 g), whereas the mean weekly alcohol intake for male controls who were current drinkers was 98 g (SD, 136 g; \(P=.01\)). Conversely, among female patients, current drinkers drank less than controls—21 g per week (SD, 40 g) versus 26 g per week (SD, 33 g; \(P=.01\)). A total of 19 (6%) patients (17 of whom were male) were current heavy drinkers (greater than 180 g [21 units] per week for men and 120 g [14 units] per week for women) before their stroke compared with only 7 (2%) control subjects (all of whom were male) (\(P<.05\)).

Stroke occurring after “binge drinking” is well recognized.\(^{11}\) Although two patients were in a pub at the time of their stroke, none of the patients admitted to a heavy drinking session before admission. The type of alcohol consumed was similar in both groups, but the study was unable to fully explore differences between types of alcoholic drink.

Table 4 shows previous maximum regular weekly alcohol consumption. Similar proportions of male patients (51%) and controls (55%) had previously drunk more than currently. Only 17 (10%) female patients and 33 (19%) control subjects had previously had a higher intake of alcohol (\(P=.02\)). The current recommended maximum sensible weekly intake of alcohol is 180 g (21 units) for men and 120 g (14 units) for women. Sixty-two (45%) male patients and 63 (46%) controls admitted to having previously consumed more than this level regularly for a mean duration of 22 years and 18 years, respectively (not significant). Very few women had regularly drunk more than the recommended maximum level (6 [4%] patients and 3 [2%] controls).

Fig 2 shows the odds ratios of risk of stroke in current and previous drinkers. Moderate drinking (≤180 g per week for men and ≤120 g per week for women) was the reference group, as this group is representative of national drinking habits. Odds ratios were corrected for age, smoking (current smokers, former smokers, and nonsmokers), and social class (high, middle, and low). Hypertension was not included as a confounding variable because this is a potential mechanism through which high alcohol intake can produce stroke. Hypertension was identified as a risk factor for stroke, which was statistically significant for all categories of current and previous alcohol consumption.

Lifelong abstention from alcohol is independently associated with an increased risk of stroke in both men and women. No statistically significant relation was found between current abstention from alcohol and stroke after adjusting for confounders. Current heavy drinking was a risk factor for stroke in men; however, because only two women were heavy drinkers, statistical
TABLE 3. Current Typical Weekly Alcohol Consumption

<table>
<thead>
<tr>
<th>Consumption Category</th>
<th>Men</th>
<th></th>
<th>Women</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Patients (n=137)</td>
<td>Controls (n=137)</td>
<td>Patients (n=172)</td>
<td>Controls (n=172)</td>
</tr>
<tr>
<td>None</td>
<td>No. (29)</td>
<td>No. (13)</td>
<td>No. (69)</td>
<td>No. (43)</td>
</tr>
<tr>
<td>Occasional</td>
<td>9 (7)</td>
<td>19 (14)</td>
<td>24 (14)</td>
<td>40 (23)</td>
</tr>
<tr>
<td>Light</td>
<td>58 (42)</td>
<td>84 (61)</td>
<td>27 (16)</td>
<td>59 (34)</td>
</tr>
<tr>
<td>Heavy</td>
<td>13 (10)</td>
<td>9 (7)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Fairly heavy</td>
<td>7 (5)</td>
<td>4 (3)</td>
<td>1 (0.5)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Very heavy</td>
<td>10 (7)</td>
<td>3 (2)</td>
<td>1 (0.5)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Figures are numbers (percentages) of people.

Analysis was not appropriate for this group. Previous heavy drinking was not identified as a risk factor for stroke.

Discussion

The U-shaped relation between alcohol consumption and coronary heart disease is well established. The relation between moderate alcohol consumption and stroke is less clear. This study supports the view that there is a U-shaped relation between alcohol consumption and stroke. Our study does not support the view that the increased risk of stroke in nondrinkers is due to this group containing a significant number of people who have stopped drinking due to ill health.

Lifelong abstention from alcohol is a risk factor for stroke. Several mechanisms have been proposed to explain the apparent protective effect of moderate alcohol intake. Moderate alcohol consumption raises "protective" high density lipoprotein concentration and also influences platelet aggregation and fibrinogen concentration. An alternative explanation of these results is that lifelong abstainers are an unusual group and may be at increased risk of stroke for other reasons, such as personality or diet. However, the consistency of this result in several populations suggests that an unknown confounder is an unlikely explanation of this finding.

A high level of alcohol consumption is a risk factor for stroke in men. Because very few women are heavy drinkers the relation of heavy drinking to stroke in women is not clear. Previous studies have shown that chronic heavy alcoholism and very heavy drinking are risk factors for stroke by both infarction and hemorrhage. Definitions of heavy drinking vary, and many are considerably higher than those used in this study. Fifty-three patients were excluded from the study, many of whom died before complete information could be obtained about their drinking habits. Higher levels of alcohol consumption are associated with an increased stroke mortality. It is conceivable that we may have underestimated the contribution of heavy alcohol consumption to stroke by not including in the study deaths before assessment. Heavy alcohol consumption—associated cardiac dysrhythmia or cardiomyopathy may cause stroke by embolus or hypotension. Heavy drinking is also associated with hypertension, which significantly increases the risk of both cerebral hemorrhage and infarction. Ideally, we would like to be able to differentiate between cerebral infarction and hemorrhage in all cases. Although clinical scores have been developed to distinguish between infarction and hemorrhage the only reliable method is by computed tomographic scan. Unfortunately, computed tomographic scans could only be obtained in less than 50% of cases.

High alcohol consumption has been shown to reduce cerebral blood flow via a direct toxic effect of alcohol rather than increased atherogenesis. Only patients hospitalized after stroke were included in the study. A 5-year study of acute stroke in northeast England found that 68% of cases were hospital. Lifelong abstention from alcohol is unlikely to be a factor influencing admission policy. Conversely, those with alcohol-related problems are more likely to be admitted to the hospital.

TABLE 4. Previous Maximum Regular Weekly Alcohol Consumption

<table>
<thead>
<tr>
<th>Consumption category</th>
<th>Men</th>
<th></th>
<th>Women</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Patients (n=137)</td>
<td>Controls (n=137)</td>
<td>Patients (n=172)</td>
<td>Controls (n=172)</td>
</tr>
<tr>
<td>Never</td>
<td>No. (12)</td>
<td>No. (6)</td>
<td>No. (61)</td>
<td>No. (34)</td>
</tr>
<tr>
<td>Less than recommended maximum</td>
<td>58 (42)</td>
<td>66 (48)</td>
<td>61 (35)</td>
<td>110 (64)</td>
</tr>
<tr>
<td>More than recommended maximum</td>
<td>62 (45)</td>
<td>63 (46)</td>
<td>6 (3)</td>
<td>3 (2)</td>
</tr>
</tbody>
</table>

Maximum weekly recommended intake is 180 g (21 units) for men and 120 g (14 units) for women. Figures are numbers (percentages) of people.
and it is possible that heavy drinkers are overrepresented in hospitalized stroke patients compared with those treated at home and the general population. As a result we may have overestimated the true strength of the association between heavy drinking and stroke. Data about alcohol consumption were collected retrospectively and as such are susceptible to recall bias.

Community-based subjects were selected as the control group because it was felt that their drinking habits would be representative of the population. The risk of stroke associated with alcohol consumption has been shown to vary with choice of controls.30 Heavy drinkers are overrepresented in a control group selected from general medical admissions; conversely, heavy drinkers may be underrepresented in elective surgical patients.

Acknowledgment

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References

1. Sedgewick J. A new treatise on liquors wherein the use and abuse of wine, malt drinks, water etc are particularly considered in many diseases, institutions and ages with proper manner of using them hot or cold either as physik, diet or both. London, UK: Rivington; 1725.
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