Background and Purpose—Previous research suggests that regular heavy alcohol consumption increases the risk for ischemic stroke, whereas frequent light to moderate alcohol intake may decrease the risk. However, the risk of ischemic stroke associated with transient exposure to alcohol remains unclear. In this study, we used a case–crossover approach to test the hypothesis that alcohol consumption affects the acute risk of ischemic stroke, to determine the length of time between alcohol intake and the onset of symptoms (induction time), and to examine whether the risk varies by the type of alcohol.

Methods—In this multicenter study, we interviewed 390 patients (209 men, 181 women) between January 2001 and November 2006 (median 3 days after stroke). Alcohol consumption in the hour before stroke symptoms was compared with its expected frequency based on the usual frequency of alcohol consumption over the prior year.

Results—Of the 390 patients, 248 (64%) reported alcohol consumption in the prior year, 104 within 24 hours and 14 within 1 hour of stroke onset. The relative risk of stroke in the hour after consuming alcohol was 2.3 (95% CI, 1.4 to 4.0; \( P=0.002 \)). The relative risks were similar for different types of alcoholic beverages and when the sample was restricted to those who were not simultaneously exposed to other potential triggers.

Conclusions—The risk of stroke onset is transiently elevated in the hour after alcohol ingestion.

Key Words: alcohol ■ case–crossover ■ cerebrovascular disorders ■ epidemiology ■ stroke

Moderate\(^1\) and high\(^2\)–4 intakes of alcohol have been documented to have acute potentially deleterious physiological effects within hours after consumption, including impaired fibrinolysis\(^2,3\) and increased platelet activation,\(^4\) blood pressure, and heart rate.\(^1\) On the other hand, moderate consumption of alcohol has been associated with protective effects within hours,\(^5\)–7 weeks,\(^8\)–12 or years,\(^13\)–15 including enhanced fibrinolytic activity\(^7,8\) and improvements in lipid profile,\(^12\) inflammatory markers,\(^8,11\) flow-mediated vasodilatation,\(^5,6\) soluble vascular adhesion molecules,\(^11,14\) insulin sensitivity,\(^9,15\) and adipokines.\(^9,14\) However, only a few studies\(^16\)–18 have examined the risk of ischemic stroke associated with transient exposure to alcohol.

In this study, we used a case–crossover approach to test the hypothesis that alcohol consumption affects the acute risk of ischemic stroke, to determine the length of time between alcohol intake and the onset of symptoms (induction time), and to examine whether the risk varies by the type of alcohol.

**Methods**

**Study Population**
The Stroke Onset Study was conducted in 3 medical centers (Beth Israel Deaconess Medical Center, Boston, Mass; University of North Carolina Hospitals, Chapel Hill, NC; Vancouver Island Health Authority, Victoria, British Columbia, Canada). Between January 2001 and November 2006, 390 patients (209 men and 181 women) were interviewed a median of 3 days (range, 0 to 14 days) after sustaining an acute ischemic stroke. Research staff identified eligible patients by reviewing admission logs and charts of patients admitted to each hospital’s stroke service. Additionally, patients with new onset of an acute neurological syndrome compatible with stroke were screened on admission to emergency departments. Presumed stroke etiology was classified using an abbreviated Trial of Org 10172 in Acute Stroke Treatment system.\(^19\)

Study personnel using standardized abstraction forms recorded data on demographics, medical history, and admission laboratory results. Eligible participants had a neurologist-confirmed diagnosis of acute ischemic stroke either by clinical diagnosis or appropriate imaging studies, were English-speaking, and free of dementia before the index event. Patients were excluded if they could not identify the time of onset of their stroke symptoms or if the treating clinician deemed them unable to complete the structured interview because they were cognitively impaired, had poor memory around the time of the stroke, experienced aphasia, or they were too ill to complete the structured interview that lasted 30 to 45 minutes. Across all sites, 43% of patients with confirmed ischemic stroke met all inclusion criteria. Of these, 83% agreed to participate, 5.5% refused, and 12.5% were discharged from the hospital before the interviewers were able to approach them. The protocol was approved by the

Received January 28, 2010; final revision received March 19, 2010; accepted April 1, 2010.

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The preliminary results were previously presented in an abstract at the 2006 International Stroke Conference.

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**Stroke** is available at http://stroke.ahajournals.org

DOI: 10.1161/STROKEAHA.110.580092

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Institutional Review Boards at each participating center and informed consent was obtained from each patient.

Interviewers used a structured questionnaire and asked patients to report the date and time of their first symptoms heralding their stroke. Patients were asked if they had consumed any alcoholic beverage in the year before their stroke. Patients who reported any alcohol consumption were also asked to report the last time that they had consumed an alcoholic beverage, their usual frequency of alcohol consumption over the prior year, the usual number of servings consumed each time they drank an alcoholic beverage, and the types of alcohol consumed (beer, wine, or liquor). A serving size of alcohol was defined as 12 ounces of beer, 4 ounces of wine, or 1.5 ounces of liquor straight or in a mixed drink. Patients were also asked to report the timing of their last exposure to other potential triggers and usual frequency of these factors over the prior year, including caffeine, cigarette smoking, marijuana, cocaine, stress, anger, and physical activity. Other information collected from the interview included medication use and symptoms on the day of the stroke.

Reliability and Validity of the Questionnaire
The test–retest reliability of the Stroke Onset Study questionnaire was assessed in 25 patients who were reinterviewed up to 6 days after their initial interview. The intraclass correlation for the usual frequency of alcohol consumption was excellent (0.84), and there was perfect agreement for reporting of any alcohol consumption during the past year and during each of the first 2 hours before stroke onset (κ = 1.0). In the subset of 181 subjects interviewed at Beth Israel Deaconess Medical Center who had high-density lipoprotein cholesterol levels measured at the time of hospitalization, the partial correlation between estimated alcohol consumption and high-density lipoprotein cholesterol level adjusting for sex, age, race, smoking, education, and physical activity was 0.35 (P = 0.003), comparable to that found in the Second National Health and Nutrition Examination Survey.20

Study Design
The Stroke Onset Study used a case–crossover study design to assess the change in risk of acute ischemic stroke onset during a brief “hazard period” after consumption of alcohol. In the case–crossover design, control information for each patient is based on his or her own past exposure experience. Self-matching eliminates confounding by risk factors that are constant within individuals over the sampling period but differ between subjects. Alcohol use in the hazard period, the 1-hour period immediately before the onset of ischemic stroke, was compared with its expected frequency during the past year. We conducted stratified analyses to assess the effect of alcohol consumption by the hypothesized window of its physiological effect (1 hour in the primary analysis) to estimate the amount of person-time exposed to alcohol. The unexposed person-time was calculated by subtracting this value from the number of hours in 1 year. The data were analyzed using methods for cohort studies with sparse data in each stratum.

To estimate the length of time from alcohol consumption to the onset of ischemic stroke, RRs were calculated by comparing exposure within different hypothesized windows of its physiological effect with the estimated person-time exposed to alcohol in the previous year. We conducted stratified analyses to assess the effect of alcohol consumption on the change in risk of acute ischemic stroke onset during a brief “hazard period” after consumption of alcohol.

Statistical Analysis
Each patient in a case–crossover study forms his or her own stratum and thus is his or her own control.21,22 The ratio of the observed exposure frequency in the hazard period to the expected frequency was used to calculate estimates of the rate ratio as a measure of relative risk (RR). We multiplied the usual annual frequency of alcohol consumption by the hypothesized window of its physiological effect (1 hour in the primary analysis) to estimate the amount of person-time exposed to alcohol. The unexposed person-time was calculated by subtracting this value from the number of hours in 1 year. The data were analyzed using methods for cohort studies with sparse data in each stratum.

To estimate the length of time from alcohol consumption to the onset of ischemic stroke, RRs were calculated by comparing exposure within different hypothesized windows of its physiological effect with the estimated person-time exposed to alcohol in the previous year. We conducted stratified analyses to assess the effect of alcohol consumption on the change in risk of acute ischemic stroke onset during a brief “hazard period” after consumption of alcohol. The unexposed person-time was calculated by subtracting this value from the number of hours in 1 year. The data were analyzed using methods for cohort studies with sparse data in each stratum.

Results
The characteristics of the Stroke Onset Study patients are presented in the Table. Of the 390 patients with acute ischemic stroke, 248 (64%) reported that they had consumed alcohol in the prior year (wine, n = 45; beer, n = 29; liquor, n = 32; >1 type, n = 142). Compared with nondrinkers, subjects who reported alcohol consumption were more likely to be male and to have ever smoked cigarettes. Among the 248 subjects who drank alcohol in the prior year, 47 (12%) reported drinking at least 1 serving of alcohol per day, 38 (10%) reported drinking at least once per week, and 163 (66%) reported drinking at least once per month. The median frequency of consumption among drinkers in the prior year

Table. Clinical Characteristics of the Stroke Onset Study Population*

<table>
<thead>
<tr>
<th></th>
<th>Alcohol Drinkers (n = 248)</th>
<th>Nondrinkers (n = 142)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>68±14.5</td>
<td>69±13.7</td>
<td>0.11</td>
</tr>
<tr>
<td>Male</td>
<td>143 (58%)</td>
<td>66 (47%)</td>
<td>0.03</td>
</tr>
<tr>
<td>Smoking status</td>
<td></td>
<td></td>
<td>0.09</td>
</tr>
<tr>
<td>Never</td>
<td>72 (29%)</td>
<td>56 (39%)</td>
<td></td>
</tr>
<tr>
<td>Former</td>
<td>122 (49%)</td>
<td>63 (44%)</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>54 (22%)</td>
<td>23 (16%)</td>
<td></td>
</tr>
<tr>
<td>Obesity (body mass index ≥30 kg/m²)†</td>
<td>59 (24%)</td>
<td>31 (22%)</td>
<td>0.68</td>
</tr>
<tr>
<td>Diabetes</td>
<td>56 (23%)</td>
<td>39 (27%)</td>
<td>0.28</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>101 (41%)</td>
<td>45 (32%)</td>
<td>0.08</td>
</tr>
<tr>
<td>Hypertension</td>
<td>152 (61%)</td>
<td>100 (70%)</td>
<td>0.07</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>32 (13%)</td>
<td>22 (15%)</td>
<td>0.48</td>
</tr>
<tr>
<td>History of MI</td>
<td>36 (15%)</td>
<td>14 (10%)</td>
<td>0.19</td>
</tr>
<tr>
<td>Stroke</td>
<td>41 (17%)</td>
<td>32 (23%)</td>
<td>0.14</td>
</tr>
<tr>
<td>TIA</td>
<td>29 (12%)</td>
<td>18 (13%)</td>
<td>0.77</td>
</tr>
<tr>
<td>Coronary revascularization</td>
<td>11 (8%)</td>
<td>31 (13%)</td>
<td>0.15</td>
</tr>
<tr>
<td>Carotid endarterectomy</td>
<td>2 (1%)</td>
<td>5 (2%)</td>
<td>0.66</td>
</tr>
<tr>
<td>Stroke etiology‡</td>
<td></td>
<td></td>
<td>0.31</td>
</tr>
<tr>
<td>Small vessel</td>
<td>67 (29%)</td>
<td>44 (37%)</td>
<td></td>
</tr>
<tr>
<td>Large vessel</td>
<td>46 (20%)</td>
<td>21 (18%)</td>
<td></td>
</tr>
<tr>
<td>Cardioembolic</td>
<td>57 (25%)</td>
<td>24 (20%)</td>
<td></td>
</tr>
<tr>
<td>Other/undetermined</td>
<td>60 (26%)</td>
<td>32 (26%)</td>
<td></td>
</tr>
</tbody>
</table>

*Mean±SD or no. (%).
†There was no data available on body mass index for 7 subjects.
‡At 1 of the centers, stroke etiology was not determined (n = 39).
MI indicates myocardial infarction; TIA, transient ischemic attack.
was 2.0 times per week. Subjects reported that they typically drank small amounts each time (median was 2.0 times per week. Subjects reported that they typically drinking each hour was compared with that during the control period. The error bars indicate the 95% confidence limits. The dashed line indicates the baseline risk.

There were 169 subjects who reported exposure during the week before stroke, 104 subjects drank alcohol within 24 hours of stroke onset, and 14 drank within 1 hour of stroke onset. We found that within 1 hour after alcohol consumption, the risk of stroke onset was 2.3-fold higher (95% CI, 1.4 to 4.0; \( P=0.002 \)) compared with periods of nonuse. The RR was 1.6 (95% CI, 1.0 to 2.5; \( P=0.05 \)) in the second hour after drinking and returned to baseline thereafter (Figure 1). By 24 hours, there was a 30% lower risk (RR=0.7, 95% CI, 0.5 to 0.9; \( P=0.02 \)).

Among the 14 participants who consumed alcohol in the hour before stroke onset, 7 drank liquor, 5 drank beer, and 2 drank wine. The RR for alcohol consumption in the hour before stroke onset was strongest for liquor and weakest for wine, although the difference was not statistically significant (\( P \) for interaction=0.28; Figure 2). The RRs for alcohol consumption in the hour before stroke did not vary by sex, age, smoking status, or stroke etiology (\( P \) for interaction=0.62, 0.62, 0.12, and 0.43, respectively).

Among the 248 participants exposed to alcohol in the prior year, 63 participants were exposed to other potential triggers in the hour before stroke onset. Of the 14 people exposed to alcohol in the hour before stroke onset, 4 were also exposed to vigorous physical activity and 1 drank a caffeinated beverage. When we conducted an analysis excluding the 63 people exposed to any potential stroke trigger in the hour before stroke onset did not meaningfully alter the results.

The mean usual frequency of alcohol consumption during the past year was 4.42 times per week, similar to the mean frequency of reported alcohol consumption during the past week (4.23). In a sensitivity analysis using each patient’s reported frequency of consumption in the past week as the control information, the risk of ischemic stroke onset was 3.3-fold higher (95% CI, 1.2 to 9.3; \( P=0.03 \)) within 1 hour of consuming at least 1 serving of alcohol compared with periods with no alcohol intake. Excluding the 1 person who reported drinking \( >2 \) servings of alcohol in the 2 hours before stroke onset did not meaningfully alter the results.

Discussion

In this study, alcohol consumption was associated with a transient increased risk of ischemic stroke in the subsequent hour that was 2.3 times higher than the risk during periods with no alcohol consumption. This finding is consistent with previous research indicating an acute detrimental effect of alcohol consumption.\(^{17,18}\) The risk returned to baseline by 3 hours and there was a modestly lower risk by 24 hours.

Few studies have evaluated the role of alcohol as a trigger of ischemic\(^{16-18,24} \) and hemorrhagic stroke.\(^{25} \) For instance, Hillbom et al\(^{18} \) found that moderate (151 to 300 g) and heavy (>300 g) consumption of alcohol within the week before stroke onset is associated with a significantly higher risk of stroke with adjusted ORs of 3.6 (95% CI, 1.7 to 7.8) and 3.7 (95% CI, 1.6 to 8.7), respectively. Consistent with our data, Gorelick et al\(^{24} \) reported that after accounting for coexposures including smoking, there was no statistically significant increase in risk of ischemic stroke in the 24 hours after alcohol consumption.

Previous studies on the acute effects of alcohol consumption indicate that heavy alcohol intake is associated with impaired fibrinolysis,\(^{2,3} \) increased platelet activation,\(^{4} \) and increases in blood pressure and heart rate.\(^{1} \) Furthermore, heavy consumption may acutely lead to dehydration, further increasing the transient risk of stroke. However, such heavy consumption was rare and unlikely to explain our findings.

Even moderate drinking may have acutely adverse consequences. In a clinical trial of 8 healthy men, Hendriks and colleagues\(^{7} \) found that plasminogen activator inhibitor was significantly higher after 40 g of alcohol than water after 1, 3, and 5 hours but was not significantly different after 9 hours.

On the other hand, there is evidence that moderate drinking may provide transient health improvements.\(^{5-9,11,12,26} \) Short-term randomized trials indicate that moderate alcohol consumption may have beneficial effects through changes in flow-mediated vasodilatation\(^{5,6} \) within minutes to hours and improvements in lipid profile,\(^{12} \) inflammatory markers,\(^{11} \) soluble vascular adhesion molecules,\(^{11} \) and adipokines within weeks.

In contrast to the evidence on acute effects of alcohol consumption, there is consistent evidence that habitual heavy alcohol consumption is associated with an increased risk of ischemic\(^{27,28} \) and hemorrhagic stroke.\(^{28-30} \) However, the evidence regarding light to moderate consumption is mixed.
Although some studies reported no association with ischemic or hemorrhagic stroke, recent comprehensive reviews indicate a decreased risk of ischemic stroke and a higher risk of hemorrhagic stroke associated with light to moderate consumption.

Integrating the short-term effects observed here with other studies on alcohol use and long-term risk is difficult. Although speculative, it is possible that the transiently increased stroke risk from moderate alcohol consumption may be outweighed by the health benefits for the next 24 hours, but consuming multiple drinks at once may result in a sharp increase in acute risk with potential increased long-term risk as well. Although unlikely to be carried out in the near future, long-term clinical trial evidence would require a long-term clinical trial, although speculative, it is possible that the transiently increased risk of ischemic stroke. Our finding of an acute detrimental effect and a suggestion of a decreased risk over the 24-hour period after alcohol consumption seem consistent with these findings. For example, one may hypothesize that over time, individuals who drink large amounts infrequently primarily experience the acute detrimental effect, whereas subjects who drink small amounts frequently may still experience a transient increase in risk, but this may be offset in part by the subsequent reduction in risk that follows. There are some limitations to our study. Because the case–crossover design uses subjects as their own controls, there can be no confounding by risk factors that are stable over time. Confounding by factors that change over time within individuals can occur. However, excluding subjects reporting other potential triggers in the hour before stroke onset did not materially alter the results. In an effort to minimize reporting bias, efforts were made to ensure the patient’s privacy during the interview. We used a standardized structured interview and patients were not informed of the duration of the hypothesized hazard period. Because most of the participants drank small amounts of alcohol in the hour before stroke onset, we could not examine the acute effects of different doses of alcohol. We had limited power to evaluate the effect of beverage type because few participants were exposed to each type. A larger study would help elucidate such effects. Finally, our results may not be generalizable to patients presenting with a severe or fatal stroke.

**Summary**

In conclusion, we found that the risk of ischemic stroke was transiently elevated for 2 hours after drinking as little as 1 serving of alcohol. The risk rapidly returned to baseline and was modestly lower by 24 hours. When examined in the context of long-term studies of alcohol consumption, the net clinical impact on ischemic stroke risk appears to depend on the frequency and quantity of alcohol consumption. Definitive evidence would require a long-term clinical trial, although such a trial would be logistically difficult and is unlikely to be carried out in the near future.

**Acknowledgments**

We thank Cindy Aiello for outstanding administrative assistance.

**Sources of Funding**

This work was supported by an Established Investigator Grant (0140219N) from the American Heart Association, Dallas, Texas, and T32-A1007535-11.

**Disclosures**

None.

**References**


Alcohol and Acute Ischemic Stroke Onset: The Stroke Onset Study
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*Stroke*. 2010;41:1845-1849; originally published online July 15, 2010;
doi: 10.1161/STROKEAHA.110.580092

*Stroke* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the
World Wide Web at:
http://stroke.ahajournals.org/content/41/9/1845

Data Supplement (unedited) at:
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Alcohol and Acute Ischemic Stroke Onset
The Stroke Onset Study
Elizabeth Mostofsky, MPH; Mary R. Burger, MD; Gottfried Schlaug, MD, PhD; Kenneth J. Mukamal, MD, MPH; Wayne D. Rosamond, PhD; Murray A. Mittleman, MD, DrPH

Background and Purpose: Prior research has suggested that regular large alcohol consumption increases ischemic stroke risk, while moderate alcohol consumption has a protective effect. However, the risk of ischemic stroke following a one-time alcohol intake is still unclear. The present study used a case-crossover design to test alcohol intake and acute ischemic stroke risk, to evaluate the interval from alcohol intake to symptom onset (exposure time) and to observe the effects of different types of alcoholic beverages on stroke risk.

Methods: A multicenter study conducted from January 2001 to November 2006 included 390 patients (209 men, 181 women, median time from stroke onset to interview: 3 days). Based on the usual drinking frequency in the previous year, alcohol intake in the 1 hour before symptom onset was compared to the expected frequency.

Results: Among the 390 patients, 248 (64%) consumed alcohol in the previous year, with 104 (27%) consuming alcohol in the 24 hours before stroke onset, and 14 (4%) consuming alcohol in the hour before stroke onset. The relative risk of ischemic stroke 1 hour after alcohol intake was 2.3 (95% confidence interval: 1.4-4.0; P=0.002). When controlling for other potential confounders, the different types of alcoholic beverages had similar relative risks.

Conclusions: Alcohol intake within 1 hour of stroke onset is associated with an increased risk of stroke. Different types of alcoholic beverages have similar relative risks.

Keywords: alcohol, case-crossover study, cerebrovascular disease, epidemiology, stroke

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分钟访谈等原因而无法完成结构化访谈。所有中心中，43％的明确的缺血性卒中患者符合入选标准，其中83％患者同意入组，5.5％拒绝入组，12.5％患者在接触前已出院。研究方案经各分中心伦理委员会批准并获得每位患者的知情同意。

访谈人员使用结构化问卷询问患者出现症状的时间及起病前一年内是否饮酒。要求所有曾经有饮酒的患者提供末次酒精饮料摄入时间、前一年里饮酒的频率、每次饮酒量和饮酒种类（啤酒、葡萄酒或烈性酒）等信息。一份酒精量的定义为12盎司啤酒或4盎司葡萄酒或1.5盎司烈性酒的直接或混合饮用。患者同时被要求提供最后一次其他潜在诱因（包括咖啡因、烟草、大麻、可卡因、应激、愤怒和体力活动）的暴露时间及最近一年中这些诱因的暴露频率。其他在访谈中收集的信息还包括药物的使用和卒中当天的症状。

问卷的信度和效度

在25名患者中进行SOS问卷的重测信度评估，他们均在首次访谈后6天再次接受访谈。饮酒的既往频率在组内的相关性高度一致（0.84），对最近一年的和卒中发生前2小时的饮酒报告也具有良好的一致性（κ=1.0）。181例在Beth Israel Deaconess医学中心住院的患者接受了高密度脂蛋白胆固醇的检测，在校正性别、年龄、种族、吸烟史、教育、体力活动等因素后，饮酒的估计量与高密度脂蛋白水平存在相关性（0.35，P=0.003），与第二次国家健康与营养检验调查发现一致[20]。

研究设计

SOS使用了病例交叉对照设计，来评估饮酒后的时间段（危险期）中，急性卒中发生风险的变化。在病例交叉设计中，每位患者自身既往所存在的暴露作为其对照信息。自身对照控制了患者在研究期间持续存在但又与其他个体不同的混杂因素，将患者危险期，即缺血性卒中症状发病前1小时的饮酒情况与基于控制数据中的预期频率相比较。我们使用卒中前一年中饮酒的频率来估计其平均1小时的频率。

统计分析

病例交叉研究中的每位患者形成了其各自独立的分层，并进行自身对照[21,22]。所观察到的危险期内的暴露频率与计算所得的预期频率的比率作为相对危险度（RR）。我们将既往每年饮酒频率乘以理论生理作用的时间窗（初步分析为1小时）来估计暴露于酒精数量的人/时数，与未暴露的人/时数在一年中减去。每层中所缺失数据的分析采用队列研究方法。为了明确饮酒至缺血性卒中发生的时间长度，RR值的计算比较了按生理作用使用不同假设时间窗的酒精暴露和估计所得的过去一年里暴露于酒精的人/时数。我们通过分层分析来评估不同酒精饮料种类（啤酒、葡萄酒、烈性酒）、性别（<65岁与≥65岁相比较）、吸烟史（近期吸烟者与非吸烟者相比较）和卒中病因学，通过一致性检验来比较其RR值。

为了评估一些潜在的诱因是否与观察结果相关，我们将卒中发生1小时内具有其他潜在诱因的（如剧烈体力活动或情绪激动）患者排除在外，进行了敏感性检验。在另一项敏感性检验中，我们将卒中前一周的饮酒量作为控制信息。我们无法明确酗酒与缺血性卒中中的关系，因为仅有1例患者在卒中发生前1小时内饮酒2个单位。以上检验均为双侧检验。

结果

SOS中患者的特征见表。据报道，在390例急性缺血性卒中患者中，有248例（64%）在近一年中饮酒。
饮酒 (其中葡萄酒 45 例、啤酒 29 例、烈性酒 32 例、大于一种 142 例)。与未饮酒者相比，饮酒者更倾向于为男性和吸烟者。在 248 例发病前一年内饮酒的患者中，47 例 (12%) 饮酒至少每日 ≥ 1 个单位，38 例 (10%) 至少每周一次，163 (66%) 至少每月一次。患者最近一年中饮酒频率的中位数为每周 2.0 次，自诉每次饮酒量较少 (中位数为 1 个单位)，仅 13 例饮酒量超过 2 个单位。

169 例患者在卒中前一周内有饮酒，104 例则在卒中发生前 24 小时内饮酒，其中 1 小时内的有 14 例。饮酒后 1 小时内发生的风险是无饮酒者的 2.3 倍 (95% 可信区间 [CI] 1.44:0.0; P=0.002)。饮酒后第 2 小时的卒中发生的相对危险为 1.6 (95% CI, 1.0:2.5; P=0.05)，之后相对危险回落至基线水平 (图 1)。在 24 小时内，风险则下降了 30% (RR=0.7, 95% CI, 0.5:0.9; P=0.02)。

在卒中发生前 1 小时内饮酒的 14 例中，7 例饮烈性酒，5 例饮啤酒，2 例饮葡萄酒。卒中前 1 小时内饮酒的相对危险高于葡萄酒者，但没有达到统计学意义 (交互后的 P 值为 0.28; 图 2)。卒中前 1 小时饮酒的相对危险与性别、年龄、吸烟史或卒中病因无关 (交互后的 P 值分别为 0.62、0.62、0.12 和 0.43)。

在 248 例一年内饮酒的患者中，63 例在卒中发生前 1 小时内暴露于其他潜在的诱因。在卒中发生前 1 小时内的饮酒的 14 例中，4 例曾进行剧烈的体力活动，1 例摄入含有咖啡因的饮料。当排除了 1 小时内具有其他潜在在卒中诱因的 63 例患者后，研究结果与之前相似。

患者在最近的一年中平均饮酒频率为每周 4.42 次，与最近一周的平均饮酒频率相似 (4.23 次)。用每位患者所报告的最近一周的平均饮酒频率为对照所做的灵敏度分析，饮用至少 1 个单位酒后 1 小时内的缺血性卒中发病风险是未饮酒者的 3.3 倍 (95% CI, 1.2-9.3; P=0.03)。排除 1 例患者在卒中发生前 2 小时内摄入 2 个单位的酒精，分析结果无明显变化。

讨论

本研究发现饮酒后 1 小时内缺血性卒中的风险将会短暂性地上升，其风险是未饮酒时的 2.3 倍。本研究所显示的饮酒后的急性损害作用，与早前研究的发现一致 [17,18]。卒中风险在饮酒 3 小时后回落至基线水平，并于 24 小时到达低点。

个别研究进行了酒精作为缺血性 [16-18,24] 和出血性卒中 [25] 的诱因的研究。如 Hillborn 等 [18] 发现卒中前一周内中度 (151-300 g) 至重度 (>300 g) 饮酒是卒中发生的显著高危因素，校正后的 OR 值为 3.6 (95% CI, 1.7-7.8)，与本研究相一致。但 Gorelick 等 [24] 研究表明，在校正了包括吸烟在内的协同暴露因素后，饮酒后 24 小时内的缺血性卒中风险未见明显升高。


即使中量饮酒也可能导致急性的不良反应。在一项对 8 例健康男性的研究中，Hendriks 等 [1] 发现相对于在饮酒 40 g 后的第 1、3、5 小时内，纤溶酶原激活抑制物显著升高，9 小时后则无显著差异。


与饮酒的急性作用相反，一系列证据显示长期大量饮酒与缺血性 [27,28] 和出血性 [28-30] 卒中的风险增加相关。然而，至少等量饮酒研究的相关证据并
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