Five-Year Survival After First-Ever Stroke and Related Prognostic Factors in the Perth Community Stroke Study

Graeme J. Hankey, MD, FRCP, FRACP; Konrad Jamrozik, MBBS, DPhil, FAFPHM; Robyn J. Broadhurst, BA, BSc; Susanne Forbes, RN; Peter W. Burvill, MD, FRANZCP; Craig S. Anderson, MBBS, PhD, FRACP, FAFPHM; Edward G. Stewart-Wynne, MBChB, FCP(SA), FRACP

Background and Purpose—Few community-based studies have examined the long-term survival and prognostic factors for death within 5 years after an acute first-ever stroke. This study aimed to determine the absolute and relative survival and the independent baseline prognostic factors for death over the next 5 years among all individuals and among 30-day survivors after a first-ever stroke in a population of Perth, Western Australia.

Methods—Between February 1989 and August 1990, all individuals with a suspected acute stroke or transient ischemic attack of the brain who were resident in a geographically defined region of Perth, Western Australia, with a population of 138,708 people, were registered prospectively and assessed according to standardized diagnostic criteria. Patients were followed up prospectively at 4 months, 12 months, and 5 years after the index event.

Results—Three hundred seventy patients with first-ever stroke were registered, and 362 (98%) were followed up at 5 years, by which time 210 (58%) had died. In the first year after stroke the risk of death was 36.5% (95% CI, 31.5% to 41.4%), which was 10-fold (95% CI, 8.3% to 11.7%) higher than that expected among the general population of the same age and sex. The most common cause of death was the index stroke (64%). Between 1 and 5 years after stroke, the annual risk of death was approximately 10% per year, which was approximately 2-fold greater than expected, and the most common cause of death was cardiovascular disease (41%). The independent baseline factors among 30-day survivors that predicted death over 5 years were intermittent claudication (hazard ratio [HR], 1.9; 95% CI, 1.2 to 2.9), urinary incontinence (HR, 2.0; 95% CI, 1.3 to 3.0), previous transient ischemic attack (HR, 2.4; 95% CI, 1.4 to 4.1), and prestroke Barthel Index <20/20 (HR, 2.0; 95% CI, 1.2 to 3.2).

Conclusions—One-year survivors of first-ever stroke continue to die over the next 4 years at a rate of approximately 10% per year, which is twice the rate expected among the general population of the same age and sex. The most common cause of death is cardiovascular disease. Long-term survival after stroke may be improved by early, active, and sustained implementation of effective strategies for preventing subsequent cardiovascular events. (Stroke. 2000;31:2080-2086.)

Key Words: Australia ■ death ■ prognosis ■ stroke ■ survival

Accurate information about the long-term prognosis after stroke is important to the patient and family and helps the stroke team to set appropriate goals, balance the potential risks and benefits of treatment options, develop a treatment and discharge plan, and make rationing decisions if resources are limited.

Optimal prognostic data are derived from complete follow-up of large community-based inception cohorts in which the diagnostic criteria, disease severity, comorbidity, and demographic details of the patients are described, important outcome events are recorded objectively, and survival data are analyzed by actuarial methods.1 Only a few studies of the long-term prognosis after stroke have been published, and very few have met the above criteria.2-9 One community-based study examined the outcome of all strokes,2 3 studied all first-ever strokes,2-5 and 1 studied first-ever cerebral infarction.6-9 The risk of dying over the first 5 years after stroke varied from 45% (95% CI, 38% to 52%)6 to 72% (95% CI, 70% to 74%).2 The poorer survival in the latter study may have been in part because recurrent strokes were included in the inception cohort. The excess risk of dying is greatest in the first 30 days but nevertheless persists for several years because of recurrent stroke and other cardiovascular problems.5 Little is known, however, about the baseline predictors

Received November 8, 1999; final revision received June 29, 2000; accepted June 29, 2000.
From the Stroke Unit, Department of Neurology, Royal Perth Hospital (Western Australia) (G.J.H., E.G.S.W.); Departments of Medicine (G.J.H.), Public Health (K.J., R.J.B., S.F.), and Psychiatry and Behavioral Science (P.W.B.), University of Western Australia, Perth; and Faculty of Medicine and Health Science, University of Auckland (New Zealand) (C.S.A.).
Reviews of this article were directed by Mark L. Dyken, MD.
Correspondence to Dr Graeme J. Hankey, Stroke Unit, Department of Neurology, Royal Perth Hospital, GPO Box X2213, Perth, Western Australia 6001. E-mail gh.ankey@cyllene.uwa.edu.au
© 2000 American Heart Association, Inc.

Stroke is available at http://www.strokeaha.org
of death within the first 5 years after stroke. Reported predictors after all first-ever stroke include increasing age, and intracranial hemorrhage and, after the first cerebral infarction, include ischemic heart disease, atrial fibrillation or flutter at time of stroke, persistent atrial fibrillation or flutter, congestive heart failure, and recurrent stroke.

The aims of this study were as follows: (1) to describe the 5-year survival after first-ever stroke in 1989–1990 in the community of Perth, Australia; (2) to compare the observed survival after first-ever stroke with the expected survival of the age- and sex-matched general population; (3) to determine the major causes of death during different time periods over the first 5 years after stroke; and (4) to determine the factors at baseline (stroke onset) among all individuals with first-ever stroke and among 30-day survivors of first-ever stroke that independently predict an increased hazard of death over the next 5 years.

Subjects and Methods

Study Design

Between February 20, 1989, and August 19, 1990, inclusive, the Perth Community Stroke Study registered all episodes of possible acute cerebrovascular disease in a geographically defined segment of Perth, Western Australia. On the basis of the Australian Bureau of Statistics 1986 Census, the estimated population of the study area (on June 30, 1989) was 138,708 persons (69,008 males and 69,700 females). Comparison with census figures for the remainder of Perth showed that the population of the study area contained proportions of elderly persons and those born overseas (particularly from Southern European countries) that were slightly higher than average. Otherwise, the socioeconomic characteristics and patterns of admission to the hospital and length of time in the hospital for stroke were generally representative of those of the whole city (total population, 1.2 million).

Baseline Assessment

All cases meeting the clinical criteria for inclusion (resident in the Perth Community Stroke Study geographic area and suffering a stroke, as defined below, between February 20, 1989, and August 19, 1990) underwent a standardized neurological assessment. Information obtained at baseline included data on associated illnesses, risk factors for cardiovascular disease, and patterns of disability and social activity in the immediate premorbid period. The physical signs recorded for each patient at the onset of stroke included an assessment of the level of consciousness, the severity of limb paresis, and the presence or absence of urinary incontinence, cardiac failure, and atrial fibrillation. Level of consciousness at the time of presentation was measured by means of the Glasgow Coma Scale: a score of 3 to 9 was defined as comatose, 10 to 14 as drowsy, and the top score of 15 as normal. The severity of limb paresis was only measured in patients assessed within 2 weeks of onset of the stroke. Severe paresis was defined as Motricity Index score of 0 to 50, moderate paresis 51 to 95, and normal or minimal paresis 96 to 100. Urinary incontinence was diagnosed if the patient had urinary accidents (eg, wet his or her clothes) or needed an indwelling catheter during admission to hospital. Atrial fibrillation must have been confirmed on ECG within 1 month after the onset of stroke. Premorbid and baseline level of disability was assessed with the modified scale of the Barthel Index of activities of daily living. Patients were defined as independent if they had a score of 20 and as having some measure of dependence if they had a score of <20.

Follow-Up

Surviving patients were followed up prospectively at 4 months, 12 months, and 5 years, with vital status at 5 years (the censoring date of June 24, 1994) initially being ascertained by electronic linkage of the study records to mortality data supplied by the Registrar General of Births, Marriages, and Deaths for Western Australia and computerized records obtained from the Australian Bureau of Statistics.

For patients who had died, we independently reviewed all of the available clinical information and results of investigations obtained from records held by hospitals and physicians in private practice and the findings at necropsy (if one was performed). We classified the causes of death using standardized diagnostic criteria for stroke, recurrent stroke, myocardial infarction and other vascular death, and nonvascular death (see definitions, below).

Definitions

Initial and recurrent strokes were defined according to the World Health Organization criteria as “rapidly developing symptoms and/or signs of focal, and at times global, loss of cerebral function, with symptoms lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin.” The term global refers mainly to subarachnoid hemorrhage. Only 14% of the patients did not have objective evidence from CT scan, lumbar puncture, or necropsy as to the pathological basis of their stroke. Standard definitions were used to classify the remaining cases into subarachnoid hemorrhage, primary intracerebral hemorrhage, or ischemic stroke.

For the purposes of this article, we classified the causes of death into the 5 groups that were used in the Oxfordshire Community Stroke Project, as follows: (1) First stroke deaths were due to the direct effects of the brain lesion or to complications of immobility resulting from the first stroke. These included deaths from bronchopneumonia even several years after the stroke if stroke-related impairments were thought to be in some way responsible and there was no other, more likely, cause of death. (2) Recurrent stroke deaths were directly due to the brain lesion or complications of immobility after a severe recurrent stroke. (3) Other cardiovascular deaths were those definitely or probably due to cardiac causes, ruptured aortic aneurysms, or peripheral arterial disease. Sudden deaths were regarded as cardiovascular unless an alternative explanation was found at autopsy. (4) Nonvascular deaths were unrelated to any stroke disability and clearly due to a nonvascular cause, eg, cancer, injuries, or suicide. (5) Unknown deaths were those in which there was so little information that no cause could be given.

Statistical Analysis

Crude associations between the occurrence of death and each of 26 independent categorical variables recorded at baseline were assessed by preliminary cross-tabulations using the $\chi^2$ test and SAS software.

All records with missing values were included in the analyses to make use of all available information. When the number of missing values for a certain variable (possible prognostic factor) numbered <15 (4%), the missing values were recoded to the mode. When the number of missing values for a variable was >14 (4%), they were included in the analysis as a specific level of the factor.

The Kaplan-Meier product limit technique was used to generate survival probabilities and survival curves based on the 210 deaths within the 5 years (ie, before the censoring date of June 24, 1994). In addition, we compared the cumulative incidence of deaths over 5 years of follow-up (observed deaths) with the expected incidence of deaths in the general population (expected deaths), derived from the age- and sex-specific rates of death from the official mortality statistics for Western Australia and calculated using the SAS macro Survexp. CIs for the ratio of the observed to the expected frequency were calculated from the Poisson distribution. We used multiple regression, Cox proportional hazards analysis, and EGRET software to develop statistical models predicting occurrence of death within 5 years of a first stroke. The 26 independent variables were screened by their individual associations with a fatal outcome after adjustment for sex, age, and age squared (each of which was forced into the model), and those that were significant at the 0.05 level then entered the initial multivariate model. When the most parsimonious model was obtained by backward stepwise elimination of the nonsignificant factors, each of the remaining variables was again
entered separately into the model to test its contribution to the final model.

**Ethical Considerations**

The protocol for the study was approved by the Committee for Human Rights at the University of Western Australia and by the Confidentiality of Health Information Committee of the Health Department of Western Australia. Patients or their next of kin gave permission for review of medical records pertaining to suspected vascular events occurring during follow-up.

**Results**

**Study Population**

The study registered 492 patients with acute stroke, among whom 370 patients (75%; 95% CI, 71% to 79%) had a first-ever stroke.

Complete follow-up data, over a range of 3.85 to 5.32 years, were available for 362 patients (98%), who form the basis of this report. The mean age of these patients at baseline was 73±13 years, with a median of 76 years. The median age at first stroke for the 194 (53.6%) men (53.6%) was 72.5 years, compared with 78 years for the 168 women.

**Outcome at 5 Years**

**Absolute Risks for All Patients**

Table 1 and Figure 1 show that the 5-year cumulative risk of death was 60.1% (95% CI, 54.7% to 65.5%). The risk of death was greatest in the first year after stroke (36.5%; 95% CI, 31.5% to 41.4%) and particularly in the first 30 days after stroke (23.5%; 95% CI, 19.1% to 27.9%). Beyond the first year, approximately 10% of survivors continued to die each year.

**Absolute Risks for Subgroups**

Stratification by age showed that older patients had a worse prognosis, particularly during the early period after stroke (Figure 2). Thereafter the case fatality was similar.

---

**Table 1. Kaplan-Meier Estimates of the Risk of Death Within Defined Time Intervals After the Index Stroke**

<table>
<thead>
<tr>
<th>Time Interval</th>
<th>Risk, %</th>
<th>95% CI</th>
<th>Cumulative Risk, %</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–30 d</td>
<td>23.5</td>
<td>19.1–27.9</td>
<td>23.5</td>
<td>19.1–27.9</td>
</tr>
<tr>
<td>1–6 mo</td>
<td>11.9</td>
<td>8.1–15.7</td>
<td>32.6</td>
<td>27.8–37.4</td>
</tr>
<tr>
<td>6–12 mo</td>
<td>5.7</td>
<td>2.8–8.7</td>
<td>36.5</td>
<td>31.5–41.4</td>
</tr>
<tr>
<td>1–2 y</td>
<td>10.0</td>
<td>6.1–13.9</td>
<td>42.8</td>
<td>37.7–47.9</td>
</tr>
<tr>
<td>2–3 y</td>
<td>11.6</td>
<td>7.2–16.0</td>
<td>49.5</td>
<td>44.3–54.6</td>
</tr>
<tr>
<td>3–4 y</td>
<td>10.4</td>
<td>6.0–14.9</td>
<td>54.7</td>
<td>49.6–59.9</td>
</tr>
<tr>
<td>4–5 y</td>
<td>11.9</td>
<td>5.3–18.5</td>
<td>60.1</td>
<td>54.7–65.5</td>
</tr>
</tbody>
</table>

---

**Figure 1.** Kaplan-Meier curve showing the probability of survival after a first-ever stroke (solid line), compared with the expected probability in the same general population remaining free from a first stroke (dotted line), derived from Perth Community Stroke Study incidence data 1989–1990. Dots on either side of the solid line indicate 95% CIs; n indicates number at risk at the beginning of each year.
Stratification by the pathology of the first-ever stroke showed that hemorrhagic stroke was associated with a substantially greater early (30-day) case fatality (primary intracerebral hemorrhage, 32%; subarachnoid hemorrhage, 38%) than ischemic stroke (12%), but the subsequent case fatality was similar, if not lower, among survivors of hemorrhagic stroke.

Relative Risk Compared With the General Population

Patients with a first-ever stroke had a 4.2 times (95% CI, 3.7 to 4.8) greater risk of dying compared with individuals of the same age and sex in the general population of Western Australia. In the first year after stroke, patients had 10-fold (95% CI, 8.3 to 11.7) relative risk of death, declining to 2-fold in each of the subsequent years (Table 2). Patients who survived at least 30 days had a 2.5-fold (95% CI, 2.1 to 3.0) greater risk of dying over the next 5 years than people in the general population.

The relative risk of dying was far greater in younger patients (Table 3). Patients younger than 45 years had a 200-fold (95% CI, 70 to 333) higher risk of dying than individuals of the same age and sex in the general population. The relative risk declined with increasing age, such that patients older than 85 years had a relative risk of dying of 3.2 (95% CI, 2.3 to 4.2) compared with individuals of the same age and sex in the general population.

Causes of Death

Figure 3 shows the causes of death during different time intervals from the onset of first-ever stroke. During the first 30 days after first-ever stroke, approximately two thirds of deaths were due to the direct neurological effects of the index stroke, and another one sixth were due to recurrent stroke. Among 30-day survivors, 27% of subsequent deaths to 5 years were due to the first (19%) or a recurrent (8%) stroke, and 31% were due to other cardiovascular causes. Among 1-year survivors, 15% of subsequent deaths to 5 years were due to the first (10%) or a recurrent (5%) stroke, and 41% were due to other cardiovascular causes.

### TABLE 2. Number of Deaths in Each Calendar Year After the Index Stroke Compared With the Expected Number of Strokes in the Same Population

<table>
<thead>
<tr>
<th>Year</th>
<th>No. at Risk</th>
<th>Observed</th>
<th>Expected</th>
<th>Observed/Expected</th>
<th>95% CI of Observed/Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>362</td>
<td>132</td>
<td>13.2</td>
<td>10.0</td>
<td>8.3–11.7</td>
</tr>
<tr>
<td>2</td>
<td>230</td>
<td>23</td>
<td>11.1</td>
<td>2.1</td>
<td>1.2–2.9</td>
</tr>
<tr>
<td>3</td>
<td>207</td>
<td>24</td>
<td>10.5</td>
<td>2.3</td>
<td>1.4–3.2</td>
</tr>
<tr>
<td>4</td>
<td>183</td>
<td>19</td>
<td>9.5</td>
<td>2.0</td>
<td>1.1–2.9</td>
</tr>
<tr>
<td>5</td>
<td>152</td>
<td>12</td>
<td>5.2</td>
<td>2.3</td>
<td>1.0–3.6</td>
</tr>
<tr>
<td>All years</td>
<td>362</td>
<td>210</td>
<td>50.0</td>
<td>4.2</td>
<td>3.7–4.8</td>
</tr>
<tr>
<td>30-day survivors (all years)</td>
<td>277</td>
<td>125</td>
<td>49.4</td>
<td>2.5</td>
<td>2.1–3.0</td>
</tr>
</tbody>
</table>
Predictors of Death Over 5 Years
Table 4 shows the multivariate prediction model for death at 5 years after first-ever stroke among 362 patients, of whom 210 died. The significant prognostic factors present at baseline for death at 5 years, after adjustment for age and sex, were intermittent claudication (hazard ratio [HR], 1.7; 95% CI, 1.2 to 2.5), severe coma (HR, 2.6; 95% CI, 1.7 to 4.0), urinary incontinence (HR, 2.2; 95% CI, 1.5 to 3.3), previous transient ischemic attack (TIA) (HR, 1.9; 95% CI, 1.3 to 2.9), prestroke Barthel index <20/20 (HR, 1.5; 95% CI, 1.1 to 2.2), baseline Barthel Index <20/20 (HR, 2.6; 95% CI, 1.4 to 4.6), and being an ex-smoker (HR, 1.6; 95% CI, 1.1 to 2.3).

Predictors of Death Over 5 Years Among 30-Day Survivors of First-Ever Stroke
Table 5 shows that the significant prognostic factors at baseline among 30-day survivors of first-ever stroke for death at 5 years, after adjustment for age and sex, were intermittent claudication (HR, 1.9; 95% CI, 1.2 to 2.9), urinary incontinence (HR, 2.0; 95% CI, 1.3 to 3.0), previous TIA (HR, 2.4; 95% CI, 1.4 to 4.1), and prestroke Barthel Index <20/20 (HR, 2.0; 95% CI, 1.2 to 3.2).

Discussion
The principal findings of this study are that the cumulative risk of death at 5 years after first-ever stroke was 60.1% (95% CI, 54.7% to 65.5%); the risk of death beyond the first year was approximately 10% per year, which is approximately 2-fold greater than that expected among the general population of the same age and sex; the risk of dying relative to the expected risk was far greater in younger patients and declined with increasing age of the patients; the most common cause of death beyond the first year was recurrent stroke and cardiovascular disease; and the important independent factors that were present at baseline among 30-day survivors of stroke and that predicted death over the next 5 years were intermittent claudication (HR, 1.9; 95% CI, 1.2 to 2.9), urinary incontinence (HR, 2.0; 95% CI, 1.3 to 3.0), previous TIA (HR, 2.4; 95% CI, 1.4 to 4.1), and prestroke Barthel Index <20/20 (HR, 2.0; 95% CI, 1.2 to 3.2).

This study was designed to meet the criteria for optimal investigations of clinical outcome, as described by Sackett et al. It provides prognostic data from a large, unselected, community-based inception cohort of patients with first-ever stroke diagnosed prospectively following a standardized neurological assessment and using standardized diagnostic criteria. It also takes into account the severity of the index event, comorbidity, and the demographic details of the patients. Outcome events were carefully defined, only 2% of patients were lost to follow-up, and the survival data were analyzed by
actuarial methods. Furthermore, the study provides estimates of relative as well as absolute risks and identifies independent prognostic factors for all patients at baseline and among 30-day survivors. As frequently occurs in studies of this kind, not all of the baseline data were collected on all patients, and changes in risk factors and effects of treatment were not reassessed over time.

Our results are very similar, and complementary, to those of the Oxfordshire Community Stroke Project, which followed 675 patients with first-ever stroke for up to 6.5 years and recorded absolute and relative risks of death and causes of death.5 However, the estimates in both studies of a very high relative risk of dying after stroke in young stroke patients (aged <45 years) are imprecise because of the small number of strokes observed and expected (hence the wide 95% CIs). Comparisons with 2 other previous studies of prognostic factors are more difficult. One of these included all patients with a first-ever stroke; it identified increasing age and intracranial hemorrhage as significant factors but was based on only 97 patients.3 Like Kojima et al,3 we also found that increasing age (as a categorical variable) was associated with a greater risk of death in a univariate analysis of the association of age with death (Figure 2), but a multivariate analysis showed that, after adjustment for other factors in the model, the association between increasing age (as a continuous variable) and death was inverse (Table 4).

An early report from Rochester, Minn, considered 594 patients with first cerebral infarction and identified age, myocardial infarction at any time before the stroke, and atrial fibrillation/flutter at the time of stroke as significant independent predictors.8 However, hemorrhagic strokes were excluded, and the only variables considered in the analysis were age, sex, calendar year of stroke, hypertension, diabetes, and individual cardiac diagnoses.8 A more recent report, involving 1111 patients with first cerebral infarction, indicated that ischemic heart disease (particularly in younger patients) and congestive heart failure were the most important predictors of death after first cerebral infarction, followed by age and persistent atrial fibrillation.9 Our findings of a history of intermittent claudication, previous TIA, and prestroke disability (Barthel Index <20/20), as independent predictors of death among stroke survivors of ≥30 days, suggest that heavy atherosclerotic plaque burden and physical or cognitive comorbidity and copathology are the important predictors of vascular and nonvascular deaths, respectively. The finding of poststroke urinary incontinence as a predictor of long-term mortality is probably a marker of stroke severity in most cases

### Table 4. Final Multivariate Model of Factors at Presentation After a First-Ever Stroke That Predict Survival at 5 Years (n=362 Patients, of Whom 210 Died Over 5 Years)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Prevalence, %</th>
<th>HR 95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (continuous variable)</td>
<td>0.87</td>
<td>0.82–0.94</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age squared</td>
<td>1.001</td>
<td>1.001–1.002</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female sex</td>
<td>46.4</td>
<td>1.14</td>
<td>0.82–1.60</td>
</tr>
<tr>
<td>History of intermittent claudication</td>
<td>15.5</td>
<td>1.74</td>
<td>1.20–2.51</td>
</tr>
<tr>
<td>Previous TIA</td>
<td>13.0</td>
<td>1.94</td>
<td>1.28–2.93</td>
</tr>
<tr>
<td>Prestroke Barthel Index &lt;20/20</td>
<td>25.4</td>
<td>1.54</td>
<td>1.07–2.21</td>
</tr>
<tr>
<td>Baseline Barthel Index &lt;20/20</td>
<td>73.5</td>
<td>2.56</td>
<td>1.44–4.56</td>
</tr>
</tbody>
</table>

### Table 5. Final Multivariate Model of Factors Present at Baseline Among Survivors of ≥30-Days After First-Ever Stroke That Predict Survival at 5 Years (n=277 Patients, of Whom 125 Died Over 5 Years)

<table>
<thead>
<tr>
<th>Variable</th>
<th>HR</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (continuous variable)</td>
<td>0.97</td>
<td>0.83–1.13</td>
<td>0.70</td>
</tr>
<tr>
<td>Age squared</td>
<td>1.00</td>
<td>0.999–1.002</td>
<td>0.375</td>
</tr>
<tr>
<td>Female sex</td>
<td>1.04</td>
<td>0.71–1.52</td>
<td>0.85</td>
</tr>
<tr>
<td>History of intermittent claudication</td>
<td>1.91</td>
<td>1.23–2.95</td>
<td>0.004</td>
</tr>
<tr>
<td>Previous TIA</td>
<td>2.38</td>
<td>1.38–4.09</td>
<td>0.002</td>
</tr>
<tr>
<td>Prestroke Barthel Index &lt;20/20</td>
<td>1.97</td>
<td>1.21–3.21</td>
<td>0.007</td>
</tr>
<tr>
<td>Urinary incontinence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No incontinence</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incontinence</td>
<td>1.96</td>
<td>1.27–3.02</td>
<td>0.002</td>
</tr>
</tbody>
</table>
and other copathologies in a minority of patients (in whom prestroke incontinence was unmasked by the stroke). The final model of prognostic factors for all patients (not just 30-day survivors) also identified ex-smokers (but not current smokers [HR, 1.38; 95% CI, 0.9 to 2.2]) as having a significant excess hazard of death compared with never smokers (HR, 1.63; 95% CI, 1.1 to 2.3) (Table 4). Although the HRs for ex-smokers (1.63) and current smokers (1.38) are similar, and their 95% CIs overlap appreciably, we did not expect that the hazard for ex-smokers would be greater than that for current smokers. However, this may be because ex-smokers stopped smoking because of poor health, whereas smokers in better health continued smoking. It is well recognized from prospective observational studies that ex-smokers have excess mortality in the first few years after quitting, and it is generally accepted that this reflects cessation of smoking after development of (subacute) life-threatening illness.25,26

Patients who survive to 30 days after a first-ever stroke continue to die at a rate of approximately 10% per year for the next 5 years, a 2-fold increase in relative mortality. These later deaths are not due to the index stroke but mainly to recurrent stroke and other cardiovascular events. The stroke survivors at greatest risk of death in the next 5 years are those with a history of symptomatic vascular disease of the brain (TIA) or limbs (intermittent claudication), prestroke physical disability (prestroke Barthel Index <20/20), and urinary incontinence after the stroke.

Acknowledgments
The Perth Community Stroke Study was originally funded by the National Health and Medical Research Council (NHMRC) of Australia. This follow-up study was supported by an additional grant from the Public Health Research and Development Committee of the NHMRC and a grant from Healthway, the Health Promotion Foundation of Western Australia. The study would not have been possible without the help of the patients and their families and the generous cooperation of doctors, nursing homes, hospitals, the Health Department, the Registrar-General, the Australian Bureau of Statistics in Australia, and the Perth Coroner.

References
Five-Year Survival After First-Ever Stroke and Related Prognostic Factors in the Perth Community Stroke Study

Graeme J. Hankey, Konrad Jamrozik, Robyn J. Broadhurst, Susanne Forbes, Peter W. Burvill, Craig S. Anderson and Edward G. Stewart-Wynne

*Stroke*. 2000;31:2080-2086
doi: 10.1161/01.STR.31.9.2080

*Stroke* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2000 American Heart Association, Inc. All rights reserved.
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/31/9/2080

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in *Stroke* can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to *Stroke* is online at:
http://stroke.ahajournals.org/subscriptions/