Stroke incidence and case fatality in Shiga, Japan 1989–1993

Yoshikuni Kita,a Akira Okayama,a Hirotugu Ueshima,a Mitsumasa Wada,a Akihiko Nozaki,a Sohel Reza Choudhury,a Ruth Bonita,b Yasuhiro Inamotoc and Takayuki Kasamatsud

Background This paper describes incidence rates and case-fatality for sub-types of stroke using data collected in Takashima, Shiga, Japan, from 1989 to 1993 and compares these with similar registers in other parts of Japan.

Methods Registered patients included all residents of the county who experienced a first-ever stroke. Stroke was defined as sudden onset of neurological symptoms which continued for a minimum of 24 hours or led to death. Almost all such patients are hospitalized in this country. Early case fatality was defined as patients who died within 28 days of stroke onset. Diagnosis of stroke type was based on clinical symptoms as well as computed tomography (CT) scans.

Results Age-adjusted incidence rates for stroke per 100 000 population aged 35 years and older were 268.7 for men and 167.5 for women. The age-specific incidence rate of both cerebral infarction and cerebral haemorrhage increased with advancing age. The occurrence of cerebral infarction in men was twice as high as in women. The 28-day case fatality for all sub-types of stroke was 16.1% in men and 15.8% in women. Case fatality for cerebral infarction, cerebral haemorrhage, and subarachnoid haemorrhage was 10.7%, 22.4% and 28.6% respectively.

Conclusions Takashima County has a moderately high stroke incidence rate and case fatality compared with other similar studies in Japan. The incidence rate of cerebral infarction in men is twice that in women, while other sub-types of stroke showed smaller differences. In order to decrease the incidence of stroke in Japan, greater efforts at primary prevention will be necessary, in particular, it is important to prevent cerebral infarction in men.

Keywords Stroke, incidence, case fatality, subtype of stroke, Japan

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incidence rate and the case-fatality for men and women and sub-types of strokes using data collected for the 5-year period 1989 to 1993.

**Material and Methods**

**Geographical conditions of investigated area**

Shiga prefecture borders on Kyoto municipal area to the northeast, and is located at about the geographical centre of Japan. Lake Biwa is located to the east of Takashima County and the Hira-san Ganges runs north south to the west. Only one primary road runs through the area and movement is therefore restricted to this extent. Takashima County has a stable population of around 53 000 with 17.6% of the population (around 10 000) aged 65 years or over.

**Case finding and diagnostic criteria**

Takashima County contains two community hospitals, one in the south which is a public facility providing 261 beds, and another in the north which is a private facility providing 72 beds. It has been estimated that approximately 98% of all hospital admissions are seen at the two community hospitals.

Registered patients included all residents of the county who were hospitalized with a first-ever stroke in the two community hospitals and one geriatric hospital which was the only care facility for elderly people in Takashima. The remaining patients are seen at three tertiary hospitals outside the county which have more sophisticated facilities for advanced treatment. Internist and specialist investigative personnel trained by neurologists carried out both the case finding and registration of patients who met the criteria. Registration procedures were investigated once every 3 months at the six facilities.

Stroke diagnostic criteria employed in this study are the criteria established for the Monitoring System for Cardiovascular Disease commissioned by the Ministry of Health and Welfare. These criteria are in accord with the World Health Organization and define a stroke as sudden onset of neurological symptoms, or underlying disorder such as arrhythmia, valvular disease, myocardial infarction or occlusive pathological findings by angiography.

Items recorded at registration of a stroke were the date and time of stroke event, the situation and symptoms at the event, the extent of neurological symptoms at the event, clinical observations at the event (blood pressure, presence of fibrillation, level of consciousness, impairment of neurological function), past history, family history, smoking history, consumption of alcohol, early (within one week) rehabilitation, fatality (within 28 days), cause of death, recurrence in acute stage, and CT scan observations.

Past history included other disorders as well as those first diagnosed at the time of the event. On admission to hospital patients were also examined for abnormal lipid metabolism and kidney function disorders simultaneously with the diagnosis of the event. Abnormal lipid metabolism was defined as a serum total cholesterol level of at least 220 mg/dl. A serum total creatinine level of at least 2.0 mg/dl over two samples taken at intervals was used as the criteria for diagnosis of kidney function disorders.

Items investigated in CT scan were the size of regions of low-density absorption in association with cerebral infarction, and the size of regions of high-density absorption in association with cerebral haemorrhage. Cerebral angiography was employed in the investigation of cerebral aneurysms and anomalies in the cerebral venous system, and secondary cerebral infarctions in association with subarachnoid haemorrhage.

Registered stroke patients were monitored annually by death certifications. Death certificates were seen with the approval of the General Affairs Office of Japan in order to establish cause of death.

**Data analysis**

Age-specific rates were calculated in 10-year age groups (35–44, 45–54, 55–64, 65–74, 75–84 and 85–) as described below. Three patients less than 35 years (two men and one woman) were registered during the study period, but have been excluded from these analyses because of small numbers. The age-specific incidence rates were determined by dividing the average annual number of cases over the 5-year period by the population of the relevant age group in Takashima County based on the 1990 census. Age-adjusted incidence rates were calculated using the Japanese population aged 35 years and older from the 1980 census as the standard population to allow comparison with other published Japanese studies. For age-specific incidence rates, age-adjusted incidence rates, and age-specific case fatality, 95% confidence intervals (95% CI) were calculated and used for these statistical analyses.

**Results**

A total of 401 patients (217 in men and 184 in women) were registered as first-ever stroke cases in the 5-year period between 1 January 1989 and 31 December 1993. Among these patients, 373 (93.0%) underwent CT scans. The remaining 28 patients who did not receive CT scan included 10 patients who met the clinical criteria for acute stroke but who died within 24 hours of stroke onset.
Average age at the time of the stroke event for the overall stroke patients was 69.1 (median: 67.9) years in men and 72.6 (median: 74.0) years in women. The average age for patients with cerebral infarction was 70.6 (median: 71.0) years in men and 73.4 (median: 74.0) years in women, for cerebral haemorrhage 66.9 (median: 64.3) years in men and 72.6 (median: 74.0) years in women, and for subarachnoid haemorrhage 58.6 (median: 63.1) years in men and 68.0 (median: 68.4) years in women.

Table 1 shows age-specific rates and age-adjusted incidence rates for all strokes and for all sub-types of stroke. Age-adjusted incidence rates for stroke per 100 000 population aged 35 years and older was 268.7 (95% CI: 234.8–307.5) for men and 167.5 (95% CI: 143.9–194.9) for women, and the rate in men was significantly higher (1.6 times) than in women. The age-specific incidence rate of both cerebral infarction and cerebral haemorrhage increased with advancing age. The age-specific incidence rates of cerebral infarction were higher in men than in women for all age groups. Ratios of age-adjusted incidence rate of cerebral infarction versus cerebral haemorrhage were 3.3:1.0 for men, 2.0:1.0 for women and 2.6:1.0 for men and women together.

The occurrence of cerebral infarction in men was twice that in women, especially in the age groups under 64 years old. There were no differences in the incidence of cerebral haemorrhage or subarachnoid haemorrhage between men and women.

Case fatality at 28 days is shown in Table 2 for the three sub-types of stroke. Overall, 64 people (35 men and 29 women) died within 28 days. The average age for fatal cases was 71.8 (median: 71.2) years in men and 74.3 (median: 77.9) years in women. Overall (men and women combined) case fatality rate for all sub-types of stroke was 16.0% (95% CI: 12.5–20.4). Case fatality for all sub-types of stroke was 16.1% (95% CI: 11.6–22.5) in men and 15.8% (95% CI: 11.0–22.7) in women. Age-specific case-fatality rates were higher in men than in women except for patients aged 35–44 and 75–84 years. Overall case-fatality rate for cerebral infarction, cerebral haemorrhage and subarachnoid haemorrhage were 10.7% (95% CI: 7.4–15.5), 22.4% (95% CI: 14.8–34.1) and 16.0% (95% CI: 12.5–20.4) respectively.
Table 2: Case fatality at 28 days by stroke sub-type, age group, and sex in Takashima, Shiga Prefecture, 1989–1993

<table>
<thead>
<tr>
<th>Age group</th>
<th>Cerebral infarction</th>
<th>Cerebral haemorrhage</th>
<th>Subarachnoid haemorrhage</th>
<th>Total casesb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Patient Fatality Rate (%)</td>
<td>Patient Fatality Rate (%)</td>
<td>Patient Fatality Rate (%)</td>
<td>Patient Fatality Rate (%)</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35–44</td>
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<td>0</td>
<td>0.0 – 0.0</td>
<td>4</td>
</tr>
<tr>
<td>45–54</td>
<td>12</td>
<td>0</td>
<td>0.0 – 0.0</td>
<td>19</td>
</tr>
<tr>
<td>55–64</td>
<td>35</td>
<td>4</td>
<td>11.4 4.3–30.5</td>
<td>54</td>
</tr>
<tr>
<td>65–74</td>
<td>152</td>
<td>3</td>
<td>5.8 1.9–17.9</td>
<td>65</td>
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<tr>
<td>75–84</td>
<td>40</td>
<td>4</td>
<td>10.0 3.8–26.6</td>
<td>54</td>
</tr>
<tr>
<td>85+</td>
<td>15</td>
<td>4</td>
<td>26.7 10.0–71.1</td>
<td>18</td>
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<tr>
<td>Total</td>
<td>155</td>
<td>15</td>
<td>9.7 5.8–16.1</td>
<td>217</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>0</td>
<td>0.0 – 0.0</td>
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<td>5.3 0.7–37.4</td>
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<tr>
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<td>3</td>
<td>9.4 3.0–29.1</td>
<td>2</td>
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<tr>
<td>75–84</td>
<td>37</td>
<td>5</td>
<td>13.5 5.6–32.5</td>
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<tr>
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<td>14</td>
<td>4</td>
<td>28.6 10.7–76.1</td>
<td>8</td>
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<tr>
<td>Total</td>
<td>107</td>
<td>13</td>
<td>12.1 7.1–20.9</td>
<td>184</td>
</tr>
<tr>
<td>Total</td>
<td>262</td>
<td>28</td>
<td>10.7 7.4–15.5</td>
<td>401</td>
</tr>
</tbody>
</table>

a 95% confidence interval.

b Four fatal cases of six unclassified cases have been included in Total cases.
respectively. In men case-fatality rates for cerebral infarction, cerebral haemorrhage and subarachnoid haemorrhage were 9.7% (95% CI: 5.8–16.1), 29.8% (95% CI: 17.6–50.3) and 30.8% (95% CI: 11.5–80.2) respectively. In women the rates for cerebral infarction, cerebral haemorrhage and subarachnoid haemorrhage were 12.1% (95% CI: 7.1–15.5), 15.7% (95% CI: 7.8–31.4) and 27.3% (95% CI: 12.3–60.7) respectively. The case-fatality rate combined men and women for subarachnoid haemorrhage is the highest among sub-types of stroke, and the rate in men was higher than in women.

Discussion

Takashima County in Shiga Prefecture is located at the geographical centre of Japan. Crude mortality rates from all causes of death and from cerebrovascular disease in Shiga Prefecture are 682.0 and 97.5 per 100 000 respectively, very close to the national figures of 674.1 and 96.2 per 100 000 respectively.16 Based on these observations of geographical characteristics and population statistics, we may assume that the estimated incidence rate of stroke in our study represents the overall stroke incidence rate in Japan, and on this basis we are continuing the registration of stroke events in this prefecture to fulfil our prime aim of measuring secular trends.

The necessity for comprehensiveness of the registration system for diseases like stroke is a significant problem in determining incidence in a particular area. A system to capture all patients in the study area, together with very accurate diagnosis, is required to ensure comprehensive registration.17,18 Factors which reduce the comprehensiveness of registration are the non-registration of sudden death for which no confirmed diagnosis is available, non-registration of stroke patients admitted to hospitals outside the registration area, and non-registration due to stroke patients being cared for at home and in nursing homes.

We used comprehensive and multiple case-finding sources including identification through the emergency system which operates in Takashima County. Overall 91% of 123 patients admitted via the emergency system in Takashima County with stroke-like symptoms during a 2-year period were admitted to the two community hospitals inside Takashima County. Therefore it is considered that only a very small number of patients with acute stroke, who required emergency care, would have been missed, since in Japan stroke is seen as an emergency requiring immediate attention in hospital. To ensure that eligible patients hospitalized outside the county through other systems were not excluded, registration procedures were also conducted at the three high-level medical facilities outside the county. This allowed us to estimate that 96% of all admissions with stroke-like symptoms via the emergency system in the county were registered at the hospitals. The major limitation of our case-finding methods related to fatal and non-fatal strokes managed outside the three main medical facilities. However, because the practice in Takashima County is to admit almost all acute stroke cases to hospital, we estimate that there would be few such cases. Almost 100% of residents of Japan have health insurance offered by sources such as Ministry of Health and Welfare and there are many types of mutual benefit societies.19 Health insurance is not expensive and policies cover all disease excluding injury by road traffic accident. Therefore, people with mild stroke who attended general physicians in the community are almost always referred to secondary or tertiary level hospitals for extensive investigations. This is the usual practice in Japan and so we believe that only a few cases with mild stroke were not registered in our system. As in most population-based studies of stroke in Japan, access to death certificates is limited, and we do not know how many fatal events occurred before emergency help was sought. The proportion of such cases is likely to be fewer than the 6% quoted in other population-based studies where stroke is not viewed as a medical emergency.20

The strength of this study is the comprehensiveness of diagnostic investigations, which has allowed almost complete categorization of stroke sub-types. This allows a comparison of stroke incidence rates with a similar study in Akita, Japan21 (Table 3). Age-specific and age-adjusted incidence rates for the different sub-types of stroke and total stroke in Akita and Takashima are shown in Table 3. Rates for cerebral infarction were higher in Takashima than in Akita. In contrast, incidence of cerebral haemorrhage and subarachnoid haemorrhage in Takashima were lower than in Akita. Overall (all sub-types combined), the rates appear higher in Akita than in Takashima (177 per 100 000).

A comparison of rates with a study in Okinawa (1989–1991)8 suggested higher rates in Takashima (165 per 100 000 population) than in Okinawa (137 per 100 000 population). These patterns are in keeping with the geographical distribution of stroke in Japan where stroke mortality rates are higher in the northern regions of Japan than in the southern region.22 We believe that stroke incidence rates in Takashima are close to the national average in Japan.

In comparison with results from hospital-based studies in other Far East countries, stroke incidence rates in Takashima were similar to the rates in Taiwan.23 We compared our data to those of MONICA Projects, although the case-finding methods are different in some respects, and our data showed that the stroke incidence rates for both of men and women in our study were similar to the middle rate group of MONICA Project participating countries.24

In Takashima, incidence rates of cerebral infarction in men were more than twice as high as the rates in women. The differences were particularly great in the middle-aged group. These patterns of incidence of stroke in men and women have also been noted in a large stroke registry in Akita21 and Okinawa.8 In small community and cohort studies the differences in incidence rates for cerebral infarction between men and women were smaller.25–27 Also a population-based study in Europe reported that incidence rate of cerebral infarction in men was higher than in women, but the differences were smaller than in Takashima.28

In this study, we observed that overall 28-day case fatality (all stroke sub-types combined) was higher than that reported in seven area studies in Japan (Akita, Nagano, Shiga, Osaka, Ehime, Nagasaki and Okinawa).8,21,29 Severity of stroke, type of stroke, the age of onset of stroke event and sex are important factors which influence early case fatality.30 Incidence of haemorrhagic stroke which has a poor prognosis26 was lower in Takashima than in Akita and Okinawa. Furthermore, average age of stroke onset in both men and women in Takashima was higher than in Okinawa (5.2 years for men and 3.6 years for
women), and the age-rank distribution of stroke patients in both men and women in Takashima had shifted to higher age groups than that in Akita. Therefore, we conclude that case fatality in this study is high as a result of higher age at stroke onset.

Our study showed that Takashima County has moderately high incidence rates and case fatality compared with other centres in Japan. It also confirms the higher incidence rate of cerebral infarction in men than in women. In order to decrease the incidence of stroke in Japan, greater efforts at primary prevention will be necessary.

Ongoing monitoring of stroke in Takashima County is feasible and will in the future develop understanding of the reasons for the continuing decline in stroke mortality which has been noted in all regions of Japan.

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