Increasing Incidence of Stroke Among Swedish Women

Andreas Terén, MD, PhD

The incidence of stroke and transient ischemic attack was studied prospectively in the municipality of Söderhamn, Sweden, during the periods 1975–1978 and 1983–1986. A total of 723 cases of stroke and 111 cases of transient ischemic attack were registered during the two periods. The number of first-ever strokes increased by 28% between the 1970s and the 1980s, while the annual incidence of first-ever stroke rose from 2.90 to 3.53/1,000 (p < 0.02). Female incidence increased by 38%, from 2.62 to 3.62/1,000 (p < 0.05) between the study periods. Male incidence, however, changed nonsignificantly from 3.19 in the first period to 3.43 in the second. In 1975–1978, male incidence was four times greater than that of females up to 65 years of age, but the distribution became balanced in 1983–1986, when the increment of female incidence was 47% in the group 25–44 years old and 232% (p < 0.05) in the group 45–64 years old. The annual incidence of first-ever transient ischemic attack was 0.43/1,000 in men and 0.48/1,000 in women in 1975–1978. The corresponding rates for 1983–1986 were 0.56 and 0.45/1,000, respectively. These changes were not significant. The cause of the increase in the incidence of stroke among women has not been established. (Stroke 1988;19:598–603)

The decline in mortality from cerebrovascular diseases (CVD) that has been reported is not a uniform phenomenon. On the contrary, according to national statistics, CVD mortality in certain countries showed an increasing trend from the end of the 1960s to the end of the 1970s. These CVD statistics include not only persons with acute stroke but also those with slowly deteriorating nonfocal cerebral disorders, but reflect the incidence of stroke nonetheless. Thus, in those countries with a declining CVD mortality (the United States, Japan, and Finland), stroke incidence has also decreased.

Little is known about the incidence of stroke in countries showing stable or rising mortality rates for CVD. In Sweden, the CVD mortality has been relatively low and stable. My study was undertaken to update the incidence figures for stroke and transient ischemic attacks (TIAs) in a Swedish community. My report deals with the incidence in the 1970s and the 1980s and the developmental trend.

Subjects and Methods

I established stroke registry to record all cases of cerebrovascular stroke and TIA for permanent residents of Söderhamn, Sweden, aged 16 years and older, according to the recommendations of the World Health Organization in 1975. The first survey was performed between May 1, 1975, and April 30, 1978, and the second between September 1, 1983, and August 31, 1986.

The study area included the town of Söderhamn and its rural surroundings. The municipality is situated at 61° N, 7° E (Figure 1) and has only one hospital.
I made the final diagnoses of stroke or TIA during both study periods. The frequencies of exclusion of suspected cases in the two periods were 11% and 13%, respectively.

Subgrouping of the stroke patients was based primarily on computed tomography (CT) (21%) and postmortem examination (6%), secondarily on cerebrospinal fluid (CSF) analyses (47%), and finally on clinical grounds (26%). The frequency of CT was 1% during the first period and 37% during the second. The frequencies of lumbar puncture were 60% and 59%, respectively. Lumbar puncture was performed on Day 3 after the onset, except if SAH was suspected, when it was performed as soon as possible. Postmortem examination was performed in 24% of the deceased during the first period and in 31% during the second.

Cerebral infarction, embolic or thrombotic, was diagnosed if CT or lumbar puncture revealed no signs of intracranial bleeding (and at autopsy when relevant). Intracerebral hemorrhage (ICH) was diagnosed if any of the above-mentioned examinations disclosed intracranial bleeding and if the patient displayed focal neurologic deficits. Neither subdural, epidural, nor traumatic ICHs were included in the study. SAH was diagnosed with the aid of CT (or autopsy when relevant) and by lumbar puncture when the CSF was macroscopically hemorrhagic while the patient lacked gross neurologic deficits. A diagnosis of unspecified stroke was given to those patients who underwent only clinical examination.

The incidence figures were age- and sex-adjusted by a direct method except when the age-specific incidence rates for the study periods were compared, when crude incidence figures were used. Student’s t test was used when testing for differences between two groups. Confidence intervals (CIs) were calculated by a standard method.16

Results

A total of 723 cases of stroke (361 men and 362 women) and 111 cases of TIA (56 men and 55 women) were registered during the two 36-month periods. The number of women enrolled was thus almost the same as the number of men, in both the stroke and the TIA groups (Table 1). The total number of first-ever stroke cases increased from 281 to 359 (28%) between the two study periods (Table 1). Concurrently the proportion of persons aged 70 years or older increased from 11.9% to 14.1% in Söderhamn.

In 1975–1978 there were more men with stroke but more women in 1983–1986. The number of women with first-ever stroke increased in all age classes, especially in the older ones (Figure 2). There was no corresponding trend in stroke for men. In the TIA group, a shift toward higher ages was seen (Figure 2).

There were 83 recurrent strokes (19%) and 14 recurrent TIs (21%) in 1983–1986, when both first-ever and recurrent events were registered. Recurrent stroke did not occur before the age of 45. Only two TIA patients were younger than 55 years, and both had experienced TIA for the first time in their lives.

The mean age of men with first-ever stroke was 71.1 years in 1975–1978 and 73.1 years in 1983–1986. The mean age of women also rose, from 75.4 years in the first period to 76.8 years in the second. The corresponding figures for men with first-ever TIA were 67.7 years in 1975–1978 and 71.2 years in 1983–1986. The mean age of women in the TIA group rose from 66.7 years in the first period to 75.0 years in the second.

Incidence of Stroke

The average annual incidence rate (number per thousand per year adjusted to the 1983 population of Sweden) for the two periods for first-ever stroke was 3.23 (95% CI 2.93–3.43). The total male incidence of first-ever stroke was 3.20 (95% CI 2.90–3.40), and the total female incidence was almost the same, 3.26 (95% CI 2.96–3.46).

Between periods the total incidence rose from 2.90 to 3.53, a significant increment ($t = -4.064$, $p < 0.02$) after adjusting for age differences. The total female

<table>
<thead>
<tr>
<th>TABLE 1. Stroke and TIA Cases in Söderhamn, Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975–1978 (First-ever)</td>
</tr>
<tr>
<td>1983–1986 (First-ever)</td>
</tr>
<tr>
<td>1983–1986 (Recurrent)</td>
</tr>
<tr>
<td>1983–1986 (Total)</td>
</tr>
<tr>
<td>Sum</td>
</tr>
<tr>
<td>1983–1986 (Sum)</td>
</tr>
<tr>
<td>Stroke</td>
</tr>
<tr>
<td>154</td>
</tr>
<tr>
<td>TIA</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

TIA, transient ischemic attack; recurrent, first attack before 1983.
incidence of first-ever stroke for all age classes increased by 38% ($t = -2.492, p < 0.05$) after adjusting for age differences, while the total male incidence did not change significantly (Table 2).

The most pronounced increment was found for women aged 45–64 years, where it reached 232% ($t = 2.600, p < 0.05$). In the first study period, the male incidence rate was about four times the female rate up to the age of 64 years. This excess was almost completely balanced by the increase in female incidence rate in the second period.

The total crude incidence rates (number per thousand per year) of different types of stroke were 0.12 for SAH, 0.46 for ICH, 2.08 for cerebral infarction, and 0.73 for unspecified stroke. The age-specific incidence rates are shown in Table 3. Cerebral infarction predominated above the age of 45, while intracranial hemorrhages (SAH and ICH) were the only diagnoses below that age. Cases of SAH were found in all age classes except the highest (85+ years). No type-specific changes of significance were noted during the 6-year study period. ICH and cerebral infarction, in particular, seemed to increase in women aged 25–64 years (Table 4).


Incidence of Transient Ischemic Attacks

The average annual incidence rate (number per thousand per year adjusted to the 1983 population of Sweden) of first-ever TIA for the two periods was 0.51 (95% CI 0.30–0.72). The total incidence for men was 0.56 (95% CI 0.45–0.77) and for women 0.45 (95% CI 0.24–0.66). The incidence of first-ever TIA was 0.43 in men and 0.48 in women in 1975–1978. The corresponding rates for 1983–1986 were 0.56 and 0.45, respectively. Neither the total nor age-specific incidences changed significantly (Table 2).

Discussion

The increase in the female incidence of stroke was an unexpected finding in this study. Less surprising was the rapid increment in the number of stroke victims in Söderhamn with increasing age.

In some previous longitudinal studies a decreasing incidence of both ICH and cerebral infarction has been found.\(^6\)\(^,\)\(^12\)\(^,\)\(^13\) These findings emerge from some populations in countries in which mortality rates among people of productive ages are higher (though decreasing) than in Sweden.\(^6\) Moreover, these optimistic reports of a declining stroke incidence were based on observations extending from the 1940s to the end of the 1970s. In Sweden a decline in the incidence of cerebral hemorrhage, according to hospital statistics, was also reported in the early 1960s.\(^15\) A recently conducted retrospective analysis of hospital and mortality statistics in Stockholm, Sweden, revealed decreasing annual death rates from CVD for men and women during the period 1974–1981.\(^16\) In contrast, the male incidence increased continuously while the female rate was stable. These results are not directly comparable with

### Table 2. Crude Age- and Sex-Specific Incidence Rates for First-ever Stroke and TIA, Söderhamn, Sweden

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Stroke</th>
<th>TIA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Rate</td>
</tr>
<tr>
<td>25–44</td>
<td>Male</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>2</td>
</tr>
<tr>
<td>45–64</td>
<td>Male</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>7</td>
</tr>
<tr>
<td>65–84</td>
<td>Male</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td>Male</td>
<td>154</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>127</td>
</tr>
</tbody>
</table>

Rate, number/1,000/yr. Total incidence rate for 1983–1986 adjusted to Söderhamn population of 1974 as population aged. TIA, transient ischemic attack. *$p<0.05$. 

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In some previous longitudinal studies a decreasing incidence of both ICH and cerebral infarction has been found.\(^6\)\(^,\)\(^12\)\(^,\)\(^13\) These findings emerge from some populations in countries in which mortality rates among people of productive ages are higher (though decreasing) than in Sweden.\(^6\) Moreover, these optimistic reports of a declining stroke incidence were based on observations extending from the 1940s to the end of the 1970s. In Sweden a decline in the incidence of cerebral hemorrhage, according to hospital statistics, was also reported in the early 1960s.\(^15\) A recently conducted retrospective analysis of hospital and mortality statistics in Stockholm, Sweden, revealed decreasing annual death rates from CVD for men and women during the period 1974–1981.\(^16\) In contrast, the male incidence increased continuously while the female rate was stable. These results are not directly comparable with
the present ones, however, as chronic and unspecific disorders were included.

The average annual incidence rate of stroke in Söderhamn, 3.23, may seem higher than the averages of 2.23 in Europe and 3.10 in the United States that have been reported earlier. The figures for total incidence are extremely dependent, however, on the age distribution of the study populations. The Söderhamn population contains a disproportionate number of elderly people. The proportion of those aged 65 years and older was 20% in this population, compared with 9-12% in other studies.

The comparison between prospective epidemiologic studies, using the World Health Organization's definition of stroke, is further complicated by the fact that some reports present age-specific incidence figures for patients with first-ever stroke, while others give age-specific data only for patients with first-event stroke. The proportion of first-ever stroke varies from 63% to 87% in these reports. Therefore, the age-specific incidence rates for first-ever stroke are most fitted for comparisons. The age-specific incidence of stroke in Söderhamn was low before the age of 55 years (Table 5).

My finding of a low stroke incidence in young and middle-aged people in Sweden is in accordance with the results of a large study of stroke in people aged 65 years and younger in Göteborg, Sweden. Thus, the impression of a fairly low risk of stroke at productive ages in Sweden that emerges from the national statistics is strengthened by these morbidity data.

Comparing the incidence of different types of stroke is even more hazardous, both between the two periods as in my study and between different investigations, as the use of CT has been shifting. In Rochester, Minnesota, an increase in the incidence of ICH was noted when CT began to be used more frequently, at the end of the 1970s.

The rapid rise in the incidence of stroke among middle-aged women is not easily explained. Regression to the mean may be one reason, and bias another. Continued follow-up may be necessary to exclude the former possibility. Regarding the latter, it seems improbable that bias due to missing data in 1975-1978 is the explanation. The routines for tracing and classification were exactly the same during the two study periods. The identical 1-month death rates indicate successful case finding. It may also be assumed that no or almost no woman of this age class will stay at home after having had a stroke without contacting any doctor or nursing institution. Instead, real causes must be discussed.

The risk factors for stroke are numerous. The risk factor profile of a certain population depends at least in part on behavioral habits. In North Karelia in Finland, a preventive project has been run with the aim of changing dietary and smoking habits and of treating hypertension. Decreasing cardiovascular mortality in this province of Finland has been attributed to the preventive program. The only exception to the decline seems to have been stroke mortality during the end of the 1970s and the start of the 1980s. In North Karelia, an increase in the incidence of stroke among women was found during the same period. This finding is consistent with my results. No clear reason has been identified, however.

Heavy alcohol drinking has been a much more common cause of stroke in men than in women. The sex ratio regarding the incidence of stroke in younger and middle-aged women may be due to changing drinking habits, but also to an increase of more sex-specific risk factors. In one large series of young

**Table 3.** Crude Incidence Rates for Types of First-ever Stroke in 1975-1978 and 1983-1986, Söderhamn, Sweden

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Subarachnoid hemorrhage</th>
<th>Intracerebral hemorrhage</th>
<th>Cerebral infarction</th>
<th>Unspecified stroke</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-44</td>
<td>0.08</td>
<td>0.04</td>
<td>0.13</td>
<td>0.00</td>
<td>0.25</td>
</tr>
<tr>
<td>45-64</td>
<td>0.22</td>
<td>0.38</td>
<td>0.90</td>
<td>0.04</td>
<td>1.54</td>
</tr>
<tr>
<td>65-84</td>
<td>0.36</td>
<td>2.18</td>
<td>7.34</td>
<td>2.61</td>
<td>12.49</td>
</tr>
<tr>
<td>85+</td>
<td>0.00</td>
<td>5.36</td>
<td>12.00</td>
<td>13.85</td>
<td>30.47</td>
</tr>
<tr>
<td>Total</td>
<td>0.13</td>
<td>0.53</td>
<td>1.63</td>
<td>0.61</td>
<td>2.90</td>
</tr>
</tbody>
</table>

No person 16-24 years old was registered. No adjustment for age and sex differences. Rate, number/1,000/yr.

**Table 4.** Crude Incidence Rates for Types of First-ever Stroke for Class Aged 25-64 Years in 1975-1978 and 1983-1986, Söderhamn, Sweden

<table>
<thead>
<tr>
<th>Sex</th>
<th>Subarachnoid hemorrhage</th>
<th>Intracerebral hemorrhage</th>
<th>Cerebral infarction</th>
<th>Unspecified stroke</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>0.25</td>
<td>0.34</td>
<td>0.76</td>
<td>0.04</td>
<td>0.00</td>
</tr>
<tr>
<td>Female</td>
<td>0.04</td>
<td>0.09</td>
<td>0.26</td>
<td>0.00</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Rate, number/1,000/yr.
women there seemed to be a correlation between the expanding use of oral contraceptives and thromboembolic stroke.34

My figures may be compared with those of another recent study of TIA in Japanese men in Honolulu.39 The yearly incidence rate of probable TIA in that population was 0.58 in the class aged 45–64 years. This is very close to the male incidence in Söderhamn, which was 0.60 in the first period and 0.76 in the second for the same age class. However, these are minimum incidences based on a strict definition of TIA, which permits inclusion of only patients who have had focal symptoms. In the Hawaiian study the incidence almost doubled when possible cases were added. No possible cases were registered in Söderhamn.

The incidence of TIA has not changed in the Söderhamn population during the last 8 years. Still, the incidence of stroke seems to be about six times that of TIA. Most other TIA studies have not been performed in parallel with stroke surveys, with the exception of the Rochester survey.4-14 In that study the ratio of stroke to TIA was 5:1.

In conclusion, the incidence of stroke increased from the 1970s to the 1980s. This increase was attributable to an increase in female incidence, to equivalent that of males. Future studies may reveal the underlying cause of the unfavorable trend of stroke incidence not only in elderly but also in younger women. The incidence of TIA seems to be stable and six times lower than the incidence of stroke.

Acknowledgment

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References


**Key Words** cerebrovascular disorders • epidemiology • Sweden
Increasing incidence of stroke among Swedish women.

A Terênt

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