Stroke Incidence Rates Were Unchanged, While Fatality Rates Declined, During 1971–1987 in Göteborg, Sweden

Per Harmsen, MD; Alecka Tsipogianni, BSc; and Lars Wilhelmsen, MD, PhD

Background and Purpose: Stroke risk factors have been shown to change with time in several places; simultaneously, stroke incidence rates have increased in some and decreased in other places. In Göteborg, Sweden, cardiovascular epidemiological research has included stroke registration since 1971. From these data on stroke, incidence and fatality rates from a 17-year period are given.

Methods: During the period 1971–1987 all cases of stroke occurring in people aged 15–65 years in the city of Göteborg were uniformly recorded, with an estimated case detection rate of 90% or more.

Results: Age-adjusted incidence rates of first-ever stroke by sex did not change during the period. Age-specific rates and rates for individual types of stroke (subarachnoid hemorrhage, intracerebral hemorrhage, and cerebral infarction–unspecified stroke combined) were also largely unchanged. A slight increase in the incidence rate of intracerebral hemorrhage may be due to better detection after computed tomography came into use in 1976. Stroke fatality rates declined through the whole period in both sexes and all age groups, markedly so for intracerebral hemorrhage and subarachnoid hemorrhage.

Conclusions: This conforms with vital statistics for Göteborg and for Sweden of declining stroke mortality during the period. The decline in stroke fatality rates may be related to decreases in smoking habits and blood pressure together with an increase in the percentage of people on antihypertensive treatment among middle-aged men, and to some extent even middle-aged women, reported from the same population. Why stroke incidence rates did not decline concomitantly is unexplained. (Stroke 1992;23:1410–1415)

Key Words • cerebrovascular disorders • epidemiology • incidence • Sweden

Stroke mortality has been declining in a number of countries during the last decades, even before antihypertensive treatment became common,1–10 while in some places an increase in mortality has been noted.11,12 Studies of temporal trends in stroke incidence are few and difficult to compare.13 Increasing or unchanged incidences have been reported from Sweden,14,15 decreasing incidences from Finland16–18 and Japan,19–22 and, notably, after a long period of decreasing incidence in Rochester, Minn., an increase in stroke incidence has followed during the 1980s.23 We report the temporal trends of stroke incidence and fatality rates based on the stroke register in Göteborg, Sweden, from its start in 1971 through 1987.

Subjects and Methods

Since 1971 stroke cases in residents of the city of Göteborg aged 15–65 years have continuously been registered, as described previously.24 The organization of the registration procedures has been unchanged throughout. From each patient hospitalized with suspected stroke a register nurse collects information at set intervals and records this on special record forms. Clinical information as well as details of examinations performed obtained immediately after stroke onset and at 3 weeks allow for allocating stroke type diagnosis. Fifteen percent of cases were detected through death certificates. For these cases hospital case notes were searched for clinical details and findings at autopsy.

The stroke register includes all cases of subarachnoid hemorrhage, intracerebral hemorrhage, cerebral infarction, and unspecified stroke. Diagnostic criteria were specified; for stroke these were according to the World Health Organization (WHO)25: rapidly developed signs of focal (or global) disturbance of cerebral function, leading to death or lasting longer than 24 hours, with no apparent cause other than vascular. The term “global” applies mainly to cases of subarachnoid hemorrhage without focal neurological signs. For subarachnoid hemorrhage the criteria were history of sudden onset of headache, with or without focal neurological deficit, and blood-stained cerebrospinal fluid (xanthochromia at spectrophotometry) and/or computed tomogram (CT...
showing subarachnoid hemorrhage and/or angiogram showing aneurysm. For intracerebral hemorrhage the criteria were history of rapidly developed focal neurological deficit and CT scan showing intracerebral hematoma and/or blood-stained lumbar cerebrospinal fluid (xanthochromia at spectrophotometry) and/or angiogram consistent with intracerebral hemorrhage. For thromboembolic cerebral infarction the criteria were history and clinical course not characteristic of either subarachnoid or intracerebral hemorrhage, with focal neurological deficit and CT scan normal or showing low-attenuating area(s) or lumbar cerebrospinal fluid without xanthochromia. For unspecified acute cerebrovascular disease the criteria were symptoms and signs consistent with stroke, but examinations (in particular, CT scan or lumbar puncture) to allow diagnosis of type as above were not performed. Echoencephalography and/or electroencephalography were not considered sufficient for a diagnosis of stroke type.

Death certificates have continuously been collected for the registered persons, and the time of and diagnosis at death have been recorded. Validation of the detection rate of stroke in the population by the register for the years 1971–1976 was estimated to be 90% or more; for the years 1973–1980 within-hospital searches for detection of additional cases yielded between 0% and 5% per year, with the exception of 12% for one year. At a recent random population screening examination for cardiovascular risk factors in Göteborg during 1985–1986 (the MONICA study of WHO) 1,421 persons aged 25–64 years participated (69% of men, 73% of women). A question about previous stroke was answered positively by 14 persons. Of these persons, six were identified in the stroke register. The remaining eight were found not to have had stroke when their case histories were examined and register criteria applied.

The total population of Göteborg decreased slightly from 1971 to 1987, from 448,792 to 431,521; the study population 15–65 years of age decreased from 309,390 to 289,402. During the same period the most marked change was an increase in people more than 65 years of age, from 12.4% to 17.7%.

As outlined previously, one hospital dominated medical somatic care in the city until 1977; since then two hospitals account for acute somatic care. Through the whole period it was customary that all cases of stroke were taken to a hospital emergency department. The national health insurance system covers all inhabitants, hospital care is free of charge, and outpatient care is heavily subsidized.

Incidence, fatality, and mortality rates were calculated for the years 1971–1987. All rates were age-adjusted to the 1971 Göteborg population. Three-year moving averages were used to smooth out random variations. Any time trend was assessed by using the $\chi^2$ test for trends.

**Results**

During the period 1971–1987 a total of 3,044 cases of first-ever stroke were identified in the population 15–65 years of age; 1,925 were men and 1,119 were women. Incidence trends of first stroke for men and women are shown in Table 1 for various calendar periods of 3–5 years during 1971–1987; rates for each sex are age-adjusted to the 1971 Göteborg population. No evident changes in incidence appear; a slight decrease in women during the 1970s seems to have shifted toward a slight increase since 1980, and a slight increase in incidence for men seems to have been accentuated since 1975. Age-specific incidence rates (Figure 1) show similar trends in each age group. A shift toward an increase in incidence in women appears to have started earlier (1975) in the youngest age group and spread to the older age groups later (1980 and 1982). Trends for individual stroke types
are given in 3-5-year periods to allow adequate numbers (Figure 2). Numbers are combined for cerebral infarction and unspecified stroke. After 1976 CT of the brain gradually came into use, and it was performed in 90% of stroke cases in these age groups from 1983 onward. Concomitantly, the relative frequency of unspecified stroke decreased and that of cerebral infarction increased (Table 2), and the relative frequency of intracerebral hemorrhage increased. If any increase in the incidence of a stroke type is noticeable, this would be for cerebral infarction and unspecified stroke.

Stroke fatality rates at 28 days are given for each age group and sex for 3-5-year periods in Figure 3. Marked decreases in fatality rates are noted for all age groups through the whole period 1971-1987, and the decrease is significant in each age group. Decreases in fatality rates are also noted for all stroke types, most markedly for intracerebral hemorrhage and subarachnoid hemorrhage in men but even in cerebral infarction and unspecified stroke in women (Figure 4).

Mortality figures for the period 1970-1987 were collected from the Central Bureau of Statistics in Sweden. Figure 5 shows age-specific stroke mortality for Sweden, including data for the 65-74-year-old age group. Declines through the whole period are noted except for men more than 55 years of age during 1970-1975. Stroke mortality for the city of Göteborg was similar (not shown).

### Table 2. Relative Frequencies of Stroke Types During 1971-1987 in Göteborg, Sweden

<table>
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<tr>
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<tbody>
<tr>
<td>Subarachnoid hemorrhage</td>
<td>20</td>
<td>20</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Intracerebral hemorrhage</td>
<td>20</td>
<td>13</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>Cerebral infarction</td>
<td>29</td>
<td>37</td>
<td>50</td>
<td>54</td>
</tr>
<tr>
<td>Unspecified stroke</td>
<td>31</td>
<td>60</td>
<td>68</td>
<td>69</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>99</td>
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Data are percent.
The age composition of persons with a first stroke was unchanged throughout the period. The proportion of persons in the group aged 55–65 years was 64% during 1971–1974 and 65% during 1985–1987.

Recurrence rates within 1 and 2 years after first stroke in Göteborg did not change during the period 1971–1987. Recurrence was around 3% within the first year and 4.5% within 2 years. A decrease during 1985–1987 to almost half was not significant because numbers for this period were smaller.

In the group aged 55–64 years around 66% of both sexes were reported to be hypertensive at stroke onset, and this proportion was unchanged throughout the period. However, the proportion of reported hypertensive persons on treatment increased during the period from 66% of both sexes in the period 1971–1974 to 80% of women and 90% of men in 1985–1987.

Discussion

Stroke incidence rates were unchanged in Göteborg during the period 1971–1987. This is in accordance with previous Swedish reports of unchanged or increased incidence rates\(^{14,15}\) but not with the reported decline in incidence rates in Finland\(^{16–18}\) and Japan\(^{19–22}\) where stroke is more common. Incidence rates in Rochester, Minn.,\(^{23}\) declined during the 1970s and came close to the low levels in Göteborg when compared for specific age groups (those aged 55–64 years). The increase in Rochester during the 1980s was not evident in Göteborg. Even stroke recurrence rates did not change in Göteborg, a finding similar to that in another Swedish study and in Rochester.\(^{27,28}\)

The age composition of cases of first stroke in our series did not change. There was no shift with time toward older cases within each age group. This might otherwise have tended to increase the incidence rates. During the period CT of the brain came into use, and a corresponding increase in the relative frequency of cerebral hemorrhage was seen, as reported by others,\(^{29,30}\) but we found no increase in total stroke incidence. This diagnostic method improves stroke type ascertainment and could even increase the total stroke detection rate because of its use combined with an increased awareness of stroke in routine clinical work, although stroke diagnosis still rests mainly on clinical judgment and has good accuracy,\(^{31}\) especially in younger persons like those of the present study.

During the same period antihypertensive treatment came into wide use, and a larger part of the population gradually received treatment. In the Göteborg population antihypertensive treatment in middle-aged men increased from 7% in 1970 to 20% in 1983 according to findings in the control group of the Multifactor Primary Prevention Trial.\(^{32}\) Correspondingly a decrease in population mean blood pressures was noted, and simultaneously overall positive changes in other cardiovascular risk factors were noted in both sexes in the same Göteborg population.\(^{33}\)

Therefore, decreases in both stroke incidence and mortality could have been expected in Göteborg. However, only mortality rates (and mortality) declined. Considering the consistent findings of decreasing incidence of stroke with antihypertensive treatment in clinical trials,\(^{34}\) the present findings are puzzling. The increase in treatment prevalence ought to have had some effect on stroke incidence. Possible reasons for this lack of a measurable effect are delineated below.

Incidence rates of stroke were already low in 1971 in Göteborg, as mentioned. Further, Sweden has long had among the lowest stroke mortality rates in the world.\(^{12}\)

Very high blood pressures were already treated in 1970. In 1964 a decline in hospital admissions for intracerebral hemorrhage in Göteborg was first noted.\(^{35}\) The decrease in the relative frequency of intracerebral hemorrhage during 1971–1979 (Table 2) might be a further effect of antihypertensive treatment. Consequently, a near-maximal effect of antihypertensive treatment on stroke incidence might already have been achieved in the early 1970s. This is compatible with the report from Rochester, Minn., of a decrease in primary intracerebral hemorrhage coinciding with the introduction of antihypertensive treatment.\(^{36}\)

Antihypertensive treatment at relatively low blood pressure levels might be less effective than treatment at the higher levels pertaining in most antihypertensive treatment trials. In the aforementioned controlled trial\(^{32}\) there were no differences in stroke and coronary heart disease incidence and mortality rates between the intervention group (27% treated for hypertension) and the control group (20% treated).

Antihypertensive treatment trials have revealed effects on stroke incidence within a few years.\(^{34}\) In the
present study blood pressure treatment had been in active use for a longer period, so a too-short follow-up does not explain the lack of effect on stroke incidence. Other risk factors for stroke may have to be considered in explaining the consistency of the stroke incidence rates. Smoking is a risk factor for stroke.37 However, smoking rates declined during the study period.33 We do not know the time trend of another stroke risk factor, severe psychological stress,37 nor that of yet another risk factor for stroke, fibrinogen level,38 which in turn is influenced by several environmental factors.39 Case fatality rates did, however, decrease markedly, similar to reports of others37,40–42 and corresponding to the decreasing stroke mortality.

In conclusion, an increased prevalence of antihypertensive treatment during the period 1971-1987 did not affect stroke incidence rates in Goteborg, Sweden. Whether the decline in fatality rates and mortality might be due to the increasing use of such treatment is unknown. No indications were found of management of acute stroke having changed during the period, nor have hospital admission policies changed.

Acknowledgments

References


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