Incidence, Mortality, and Case-Fatality Rate of Stroke in Northern Israel

Leon Epstein, Shmuel Rishpon, Ephraim Bental, Gerald Brook, Ada Tamir, Bella Gross, Migel Szwarc, Judith Manelis, and Thomas Pillar

We studied the incidence and mortality of stroke in northern Israel to determine possible reasons for the differences previously found in mortality from this condition between the sex and ethnic groups in Israel as a whole. We identified 1,149 cases of stroke during 1984. While the age-standardized incidence was higher in men, the case-fatality rate was twice as high in women. After controlling for ethnic origin, we found that incidence was higher only in men of Western origin, while the female rates were higher in women of Asian and North African extraction. The case-fatality rate was substantially higher in women in all ethnic groups. These differences, especially in relation to the case-fatality rate, have important implications for health services in relation to both possible preventive action and to management of the acute disease phase. (Stroke 1989;20:725-729)

Previous studies have shown that the age-standardized mortality from stroke in Israel among Jews is higher among women than among men. This finding holds true for each of the three major ethnic groups (those born in Western countries, in Asia, or in North Africa1-2) (Figure 1) and is in contrast to published data from most other countries, in which mortality is higher among men. In addition, there are clear differences in mortality among ethnic groups in that both men and women of North African origin have the highest and immigrants from Europe and other Western countries the lowest rates, while the rates of those of Asian extraction fall between the two extremes.

When considering the reasons for these differences in mortality, two possibilities need to be taken into account. One is the difference in incidence rate among the three ethnic groups; another is the difference in case-fatality rates among the ethnic groups, which results in a mortality differential even when the incidence is similar. Furthermore, a combination of the two possibilities might well be operating. In view of the importance of the different mortality rates, both epidemiologically and for the provision of health services, we examined the possible underlying reasons as part of our study performed in the northern part of Israel.

Subjects and Methods

The study population included all the cases of acute, nontraumatic stroke that occurred among Jews in the Haifa and Acre subdistricts (the region) in the northern part of Israel (population approximately 600,000) from January 1, 1984, until December 31, 1984. (The Arab population of the region was excluded from the study because of the incomplete nature of data on stroke morbidity in this ethnic group.) The ethnic origin of each person identified was defined by the country of birth of his or her father; Western origin included all European countries and the US. The diagnostic categories included were acute stroke, cerebral infarction, subarachnoid hemorrhage, intracerebral hemorrhage, stroke-in-regression, and stroke-in-evolution (Codes 430-438, Eighth Revision, International Classification of Diseases3); we excluded transient ischemic attacks. Mortality was defined as a death occurring within 3 months following a stroke. Therefore, follow-up of the death certificates continued until March 31, 1985. Three types of stroke were defined: definite stroke, diagnosis made by a neurologist or a pathologist; probable stroke, diagnosis made by a physician not a neurologist in a general or specific (geriatric) hospital; and possible stroke,
other diagnosis of stroke recorded by a physician not a neurologist.

To ensure as complete coverage as possible, we used a number of different sources of data, including the departments of neurology and internal medicine of the four general hospitals in the region, the department of rehabilitation medicine in one of the above hospitals, and the single geriatric rehabilitation hospital in the region. A specially trained registered nurse visited each of these twice a week to review the charts of patients in the hospital and those discharged since her previous visit and to identify any patients with one of the relevant diagnoses.

Death certificates of persons residing in the subdistricts were reviewed by the nurses weekly. These certificates are dispatched to the District Health Office in the region from the area in which the person died. Therefore, the records are complete, irrespective of where the individual died. Information obtained from a number of sources was combined on a single form for each individual.

We carried out a number of additional checks to investigate the possibility that not all persons surviving a stroke were hospitalized. First, we contacted the responsible professionals in old-age homes and institutions for the chronically ill in the region every 2 months and requested information as to the patients who had suffered a stroke and were not hospitalized. When such a case was reported, a nurse visited the institution to obtain as much data as possible on the individual and diagnosis. Second, a 15% random sample of the general practitioners in the region was selected every 2 months and the procedure described above was followed. However, after three such contacts no new cases undetected by the other methods were found, and the procedure was discontinued. Finally, a sample check was made of the emergency room of one of the university hospitals in the region. From all these efforts, it was concluded that the data on diagnosed cases of stroke in the study population were as complete as possible.

Incidence and mortality were calculated using data from the 1983 National Census as the denominator. A 20% sample of the data was available on magnetic tape. To compare incidence and mortality among the different sex and ethnic groups, they were standardized by the direct method using the world population of 1970 as the standard population.4 Statistical significance was calculated using the Z test for comparing two standardized rates on two populations, the $\chi^2$ test for comparing more than two populations, and the $t$ test to compare means between two populations. $p<0.05$ was considered to indicate statistical significance.

**Results**

We identified 1,149 cases of stroke during 1984. The ethnic origin of the cases was Western in 902 (78.5%), North African in 125 (10.9%), Asian in 121 (10.5%), and Israeli in one (0.1%; this single case was excluded from further analyses). Among the 590 men, 534 (90.5%) had suffered either a definite or a probable stroke, while 485 (86.5%) of the 559 women were so typed.

Because only one autopsy was performed in the total series, the only measure available to test the validity of our data is reflected by the proportion of definite or probable strokes (1034, 90%). There were no significant differences in the proportion of such diagnoses by age, sex, or ethnic origin. As part of the diagnostic process, certain special diagnostic investigations were performed (electroencephalography in 820 [71.4%], computed tomography in 244 [21.2%], isotope scans in 217 [18.9%], cerebral angiography in 43 [3.7%], and lumbar puncture in 256 [22.3%]). The data on the performance of these tests were lacking in 172 (15%) of the cases, most of whom had died outside hospital. There was no difference in the proportion of patients undergoing these special investigations by age, sex, or ethnic origin.

In both sexes, incidence rose with age (Table 1) and was higher in men in all except the oldest (80+ years) age group. The total crude incidence rate for those older than 44 years was 20% higher in men than in women. There were only 15 cases in persons younger than age 45 or whose age was unknown, and these 15 were excluded from subsequent analyses.

Four hundred forty-eight persons died within 3 months after the acute event, 276 (61.6%) of them in a hospital, 111 (24.8%) in an institution, 41 (9.1%) at home, and 20 (4.5%) in an unknown place. There were no proportional differences in the place of death.
TABLE 1. Age- and Sex-Specific Incidence of Stroke in Population of Jews in Northern Israel

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Men (n=584)</th>
<th>Women (n=550)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Rate</td>
</tr>
<tr>
<td>45-54</td>
<td>23</td>
<td>10.8</td>
</tr>
<tr>
<td>55-59</td>
<td>32</td>
<td>28.0</td>
</tr>
<tr>
<td>60-64</td>
<td>64</td>
<td>56.1</td>
</tr>
<tr>
<td>65-69</td>
<td>72</td>
<td>84.3</td>
</tr>
<tr>
<td>70-74</td>
<td>151</td>
<td>190.4</td>
</tr>
<tr>
<td>75-79</td>
<td>180</td>
<td>236.4</td>
</tr>
<tr>
<td>80+</td>
<td>112</td>
<td>252.3</td>
</tr>
<tr>
<td>Overall</td>
<td>584</td>
<td>62.7</td>
</tr>
</tbody>
</table>

Data exclude 15 persons (six men and nine women) younger than 45 years or in whom age was unknown. Rate per 10,000 population.

death by sex or ethnic origin. However, those who died were, on the average, 5 years older than those who survived (75.5 compared with 70.5 years; t=8.51, p<0.001).

The case-fatality rate rose with age in both sexes (Table 2) and was higher in women than in men at all ages. This difference was greatest in those younger than 65 years and became smaller with increasing age. However, the age-standardized incidence of stroke was higher in men than in women (60.68 compared with 50.36 per 10,000; Z=3.00, p<0.003; Table 3). As in previous studies in Israel, the age-standardized mortality from stroke was slightly, but not significantly, higher in women than in men despite the substantially higher incidence of stroke in men. This finding may be explained by the fact that the age-standardized case-fatality rate is almost twice as high in women as in men (37.86% compared with 20.21%; Z=2.31, p<0.0104).

Table 4 shows these findings in relation to ethnic origin. The age-standardized incidence of stroke was higher in both men and women of North African and Asian origin than in those from Western countries. While the differences were not significant among men, the rate among women of Western origin was significantly lower than that of North African women (Z=2.37, p<0.02) and of Asian-born women (Z=3.49, p<0.0002). The incidence was higher in men only in the Western group, but because of the relatively large numbers in this group, the overall incidence in men was significantly greater than that in women. There was little difference in mortality rates except in Asian-born women, whose rate was substantially higher than that of Asian men and significantly higher than that of Western women (Z=2.26, p<0.025). Case-fatality rates were consistently higher in women than in men across ethnic groups. This finding was especially marked in the Western and Asian groups. Whereas the relatively few cases in each sex/ethnic group resulted in these differences not reaching the level of significance, the consistency of these findings in all groups certainly contributed to the highly significant difference in overall case-fatality rate between the sexes.

A detailed clinical diagnosis of the category of stroke was available in approximately 70% of both men and women. Within these subgroups, 82.7% of the women and 81.8% of the men were diagnosed as having a cerebral infarction, whereas the proportions having cerebral (subarachnoid or intracerebral) hemorrhage were 7.4% and 6.2%, respectively. Mortality in the two sexes was similar in each diagnostic category, and there were no differences in the proportion of cases when comparing the three ethnic groups by sex. The proportion of those without a detailed diagnosis was slightly lower in those of Asian origin in both sexes. Because of the small numbers, detailed comparisons of diagnostic categories in each sex/ethnic group was difficult, but no major differences were readily apparent. In both men and women, approximately 85% of the known diagnoses among those of North African and Western origin were cerebral infarction, while 5–9% were cerebral hemorrhage. In both men and women of Asian origin, the proportion having cerebral infarction was slightly lower (75%) but the proportion having cerebral hemorrhage was higher (10%). No difference was statistically significant.

**Discussion**

Adler3 reported in 1969 on the epidemiologic and clinical aspects of stroke in Israel during the years 1957–1961. Based only on hospitalizations, he found that the incidence of stroke was higher in men and its mortality lower in women until the age of 60 years, after which it was higher in women. In that study, the lack of data regarding either deaths or patients surviving a stroke outside a hospital made it difficult to assess the validity of the relations among incidence, mortality, and case-fatality rates.
TABLE 4. Age-Standardized Incidence and Mortality (per 10,000 Population) and Case-Fatality Rates (%) From Stroke by Sex and Ethnic Origin in Population of Jews in Northern Israel

<table>
<thead>
<tr>
<th></th>
<th>Western</th>
<th>North Africa</th>
<th>Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Rate</td>
<td>n</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidence</td>
<td>461</td>
<td>59.8</td>
<td>56</td>
</tr>
<tr>
<td>Mortality</td>
<td>178</td>
<td>21.7</td>
<td>23</td>
</tr>
<tr>
<td>Case-fatality</td>
<td>178</td>
<td>22.3</td>
<td>23</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidence</td>
<td>405</td>
<td>43.5</td>
<td>62</td>
</tr>
<tr>
<td>Mortality</td>
<td>189</td>
<td>19.9</td>
<td>28</td>
</tr>
<tr>
<td>Case-fatality</td>
<td>189</td>
<td>41.5</td>
<td>28</td>
</tr>
</tbody>
</table>

*†‡p<0.02, 0.0002, 0.025, respectively, different from Western women.

It is clear that with so few autopsies in Israel (and only one in our series) questions regarding the validity of diagnoses may arise. However, the proportions of cases hospitalized (88%), those with a stroke diagnosed by a neurologist (90%), and those undergoing the special diagnostic investigations was similar to or greater than that reported from other community-based studies of stroke.6,7 Thus, the validity of our diagnoses should be similar and should not differ by sex or ethnic group since the proportions of our cases did not vary with these characteristics. Further, when comparing the proportion of those in whom a detailed diagnosis of the category of stroke was made, there were no significant differences by sex or ethnic group. As expected, mortality from cerebral hemorrhage was substantially higher than that from cerebral infarction but, once again, not different when comparing ethnic groups.

The only other incidence data from Israel are not comparable with ours since they do not relate to the same population group.8 The marked rise in incidence with age compares with findings from similar community studies in other countries. In addition, it is of interest to note that the high incidence of stroke for men up to the oldest age group studied has been reported in other studies, as has the relatively higher incidence in women in the oldest age groups.

The female preponderance in case-fatality rates has also been reported in studies from the Netherlands6 and New Zealand.7 However, only the Dutch work reported a greater difference at younger ages. It should be stressed that comparisons are difficult because of the different intervals used to calculate case-fatality rates.

Our previous finding1,2 of higher stroke mortality in Israel from 1969 to 1982 among women and among those of North African origin of either sex was surprising since higher mortality from stroke among women has only rarely been reported.9,10 In our present study, the increase seems to be related to both the slightly higher incidence in women of Asian origin and to the higher case-fatality rate in women of all ethnic groups. It should be clear that the higher rates in women are not explained solely by their greater numbers in the older age groups since the rates comparing ethnic groups were all standardized by age.

These differences could be attributed to various factors that modify and influence the pathogenesis of the stroke and its clinical course, such as the distribution of risk factors for the disease (e.g., hypertension or smoking), a different pathophysiology of the disease in different ethnic groups, differences in the identification and possible treatment of persons at risk, a delay in seeking medical care after the start of an acute episode, a delay or error in diagnosis that differs among ethnic groups, and varying responses to supportive therapy.

It must be stated that there is relatively little data that can adequately answer these questions. In 1961, Dreyfuss et al11 observed that immigrants from Morocco in North Africa had higher blood pressures than expected when they arrived in Israel. While later studies have not revealed consistent differences in this connection, Modan12 has reported a higher prevalence of hypertension in this ethnic group from a study of a representative sample of male and female Israeli Jews aged 30–59 years. The possibility arises that differences in the distribution of hypertension, a major risk factor for stroke, could partially explain our findings.

A national program related to the early diagnosis of hypertension and its subsequent management is conducted by Kupat Holim, the Health Insurance Institute of the General Federation of Labor, with which >85% of the population are insured. There are, however, no data available on differential case finding or response to treatment in the groups identified in that program.

A recent report13 indicated that women with acute myocardial infarction tended to begin treatment later than men. A question arises as to whether this is true with stroke as well and whether it provides a possible explanation for the sex and ethnic differences found. There is little doubt that illness behavior varies in the different groups of the heterogeneous ethnic society of Israel. Its specific
relevance to the natural history of stroke needs to be investigated.

Differences in the pathophysiology of stroke may certainly occur. Some years ago, differences in the development of atherosclerosis in the circle of Willis of men and women were reported. Bonita et al have indicated that cerebral hemorrhage is more frequent in females and produces a higher mortality. We found no differences in the proportion of cases with cerebral hemorrhage among the 70% in whom the category of stroke was determined.

Differences in incidence, mortality, and case-fatality rates from any disease have important implications for the planning of medical care for different population groups. Our findings underline the need to investigate further the processes underlying these differences and to adapt available services to the problems in relation to both the prevention and the management of all stages of the disease process.

References
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