Cardiovascular disease mortality has declined in many industrialized countries in recent decades although rates have increased in eastern European countries. While considerable attention has been paid to the declining coronary heart disease component of cardiovascular disease, less attention has been paid to the even more dramatic decline in cerebrovascular disease (stroke) mortality, which in many countries began well before the decline in coronary heart disease.

This paper focuses on international variations in the levels and trends of stroke mortality during 1970-1985 using routine mortality statistics. In the absence of secular data from stroke registers, these data provide the only reliable routine source of information for comparing trends among countries. Comparisons are made between the rates of decline of stroke and coronary heart disease mortality and between the sexes.

**Subjects and Methods**

Age-standardized mortality rates were provided by the World Health Organization data bank for cerebrovascular disease (International Classification of Disease, Eighth and Ninth Revisions codes 430-438) and coronary heart disease (International Classification of Diseases, Eighth Revision codes 410-413 and Ninth Revision codes 410-414) for the period 1970-1985 for the group aged 40-69 years by sex for the countries that have been used in an earlier description of cardiovascular disease mortality trends. Italy and Israel were excluded because of incomplete data, and Hong Kong and Singapore were included to extend representation from the western Pacific region. The selected countries are believed to provide accurate population estimates, complete death registration, and comparable cause of death coding. Rates have been age-standardized to Segi's European population.

A regression model was used to calculate the yearly percentage decline in both stroke mortality and coronary heart disease mortality since 1970 for each country by sex. This method regresses the logarithm of the rates and assesses percentage changes rather than absolute changes in rates.

**Results**

Stroke mortality rates in 1985 for 27 countries ranked from the highest to the lowest are shown by sex in Table I. The rate varies by more than sixfold in both men and women, with the highest rates in Bulgaria and the lowest in Switzerland. Rates for men are 23%-115% higher than those for women in all countries. The greatest disparities between the sexes are in countries that have low rates of stroke mortality (France, Austria, and Switzerland). In general, eastern European countries (Bulgaria, Hungary, Czechoslovakia, and Romania) have the highest rates and the Scandinavian countries (Denmark, Norway, and Sweden) together with the Netherlands, the United States, Canada, and Switzerland have the lowest rates. Countries that have high rates of stroke mortality in men generally have high rates in women as well.
The rank order of countries has changed little since the beginning of the period under investigation, with the exception of Japan, which had the highest stroke mortality rate for both men and women in 1970 (324 and 180 per 100,000 in men and women, respectively) but only the seventh and eleventh highest rate in 1985 (107 and 60 per 100,000 men and women, respectively). Japan also experienced the greatest rate of change during this period, a 7%/yr decline in stroke mortality rates for both men and women since 1970 (Table 2).

For both men and women, countries with the highest stroke mortality rates are also those with the least favorable secular trend. For men, the eastern European countries have all experienced either an increase (Hungary, Poland, and Bulgaria) or virtually no change (Yugoslavia, Romania, and Czechoslovakia) in stroke mortality rates since 1970 (Table 2). The only countries in which an increase was recorded for women were Hungary and Poland. In contrast, most other countries experienced a decrease in stroke mortality rates, with Japan, the United States, and Australia all experiencing improvements of >5%/yr for both men and women.

Figure 1 compares the yearly percentage changes in stroke mortality rates during 1970–1985 for men and women in each country. The line indicates equal percentage changes for men and women. Countries that fall below the line therefore experienced a lower rate of decline in men than in women, or conversely, a greater rate of increase in men than in women. Of the 21 countries experiencing a decline in stroke mortality in men, women experienced an even greater decline in 15 countries; only in Hong Kong, Singapore, Northern Ireland, the United States, and Japan did men improve at a faster rate than women. There was no difference in the yearly percentage declines for men and women in England and Wales.

Trends in coronary heart disease mortality rates for the same period (data not shown) show a similar pattern. In contrast to stroke mortality rates, however, there was a 10-fold difference in coronary heart disease mortality rates between the highest and lowest countries and the rates in men were three to four times those in women. Again, increases in coronary heart disease mortality rates were observed in eastern European countries, with all other countries except Singapore experiencing declines, although not to the extent as for stroke mortality. For example, the
decline in coronary heart disease mortality was >2%/yr in seven countries for men and in nine countries for women while the decline in stroke mortality was >2%/yr in 20 countries for both men and women.

Yearly percentage changes in stroke and coronary heart disease mortality rates in men are compared in Figure 2. The line indicates equal percentage changes for stroke and coronary heart disease mortality rates. Countries that fall below the line experienced a greater rate of decline in stroke than in coronary heart disease mortality, or conversely, a greater rate of increase in coronary heart disease than in stroke mortality. Thus, in all 20 countries experiencing a decline in both coronary heart disease and stroke mortality, the rate of decline was greater for stroke mortality. The pattern is similar for women (data not shown). Countries experiencing an increase in stroke mortality (Hungary, Poland, Bulgaria, Czechoslovakia, Yugoslavia, and Romania) also experienced an increase in coronary heart disease mortality. Only Singapore experienced a decrease in stroke mortality but an increase in coronary heart disease mortality.

Discussion
Changes in stroke mortality during the 15-year period 1970–1985 varied widely among 27 countries. The patterns within countries, between sexes, and between stroke and coronary heart disease are remarkably consistent. On the whole, the decline in stroke mortality is greater than that in coronary heart disease mortality. The eastern European countries

Figure 1. Scatterplot of yearly percentage changes in age-standardized stroke mortality rates in men and women during 1970–1985 for 27 countries. Line indicates equal percentage changes for men and women. NZ, New Zealand.

Figure 2. Scatterplot of yearly percentage changes in age-standardized stroke and coronary heart disease mortality rates in men during 1970–1985 for 27 countries. Line indicates equal percentage changes for stroke and coronary heart disease.
with the highest rates of stroke mortality are experiencing increases in both stroke mortality and coronary heart disease mortality. Conversely, for those countries experiencing declines in both coronary heart disease mortality and stroke mortality, the rate of decline is greater for stroke mortality. The six- to sevenfold difference in stroke mortality rates among countries gives some idea of the potential for primary prevention.

While data based on death certification is less than ideal, they provide the only source of comparable secular information among countries. In particular, these data provide no information on trends in the subcategories of stroke. It has been shown that disagreements in the underlying cause of death and the subcategory of stroke occur in up to 30% of death certificates. However, the parallel declines in coronary heart disease mortality and stroke mortality observed in most industrialized countries means that it is unlikely that there has been a systematic shift from one diagnostic category to another.

There is direct evidence that in the Japanese middle-aged population, the diagnosis for all stroke subcategories combined after 1972 is surprisingly accurate. The striking decline in stroke mortality in Japan is likely to be real.

The best information for unraveling the determinants of cardiovascular diseases will come from the World Health Organization’s project monitoring the trends and determinants of cardiovascular disease in 27 countries (the MONICA project). The major emphasis in this project is on coronary heart disease in middle-aged people. The difficulties of monitoring stroke include problems with criteria and case finding and differing management practices among countries.

Although direct evidence is lacking, it seems that the most likely explanation for the decline in stroke mortality is a decline in the average levels of risk factors in the population because most cerebrovascular events occur in people in the middle of risk factor distributions. It has been suggested on the basis of ecological analyses that the control of hypertension in individuals at high risk of stroke contributes only little to the overall decline in stroke mortality. Before devoting even more resources to a “high-risk” approach, we need a better understanding of the reasons for recent trends in the changes in stroke mortality, particularly in countries with increasing stroke mortality rates.

Acknowledgments

The authors gratefully acknowledge the assistance provided by Dr. K. Uemura of the Division of Epidemiological Surveillance, World Health Organization.

References


KEY WORDS • cerebrovascular disorders • coronary disease • mortality • risk factors
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Stroke. 1990;21:989-992
doi: 10.1161/01.STR.21.7.989

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