

# Trends in Mortality from Cerebrovascular Disease in Taiwan

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**SUMMARY** The rate of decline in the age-adjusted death rate from cerebrovascular disease (CVD) in Taiwan is not as rapid as in the United States and Japan, and the trends of CVD mortalities have not decreased steadily during the period 1972-1983. A low record of hypertension regulation (5.0%–12.7%), a high proportion (47.1%) of stroke due to cerebral hemorrhage (by clinical assessment), and a high fatality rate (40.1%) for cerebral hemorrhage may account partially for the slower declining rate. A geographic difference in the downward trend of CVD death rate was observed in this period. Districts remote from the major cities have had the lowest decline in CVD death rate.

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CEREBROVASCULAR DISEASE ranked as the most common cause of death in Taiwan in the 20 years from 1963 to 1982. It is now the second cause of death, behind cancer. It has been reported that stroke mortality has declined over the past 30 years both in the United States and Japan.<sup>1,2</sup> Stroke mortality in Taiwan appears to have been diminishing since 1967,<sup>3</sup> but the rate of decline is not as rapid as in the United States and Japan. This paper presents data on the secular trends in stroke mortality in Taiwan during a 10 year period between 1972 and 1983, and the seriousness of the problem of cerebrovascular disease in Taiwan is compared to the United States and Japan.

## Materials and Methods

The mortality rates from cerebrovascular disease by sex, age and population were obtained from the Vital Statistics of the Department of Health, R.O.C. between the 1972 and 1983 editions. For an understanding of the difference between rural and urban areas, the data of stroke mortality by sex and age in the period 1972 through 1973 and 1982 through 1983 in every city and county were obtained directly from the Department of Health, Taiwan Province. Also for comparison with the U.S. stroke mortality, the death rate from cerebrovascular disease by sex, age, and 4 major sex-color groups were obtained from the Vital Statistics of the United States, 1970 edition to 1979 edition, published by the Public Health Service, National Center for Health Statistics. In order to make comparisons, the standard population for computing the age-adjusted death rate by sex was based on the census of the United States in 1970.<sup>4</sup>

## Results

Table 1 presents the crude death rate and age-adjusted death rate from cerebrovascular disease in Taiwan from 1972 to 1983. The crude death rates increased slightly from 1973 to 1983; on the contrary, the age-

adjusted death rates declined in this period. The discrepancy between the crude death rates and age-adjusted death rates could be explained by the fact that the proportion of the aged in the population of Taiwan increased during this period.

As can be seen from figure 1 and figure 2, the trends of stroke mortality did not always exhibit a steady decline. Stroke mortality was much higher in Taiwan for both males and females than in the United States and higher for females in Taiwan than in Japan since 1977. As can be inferred from the secular trends, the mortality rate from cerebrovascular disease for males in Taiwan was predicted to be higher than in Japan after 1979, and the inference was confirmed by the report of the WHO in 1981.<sup>5</sup>

Table 2 shows that the stroke death rate declined 17.5% for males in Taiwan from 1972 to 1983, 18.5% for females. From 1972 to 1979, the stroke mortality rate declined 13.8% for males, 16.6% for females in Taiwan, but in Japan it declined 32.6% for males and 29.0% for females, in the United States it declined 34.5% for white males; 32.4% for white females; 32.2% for non-white males and 35.8% for non-white females.

As can be seen from the appendix 1, the mortality from cerebrovascular disease is much higher after 45, and in each age group generally it showed a slowly decreasing trend. Our age-specific death rates for 75 and over compared with Japan,<sup>2</sup> are lower in Taiwan, but before 75 the death rates from cerebrovascular disease are higher than Japan. This implies that people in Taiwan suffer from stroke mortality at earlier ages than in Japan.

In an attempt to characterize the relationship between trends of stroke mortality and geographic location in Taiwan, we compared the difference between the average stroke mortality of 1972-73 and the average mortality of 1982-83 in each region to see whether the stroke mortality rates were on the increase or decrease in this ten year period. Table 3 shows a much more apparent decline of stroke mortality in urban districts than in rural (male 27.4%:7.8%, female 23.3%:13.1%). Table 4 shows that the more remote a district is from the industrialized cities, for instance the southern and eastern part of Taiwan, the less its decline in stroke mortality.

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TABLE 1 Age-adjusted and Crude Mortality Rates from Cerebrovascular Disease by Sex, 1972-83, Taiwan

Year	Male		Female	
	Age-adjusted rate	Crude rate	Age-adjusted rate	Crude rate
1972	212.7	72.8	182.5	69.9
1973	214.6	76.6	199.0	69.8
1974	207.3	76.2	175.6	70.1
1975	199.0	76.3	164.6	67.1
1976	193.0	78.4	165.9	70.0
1977	195.2	80.9	165.6	70.9
1978	195.5	84.0	162.2	71.4
1979	183.4	82.5	152.1	68.8
1980	176.6	80.9	150.6	69.3
1981	178.7	83.2	159.2	74.5
1982	171.9	83.9	149.3	71.5
1983	175.5	88.0	148.7	72.5

Rate per 100,000 population. Mortality data were adjusted to the 1970 U.S. census population by direct method for each sex.

### Discussion

Epidemiologic analysis of data from vital statistics always must contend with the problem of their validity. The antemortum diagnosis of stroke, particularly in the rural regions of Taiwan, rests primarily on the evaluation of signs and symptoms rather than on laboratory confirmation. Furthermore, in Taiwan, it is estimated that about 0.7% to 1% of death certificates are completed by herb doctors,<sup>6</sup> who are not familiar with

TABLE 2 Absolute and Percent Changes in the Age-adjusted Mortality Rates from Cerebrovascular Disease by Sex

Country/year	Male		Female	
	Absolute change	Percent change	Absolute change	Percent change
Taiwan				
1972-1983	-37.2	-17.5	-33.8	-18.5
1972-1979	-29.3	-13.8	-30.4	-16.6
United States*				
1972-1979 (white)	-38.4	-34.5	-29.9	-32.4
1972-1979 (non-white)	-47.7	-32.2	-48.2	-35.8
Japan†				
1972-1979	-93.2	-32.6	-56.7	-29.0

\*American data were calculated from appendix 2.

†Japanese data were calculated from reference 2, reported by Heizo Tanaka et al.

the form of death certificates and diagnostic criteria for cerebrovascular disease. We also have to take into consideration that other forms of morbidity, for instance, heart disease and hypertension, renal disease, pneumonia, often accompany stroke, as complications or as contributing factors to stroke, and the designation of cause of death depends on the judgement of the certifying physician, medical examiner or coroner's physician.

Other practices, such as revisions of the International Classification of Disease, Injuries, and Cause of

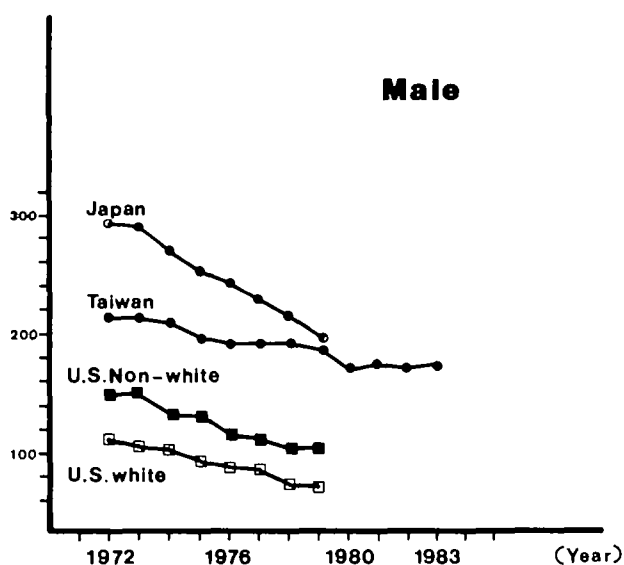


FIGURE 1. Secular Trends in the Age-adjusted Mortality Rates from Cerebrovascular Disease, 1972-1983, Male. Rate per 100,000 Population. (Japanese mortality data were obtained from Heizo Tanaka et al. report.<sup>2</sup> American mortality data were obtained from the Vital Statistics of the United States, see appendix 2. All data were age-adjusted to the 1970 U.S. census population by the direct method.)

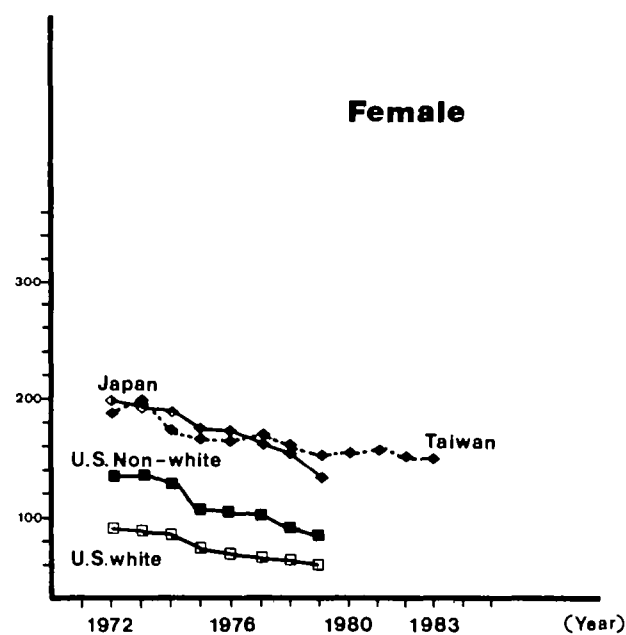


FIGURE 2. Secular Trends in the Age-adjusted Mortality Rates from Cerebrovascular Disease, 1972-1983, Female. Rate per 100,000 Population. (Japanese mortality data were obtained from Heizo Tanaka et al. report.<sup>2</sup> American mortality data were obtained from the Vital Statistics of the United States, see appendix 2. All data were age-adjusted to the 1970 U.S. census population by the direct method.)

TABLE 3 Age-adjusted Death Rates from Cerebrovascular Disease and Percent Changes in Taiwan by Sex and Location, 1972-73 and 1982-83 (per 100,000)

Location	Male			Female		
	1972-73	1982-83	Change	1972-73	1982-83	Change
Urban	229.3	166.5	-27.4	204.0	156.4	-23.3
Rural	209.7	193.3	-7.8	179.6	156.0	-13.1

Death, as well as changes in diagnostic fashion must be taken into consideration in assessing the longterm variation in the frequency of disease; this has been discussed in detail elsewhere.<sup>2, 7, 8</sup> In Taiwan, the coding of the cause of death utilized for mortality statistics from 1971 to 1980 was based on the Eighth Revision (ICD Nos. 430-438) while from 1981 to 1983 it was based on the Ninth Revision (ICD Nos. 430-438). In Japan, the comparability ratio for the change of classification of cerebrovascular disease for Eight (= 1) to the Ninth Revision was estimated at 0.98822.<sup>2</sup> In this presentation the ratio was not used to adjust our data.

According to a previous report,<sup>3</sup> the death rate from cerebrovascular disease in Taiwan has been on the decrease since 1968 for males and since 1967 for females, but the rates of decline were not as rapid as those in the United States and Japan. The age-adjusted mortality rate was obviously higher than that of the United States (fig. 1, fig. 2) and become higher than Japan after 1979. This has also been observed in some earlier reports.<sup>9, 11</sup> Tseng conducted a stroke registry study for one year, January through December 1975 in Yen-Ping precinct of Taipei city, population 50,160.<sup>9</sup> He found that the annual incidence was 1.7% (males 2.0% and females 1.2%). The age-specific incidence for the 55-64 age group in Yen-Ping precinct, if compared with other countries reported by WHO,<sup>10</sup> ranked second, lower than only Akita, Japan (11.6%:13.4%), but was the highest for the age group of 65 or above. In 1978 Chu did a survey of stroke by random household interview throughout Taiwan island.<sup>11</sup> In total, 16,183 persons over 20 years of age were interviewed and the age-specific incidence rate for stroke per year for ages 45-54 was 3.1%, for ages 55-64, 3.5%, and for ages 65-74, 17.2%; all were higher than the corresponding age-specific incidence in Rochester (1.1%, 3.6%, 7.9%)<sup>12</sup> and in Maryland (1.2%, 3.2%, 7.9%).<sup>13</sup>

Cerebrovascular disease is linked with most of the risk factors known to affect atherosclerosis; its preponderant association with hypertension has been established beyond reasonable doubt.<sup>14</sup> It is also well known that considerable risk reduction results from antihypertensive treatment. It is not surprising that the sustained mortality decline observed in the United States in the last few decades has been attributed to the use of antihypertensive agents.

This report shows that the rate of decline of stroke death rate in Taiwan is much less apparent than that in the United States and Japan, and this could be explained by poor control of hypertension in our population. An arterial blood pressure survey in 6,485 per-

sons was carried out by Tseng in Taiwan in 1976,<sup>9</sup> it showed 8.2% had systolic blood pressure  $\geq 160$  mmHg and 17.3% had diastolic blood pressure  $\geq 95$  mmHg. Though the prevalence rate of hypertension in Taiwan was slightly lower than in Chicago as reported by Berkson 1977,<sup>15</sup> the rate of hypertensive persons with blood pressure adequately controlled is much lower, 5% in the former in contrast to 59.3% (1976) and 73.2% (1977) in the latter. Another hypertension survey from 1976 to 1978 in Taiwan also showed a similar result,<sup>16</sup> 87% of people with hypertension were uncontrolled. The poor control of hypertension in Taiwan may account for the slower decline rate of stroke death, even though the prevalence rate of hypertension in Taiwan is not higher than the United States.

Case-fatality ratio and incidence rates certainly have some influence on cerebrovascular disease mortality rate. It has been shown that the incidence rate of primary intracerebral hemorrhage has been declining in one population in the United States since 1945.<sup>17</sup> According to the reports from The Harvard Cooperative Stroke Registry and Alabama Stroke Registry,<sup>18, 19</sup> intracerebral hemorrhage constituted only 8% to 10% of all cerebrovascular patients. In Taiwan, a collaborative stroke registry, by 3 major teaching hospitals was carried out for one year from January to December, 1981.<sup>20</sup> The percentage of the major types of stroke in 1,120 patients, all verified by CT examination, was cerebral hemorrhage 47.1%, cerebral infarction 48.0%, subarachnoid hemorrhage 4.9%. The one-month fatality rate for cerebral hemorrhage was 40.1%, for cerebral infarction 12.1%. It is very possible that the case fatality rates would be even higher for both cerebral infarction and cerebral hemorrhage in other rural districts of Taiwan. The high stroke mortality rate in Taiwan and the high percentage of cerebral hemorrhage definitely are contributing factors to the high stroke mortality in Taiwan.

Our observations confirm previous observations that differences of environment have some influence on the rate of stroke mortality. The rate of decline in stroke mortality was triple for men and double for women in rural as compared with urban districts (table 3).

An inverse relationship has been shown between cerebrovascular disease mortality rates and social class in the United Kingdom.<sup>21</sup> This phenomenon probably can be explained, to some degree, by the fact that people in the urban district are sufficiently well educat-

TABLE 4 Age-adjusted Death Rates from Cerebrovascular Disease and Percent Changes in Taiwan by Sex and Area, 1972-73 and 1982-83 (per 100,000)

Area	Male			Female		
	1972-73	1982-83	Change	1972-73	1982-83	Change
North	213.5	168.3	-21.7	192.9	151.0	-21.7
Central	222.9	185.1	-16.9	190.0	160.0	-15.8
South	208.4	185.0	-11.3	178.9	157.7	-11.8
East	214.3	217.5	+1.5	164.9	150.1	-9.0

ed to realize and avoid the risks of cerebrovascular disease, and have better medical care with resultant decrease in the fatality rate. For instance, it has been shown that there was a decline of cholesterol and triglyceride levels in residents of Taipei city from 1973 to 1977, but not in residents of San-Chih county, a rural area near Taipei city.<sup>22</sup> It also has been shown that the average daily intake of table salt in urban Taipei population was 9.5 gm; in San-Chih county it was 13.2 gm.<sup>23</sup> The urban/rural difference in cholesterol and triglyceride levels and salt intake, to some extent, may be due to the fact that people have been educated to lower the daily intake of fat, and salt.

In a study of mortality rates from ischemic heart disease (IHD) from 1968 through 1976 for 27 countries,<sup>21</sup> Epstein and Pisa concluded that there is a tendency towards a decline for countries whose initial IHD mortality rates were high and the reverse is true for those with initially low rates. Ko reported that the IHD mortality rate in Taiwan was on the increase from 1971 to 1980.<sup>6</sup> As described earlier, during this period cerebrovascular disease mortality was on the decrease. The hypothesis that the decrease in cerebrovascular disease mortality is attributable to an increase in coronary heart disease,<sup>21</sup> is unsupported by some reports and still needs further investigation.

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APPENDIX 1 Age-specific Mortality Rates from Cerebrovascular Diseases by Sex 1972–1983, Taiwan

Year	Age									
	0–4	5–14	15–24	25–34	35–44	45–54	55–64	65–74	75–84	85–
<b>Male</b>										
1972	2.7	0.7	2.3	4.5	23.5	101.1	403.7	1133.0	2231.4	3190.3
1973	2.8	0.8	2.6	7.0	28.3	107.8	397.2	1144.1	2177.3	3424.3
1974	2.6	0.9	1.8	5.0	29.1	109.4	373.4	1086.2	2155.2	3315.1
1975	1.6	0.6	1.7	5.4	24.1	103.7	381.5	1027.5	2147.9	2794.4
1976	1.9	0.4	2.3	4.1	33.0	108.5	357.1	1070.6	1891.0	2771.0
1977	2.0	0.6	1.4	4.9	28.5	112.4	352.9	1025.2	2061.0	2809.0
1978	1.5	0.7	1.9	3.7	31.7	107.4	377.6	981.3	2052.3	2976.4
1979	2.6	1.0	1.6	3.6	24.5	106.3	342.4	952.9	1923.5	2664.8
1980	1.3	1.0	2.3	3.6	22.3	107.0	321.1	904.1	1868.9	2649.8
1981	1.5	0.9	1.8	4.5	24.3	105.6	314.0	876.2	1946.5	2931.9
1982	1.7	0.3	1.9	4.8	23.6	107.6	299.9	890.4	1822.1	2551.7
1983	1.7	1.0	2.6	4.4	22.6	101.6	311.8	896.2	1921.8	2527.7
<b>Female</b>										
1972	1.3	0.7	1.3	4.4	21.9	94.3	297.1	902.4	2137.9	2890.9
1973	1.0	0.8	1.3	4.5	20.4	88.9	275.2	1285.0	2007.0	2862.7
1974	1.4	0.5	1.3	2.9	18.7	82.4	290.3	908.8	2067.4	2536.4
1975	1.2	0.4	1.3	4.1	19.2	86.3	266.3	808.9	1888.6	2805.2
1976	0.9	0.8	1.3	3.6	19.0	92.8	260.2	847.8	1935.0	2450.2
1977	1.1	0.5	1.4	2.9	15.5	87.1	277.3	824.7	1835.5	2881.3
1978	1.8	0.5	1.0	2.9	18.1	87.2	267.2	794.1	1888.6	2616.0
1979	0.4	0.4	1.6	2.9	18.3	85.9	246.1	761.1	1690.7	2615.1
1980	0.8	0.5	1.4	1.8	12.7	81.9	240.3	736.5	1800.3	2508.0
1981	1.0	0.3	1.0	3.0	14.9	78.2	237.9	746.8	1709.5	2718.2
1982	1.4	0.7	1.6	1.6	14.3	73.4	231.1	746.8	1209.5	2718.2
1983	1.2	0.7	1.1	2.0	15.0	67.8	225.0	722.6	1794.5	2649.6

APPENDIX 2 Age-adjusted and Crude Mortality Rates from Cerebrovascular Disease by Sex and Color, 1972–1979 Rate/100,000 United States

Year	White male		White female		Non-white male		Non-white female	
	Age-adjusted rate	Crude rate	Age-adjusted rate	Crude rate	Age-adjusted rate	Crude rate	Age-adjusted rate	Crude rate
1972	111.2	93.6	92.2	112.0	148.3	96.6	134.6	100.6
1973	108.8	91.2	91.6	113.7	147.4	96.1	132.0	99.9
1974	103.6	87.6	86.6	110.3	136.3	90.9	121.0	92.3
1975	94.4	81.1	78.6	102.8	125.2	83.7	109.9	84.9
1976	87.6	76.8	74.8	100.5	119.2	79.3	104.1	82.3
1977	83.4	73.2	69.9	96.5	112.5	75.2	99.5	79.2
1978	74.3	68.9	64.1	93.5	104.0	72.5	89.4	75.0
1979	72.8	65.4	62.3	90.2	100.6	68.5	86.4	71.2

\*American mortality data were age-adjusted to the 1970 U.S. census population by the direct method for each sex-color group.

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