Prevalence of Stroke in Taiwan

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We investigated the prevalence of stroke in Taiwan in an epidemiologic study of stroke, diabetes, and cardiovascular disease that used a two-phase survey design. The study population was drawn by cluster sampling and consisted of both urban and rural communities from four regions of Taiwan. There were 8,705 people 36 years of age or older interviewed during the period of October 1 to December 31, 1986, and 143 cases of completed stroke were later identified by a neurologist. The point prevalence rate for people aged 36 or older in our study was 1,642/100,000 population (95% confidence interval 1,389–1,942/100,000). Prevalence rates differed significantly among the four study regions and between urban and rural communities; prevalence was greater in northern Taiwan and in urban communities. Percentages of the major types of stroke in 143 stroke survivors were as follows: cerebral infarction 67.1% (96 cases), cerebral hemorrhage 14.0% (20 cases), subarachnoid hemorrhage 4.2% (six cases), and unclassified 14.7% (21 cases). Of the stroke survivors, 67.1% were independent in activities of daily living, and 75.5% were independent in ambulation. Hypertension, heart disease, diabetes mellitus, and a family history of stroke were significantly more common in stroke survivors than in strokefree individuals. (*Stroke* 1989;20:858–863)

Cerebrovascular disease ranked as the most common cause of death in Taiwan in the 20 years from 1963 through 1982. It is now the second cause of death, behind cancer.[1] Heart disease, diabetes mellitus, and hypertension were fourth, fifth, and eighth, respectively, on the list of leading causes of death in 1984. To date, few epidemiologic studies concerning incidence, prevalence, and risk factors of these diseases have been conducted in Taiwan.[2,3]

In an attempt to conduct an epidemiologic investigation of these diseases, we began a study entitled "Epidemiologic Study of Stroke, Diabetes, and Cardiovascular Disease," and we present our results concerning prevalence, clinical features, and disability of stroke patients.

Subjects and Methods

Since stroke, heart disease, and diabetes affect chiefly the elderly, we selected our study population from people 36 years of age or older in both rural and urban communities. The family was used as the study unit and consisted of people born before 1950. On the basis of geographic location, we randomly chose one rural and one urban community from the northern, central, southern, and eastern regions of Taiwan (Figure 1). Thus, a stratified cluster random-sampling method was used and yielded a total sample population of 13,930. Age, sex, and educational level representative of each community were tested before we began the survey.

For the stroke survey, we used a two-phase design that included a door-to-door household survey and physical examination. The 88 interviewers consisted of public health nurses and student nurses who were specifically trained to ensure a high level of sensitivity and specificity for finding stroke. Their interviews consisted of a series of items concerning demographic information, personal disease history, family history, smoking habits, drinking, diet preference, and lifestyle. A simple physical examination was performed, including body weight, height, blood pressure measurement, and urine sugar and protein. For the screening we used a translation of the questionnaires designed by the World Health Organization to detect symptoms and signs of neurologic disorders and to measure the prevalence of all frequent neurologic diseases, including cerebrovascular disease.[4] The sensitivity and specificity of the screening procedure were 95% and 80%, respectively.[5,6] Subjects with abnormal results on the screening questionnaire and screening examination, suggesting the presence of stroke, were further

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FIGURE 1. *Four urban and four rural study communities, Taiwan, Republic of China.*

evaluated by a board-certified neurologist who carried out the necessary neurologic examination, rated the activities of daily living score (ADL, Barthel Index),[7-9] collected the medical records, and made a preliminary diagnosis. All preliminary diagnoses and medical records were presented at a meeting of senior neurologists to ensure that diagnoses conformed to the standardized diagnostic criteria.[10,11] Stroke was defined as a sudden neurologic deficit of presumed vascular origin that lasted longer than 24 hours. Transient ischemic attack and syncopal attack were not included in this prevalence study. Diagnostic criteria for hypertension were mean blood pressure higher than 160 mm Hg systolic and/or 95 mm Hg diastolic for three measurements with an interval of 5 minutes between each reading and/or people previously diagnosed with hypertension and currently taking antihypertensive medications. There were screening questionnaires and procedures to locate and identify people with heart disease or diabetes, but in our study only those diagnosed by a medical doctor as having these diseases were considered in the analysis of risk factors.

The disability grade of stroke survivors at the time of evaluation was set at four groups according to the Barthel ADL Index: Group 1 (score 0–40), patient is bedridden and needs full nursing care; Group 2 (score 45–60), patient is bedridden but requires less nursing care and can perform partial self-care in bed; Group 3 (score 65–95), patient can do some self-care or may be independent in a wheelchair; and Group 4 (score 100), patient should be able to live by himself and be completely independent.

For estimating the incidence rate, the interviewer always asked if anyone in the selected family had died within 1 year before the prevalence day. Such a case was then confirmed by a neurologist who questioned the relatives about the course of illness and who reviewed the medical records and/or death certificate.

To ensure the quality of the interview and the validity of the questionnaire, we repeated the interview in 10 families from each area. Ideally, everyone in our study population should have been interviewed and had a simple physical examination, but if the interview could not be carried out, a note was made to document the reason (such as unavailability on more than three occasions, refusal to be interviewed, or moving away).

The point prevalence rate was expressed by 95% confidence interval,[12] and comparison with other studies was made. Significance of the age- and

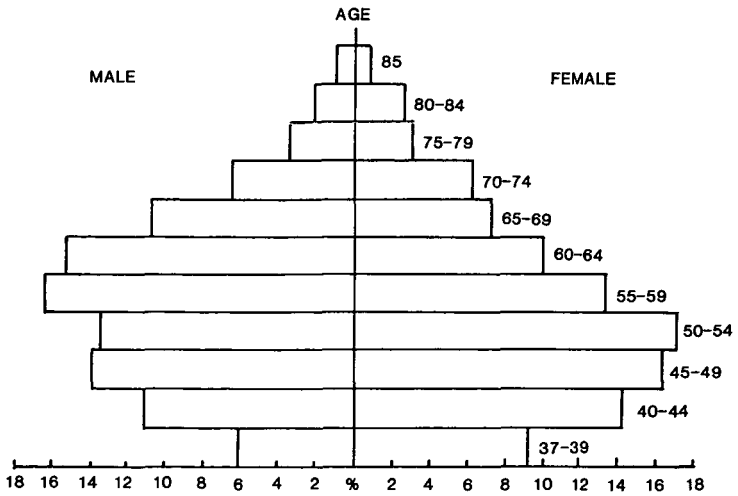

FIGURE 2. *Age and sex distribution of population surveyed October 1, 1986, in urban and rural communities of four regions of Taiwan.*

TABLE 1. Reasons for Failure to Interview

Reason	Case	%
Refused	1,076	16.1
Moved	1,284	19.3
Empty dwelling	1,420	21.3
Unavailable on three occasions	2,690	40.3
Dead	67	1.0
Others	134	2.0

TABLE 2. Prevalence of Stroke for People 36 Years of Age and Older

	Age groups						Crude rate
	36–44	45–54	55–64	65–74	75–84	85+	(per 1,000)
Male	2.6	4.0	32.1	33.5	49.4	45.5	20.6
Female	0.0	3.6	17.3	33.9	35.1	27.8	11.9
Total	1.1	3.8	26.1	33.7	42.5	37.5	16.4

TABLE 3. Prevalence of Stroke in Different Areas of Taiwan

Area	Crude rate	Age-adjusted rate*
Location		
Northern	24.1	20.8
Central	15.3	13.1
Southern	12.7	14.8
Eastern	13.8	14.1
City type		
Urban	18.4	18.9
Rural	14.8	13.0

Rates are per 1,000.
*Adjusted by 1960 US population.

sex-adjusted risk ratio[13] was tested by the Mantel-Haenszel[14] procedure.

Results

We interviewed 8,705 people during the period of October 1 to December 31, 1986. Figure 2 shows the sex and age distribution of these people. The interview response rate in this study was 62.3%; the reasons for failure to interview are listed in Table 1.

The frequency distribution of ancestry was Taiwanese 59.7%, Ha-Ka 20.6%, mainland Chinese 15.9%, and aboriginal 3.8%. More than 80% of the population interviewed were married (83.5%), 10.4% were widows or widowers, 1.4% were divorced, and 4.7% unmarried. Classification of occupations consisted of farmer or fisherman 19.6%, laborer 15.5%, government employee 14.6%, merchant 15.5%, unemployed 25.3%, and others 9.5%.

Among 8,705 screened individuals, there were 143 cases of completed stroke on the prevalence day. The point prevalence rate of this study in eight areas of Taiwan was 1,642 per 100,000 population (95% confidence interval 1,389–1,942). Prevalence seemed to increase steadily with age until the age of 85 (Table 2). Age-specific prevalence rates were usually higher in men, but were higher in women 65–74 years of age. The age-adjusted risk ratio of stroke prevalence in men and women was 1.44 ($p<0.05$). Prevalence rates differed significantly among four study areas and between rural and urban areas (Table 3). The prevalence rate was highest in the northern region ($p<0.01$) and was 1.4 times higher in urban than in rural areas ($p<0.01$).

In epidemiologic studies, hypertension is found to be the most important risk factor for stroke. In our study, hypertension was noted 8.56 times more often in stroke patients than in stroke-free individuals. Other significant diseases associated with stroke were heart disease and diabetes (Table 4). A family history of parents and/or grandparents with stroke was found 1.83 times more often in the stroke patients we studied, and a family history of hypertension was found 1.93 times more often in the stroke patients (Table 5).

The types of stroke diagnosed under the standardized diagnostic criteria were cerebral infarction in 96 cases (67.1%), cerebral hemorrhage in 20 cases (14.0%), subarachnoid hemorrhage in six cases (4.2%), and unclassified in 21 cases (14.7%). Most stroke patients had had medical care in hospitals during the acute stage of stroke, but 13 patients (9%) had been cared for by herb doctors and/or laymen.

The disability of stroke survivors was graded. More than half were completely independent,

TABLE 4. Association Between Stroke and Other Diseases in Terms of Prevalence Odds Ratio

Disease	Total case	Stroke case (%)	Odds ratio*	95% confidence interval
Hypertension				
Yes	1,929	114 (5.9)	8.56	6.20–11.81†
No	6,776	29 (0.4)		
Heart disease				
Yes	464	19 (4.1)	1.74	1.09–2.77††
No	8,241	124 (1.5)		
Diabetes				
Yes	315	18 (5.7)	2.42	1.52–3.89†
No	8,390	125 (1.5)		

*Odds ratios were controlled for age and sex; †$p<0.05$, ††$p<0.01$.

TABLE 5. Association Between Stroke and Family History of Disease

Family history	Total cases	Stroke cases (%)	Odds ratio*	95% Confidence interval
Hypertension				
Yes	1,887	35 (1.8)	1.93	1.34–2.79†
No	6,818	108 (1.6)		
Heart disease				
Yes	630	10 (1.6)	1.66	0.88–3.15
No	8,075	133 (1.6)		
Diabetes				
Yes	741	5 (0.7)	0.68	0.29–1.62
No	7,964	138 (1.7)		
Stroke				
Yes	1,120	23 (2.1)	1.83	1.19–2.82†
No	7,585	120 (1.6)		

*Odds ratios were controlled for age and sex; †$p<0.01$.

17.3% were wheelchair-confined, and 13.0% were bedridden (Table 6).

Discussion

The sample population of 13,930 was drawn from eight geographic areas of Taiwan, with 8,705 people (62%) successfully interviewed. Among the women who were not interviewed, the age distribution was similar to that of those who were interviewed; the men not interviewed consisted of more younger men. The demographic features of this study population of 8,705 are also close to those of the general population of the country as a whole for women, but there are fewer young men in this study population. Thus, knowing the age and sex distribution of the study population allows some general conclusions to be made.

Many epidemiologic studies in different countries have reported that the prevalence rate of stroke is approximately 500–800 per 100,000 population.[15–21] The prevalence rates of stroke reported recently from different countries are shown in Table 7.[18–21] Prevalence in our study is lower than that found in Japan[21] but is similar to that found in the other investigations. However, it is difficult to compare stroke prevalence in various reports because of the differences in diagnostic criteria, medical facilities, age-sex distribution, and screening procedures. The age-specific prevalence rates in our study were fairly similar to those of a stroke survey in Taiwan in 1982[2] (Figure 3). When comparing the age-specific prevalence rates among the different countries, Figure 4 shows that the stroke survivors are in a younger age group in Taiwan than are those in the USA[20] and Japan.[21] From this figure, it is interesting to note that the curves for age-specific rates are not parallel to each other except for the two curves for mainland China and Taiwan. The parallel between the latter two curves might be explained by the fact that people in mainland China and Taiwan share many of the same characteristics (e.g., race, diet, stroke type).[1,18]

As in some other stroke prevalence studies showing a geographic gradient,[18,22,23] we also found that there were geographic differences in stroke prevalence in Taiwan. The rates were the highest in the northern areas and also higher in urban compared to rural communities. These geographic differences may be related to the higher stroke mortality rates in the areas remote from the major cities[1] since prevalence rate is related to incidence and the mean duration of the disease,[24,25] and higher stroke mortality rate and poor medical care for those stroke survivors can reduce the mean duration of the disease. An investigation to explain the prevalence of geographic differences based on incidence and environmental factors is currently under way.

In our study, the prevalence of stroke in men was significantly greater than that in women except in the rural community of eastern Taiwan, where men had a prevalence rate even lower than that of women in the same area. Interestingly enough, men

TABLE 6. Activities of Daily Living of 143 Stroke Patients

Type	Case	%
Bedridden, totally dependent	11	7.7
Bedridden, partial self-care in bed	8	5.6
Wheelchair-confined, partial activities	25	17.5
Completely independent	99	69.2

TABLE 7. Prevalence Rates of Stroke in Different Countries

Population	Years	Age	Prevalence rate (per 1,000)
Daisen, Japan	1981	30+	22.9
Ama, Japan	1984	30+	19.2
Six cities, People's Republic of China	1983	All	6.2
National survey, United States	1976	All	7.6–8.2
Finland	1976	20+	8.2
Taiwan	1986	36+	16.4

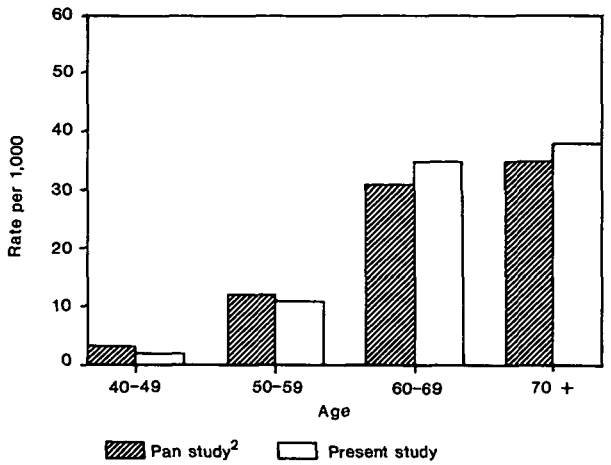

FIGURE 3. *Bar chart of comparison of age-specific stroke prevalence rates in two studies in Taiwan.*

in that area were reported to have the highest mortality rate from stroke and an upward trend of stroke mortality.[1]

Prevalence is seldom of direct interest in etiologic applications of epidemiologic research, and it is possible that the strength of an association between risk factor and disease may be underestimated if comparison is based on prevalence.[24,25] However, in our study, the frequency of hypertension, diabetes, and heart disease in stroke survivors compared with those without stroke was consistent with other cross-sectional and incidence studies of stroke.[19,26,27]

Stroke is a disease of high mortality. In a hospital-based stroke registry study in Taipei,[28] the 30-day case fatality rate is 30.7% for cerebral hemorrhage and 8.4% for cerebral infarction. Once a patient has survived a stroke, the outlook for eventual recovery of function is reasonably good. Of the 143 stroke survivors in our study, 75.5% were independent in ambulation, and 67.1% were independent in activities of daily living. However, the comparison of our study regarding residual disability of survivors with other studies is hampered by a wide variation in methods. In the few studies in which methods and choice of variables were roughly similar,[23,29-32] the frequency of independence in activities of daily living among survivors of stroke was determined. It was found to be 69% in the Framingham Study,[29] 66% in Goulburn, Australia,[30] 51% in Aust-Agder, Norway,[31] and 76% in Finland.[19]

In the Rochester, Minnesota Study,[23,32] in which the 6-month minimum time interval was observed, 36% of the survivors of stroke were "working or able to work." The Framingham Study[29] showed a frequency of 29% of persons still working or performing normal homemaking duties, and 31% of the survivors younger than 65 years of age had retained their working capacity in the Finland prevalence study.[19] We found a similar result in that 26% of male survivors younger than 65 years of age retained their working capacity at the time of examination.

Knowledge of stroke prevalence is important in planning health services and in administering med-

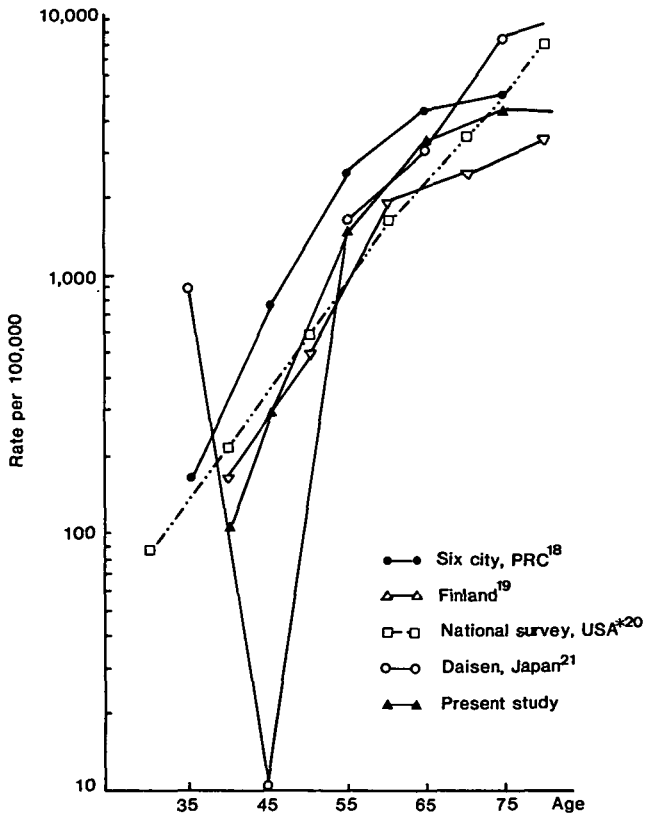

FIGURE 4. *Graph of prevalence of stroke in different countries. *High estimate of age-specific prevalence rates, July 1976.*

ical care facilities since the number of prevalence cases at any time is one determinant of the demand for health care. In addition, precise knowledge of the magnitude and pattern of long-term stroke disability in the general population is useful as a basis for planning continuing care programs for surviving stroke victims. Such knowledge permits a more accurate prognosis to be made for each patient in terms of eventual functional recovery than would be possible from hospital experience.

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