

REVIEW ARTICLES

Epidemiology of Stroke among the Chinese

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INTRODUCTION

With over a thousand million members, the Chinese race is the most populous on earth. Among this enormous population, stroke is perceived as the leading cause of death, with an estimate of one million dying each year from the condition. Of particular interest to many neurologists are whether the Chinese are indeed more prone to stroke and whether the underlying pathology and risk factors are any different from what are generally known about stroke in the western countries. By reviewing relevant studies that have appeared in indexed journals since 1985, this paper is an attempt to answer some of these questions.

INCIDENCE

To measure stroke rates accurately, prospective community-based registries are necessary but they are expensive and laborious. The age-adjusted incidence of stroke in the West is between 100 and 300 per 100,000 people per year, depending on the method of assessment, country of origin, and structure of the population in question.¹ Among the Chinese, the incidence of stroke is believed to be higher, but reliable estimates remain sketchy. In mainland China, the average age-adjusted incidence of first-ever stroke from a door-to-door survey of six cities in 1983 was 219/100,000.² There was marked geographical variation: the northeast city of Harbin had the highest figure of 441, while the southwest city of Chengdu had the lowest of 136, per 100,000 people. A further survey of seven cities (which included four that had previously been studied) between 1986 and 1990 yielded an almost identical yearly rate of 216/100,000.³ Again the north-south gradient was apparent: Harbin had an incidence of 486, while Shanghai had 81, per 100,000 people. In Shanghai itself, a community-based registry performed between 1984 and 1991 found that among people aged 35 to 74 years the age-adjusted stroke incidence was 218/100,000 for

men and 169/100,000 for women.⁴ In Taiwan, a 4-year (1986-90) prospective study of 8,562 people aged ≥ 36 years gave an age-adjusted incidence which was somewhat higher, at 348/100,000 for men and 301/100,000 for women.⁵ In Hong Kong, where the population is over 95% Chinese, no comparable study has ever been performed. Using the Hospital Authority's figure for hospital admissions under the International Classification of Diseases codings 430-438 for the year 1996 would yield a crude admission rate for stroke of 335 per 100,000 people, but this gave little clue to the real incidence since on the one hand patients who did not seek hospital admission were not counted, and on the other transfers between hospitals, re-admissions, and "other cerebrovascular diseases" were counted in the same way as first-ever strokes.

For comparison with the western countries, the World Health Organization's Monitoring of Trends and Determinants of Cardiovascular Disease (MONICA) Project has been the only source of standardized data, despite two major limitations.⁶ First, only people aged 35 to 64 years were included (thereby excluding at least two-thirds of all strokes) and second, Beijing was the only oriental population represented in the pool of 17 populations that included those from northern and eastern Europe, including Siberian Russia, but not western Europe (except Italy) or North America. During the period 1985 to 1990, the age-standardized stroke "attack rate" (for first and recurrent events) per 100,000 people for Beijing was 247 for men and 175 for women. The highest rates for both men and women was found in the Siberian city of Novosibirsk (388 and 312 respectively) while the lowest, also for both men and women, came from the Italian city of Friuli (124 and 61 respectively). Beijing residents ranked sixth among men and second among women in this multinational "league table" for stroke occurrence (Table 1). Men from parts of Russia, Finland and Lithuania fared worse than Beijing men; but

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TABLE 1: Age-standardized stroke attack rates per 100,000 in men and women aged 34-65 years in the MONICA populations

Country	City/Region	Rate for Men	Country	City/Region	Rate for Women
Russia	Novosibirsk	388	Russia	Novosibirsk	312
Finland	Kuopio	351	China	Beijing	175
Lithuania	Kaunas	308	Finland	Kuopio	173
Finland	N Karelia	280	Lithuania	Kaunas	159
Russia	Moscow C	257	Russia	Moscow I	126
China	Beijing	247	Finland	N Karelia	123
Finland	Turku	247	Russia	Moscow C	121
Russia	Moscow I	241	Sweden	Northern	111
Yugoslavia	Novi Sad	228	Yugoslavia	Novi Sad	107
Sweden	Northern	207	Finland	Turku	105
Poland	Warsaw	184	Germany*	Karl-Marx-Stadt	104
Germany*	Karl-Marx-Stadt	176	Denmark	Glastrup	92
Denmark	Glastrup	173	Poland	Warsaw	90
Germany*	Halle	151	Germany*	Halle	86
Germany*	Rest of	141	Germany*	Rest of	74
Sweden	Gothenburg	137	Sweden	Gothenburg	69
Italy	Friuli	124	Italy	Friuli	61

*Former East Germany

only women from Novosibirsk were more stroke-prone than their Beijing counterparts. In a survey of published stroke rates of 10 populations that included Novosibirsk as well as cities in Europe, Australia and North America, Novosibirsk again had the highest rate, which exceeded the rest by 30 to 160 percent.⁷ Thus, in terms of stroke preponderance, Beijing residents are more akin to northern or eastern Europeans than western Europeans or North Americans.

PATHOLOGY

In general, strokes may be classified into cerebral infarct (thromboembolic or lacunar), cerebral (or intracerebral) haemorrhage, and subarachnoid haemorrhage. In order to establish the proportion of each subtype accurately, computed tomography (CT) for every case of stroke is required. For this reason, hospital-based registries are the chief source of such data. The most complete study for a Chinese population so far is the "Taipei series" of 1984-86 which scanned 98% of 3,982 cases and found that 58% were due to cerebral infarct, 35% cerebral haemorrhage, and 7% subarachnoid haemorrhage.⁸ No distinction was made between thromboembolic and lacunar infarcts. At the same time (1984-85) in Hong Kong, 86% of 540 stroke patients aged 20-70 years were studied with CT or necropsy: 50% were found to have

cerebral infarct, 31% cerebral haemorrhage, and 4% subarachnoid haemorrhage.⁹ Of the 270 cerebral infarcts, 43% were considered to have had lacunar syndromes clinically but only 30% had lacunae visible on CT. These findings prompted the suggestion that both cerebral haemorrhage and lacunar infarct are relatively more common among the Chinese. A study performed in Shanghai in 1986-88 showed that 27% of 540 ischaemic strokes had deep cerebral infarcts, of which half were described as "giant lacunes" (>15 mm in maximal diameter).¹⁰ Another Hong Kong study, the "Shatin Stroke Registry", which in 1989 scanned 96% of all patients admitted with stroke irrespective of age, showed that cortical and subcortical infarcts occurred in 50%, supratentorial lacunar infarcts in 19% (i.e. 28% of supratentorial infarcts), and intracerebral haemorrhage in 27% of 777 patients included in the registry (patients with subarachnoid haemorrhage were excluded).¹¹ In Singapore, a registry of 1,147 stroke patients admitted in 1992-94 also showed that "haemorrhagic stroke" in patients of Chinese origin was nearly as common there (25%) as in Hong Kong.¹² Using the "TOAST" classification of ischaemic strokes, the National Taiwan University Hospital Stroke Registry performed in 1995 found that of 676 infarct patients, 17% had large-artery atherosclerosis, 29% lacunae,

20% cardioembolism, and the remainder 34% had other or unknown causes.¹³ It may therefore be concluded that among Chinese stroke patients who are admitted to hospitals, the proportion of those with cerebral haemorrhage is likely to be between 25 and 35 percent; and of those with cerebral infarction, approximately 30 percent may have lacunae. From a comparative point of view, since it is well-established at least in western Europe that between 8 and 15 percent of strokes in whites are due to cerebral haemorrhage,⁷ Chinese have clearly a significantly higher risk of cerebral haemorrhage. On the other hand, because the proportions of lacunae vary widely among a number of western studies (from 10 to 27 percent of all infarcts in one review¹³), it is still uncertain whether Chinese have an excess of lacunar infarction as well.

Recent studies from Hong Kong and Beijing have highlighted the importance of intracranial arterial stenosis as a cause of stroke in the Chinese. An autopsy study of consecutive individuals who died from various causes found that severe intracranial stenosis (defined as >50% luminal narrowing in at least one cerebral artery) was present in 31% of 114 brains studied.¹⁴ Of 96 patients who presented to a Beijing hospital for transient ischaemic attacks, 51% were found on transcranial Doppler examination to have intracranial stenosis or occlusion, in contrast to 19% with extracranial disease.¹⁵ A similar study performed on 66 ischaemic stroke patients in Hong Kong showed that 33% had intracranial occlusive disease while only 6% had extracranial disease.¹⁶

RISK FACTORS

In general, stroke risk factors operate in very much the same way in the Chinese as in Caucasians, and there is no major difference in their effects between rural and urban Chinese. A case-control study conducted in rural areas of mainland China concluded that history of hypertension, and physical findings of high blood pressure, fundoscopic arteriosclerosis and hypertrophy of the heart were risk factors for haemorrhagic stroke while, in addition to these factors, history of heart disease and transient ischaemic attack, consumption of tobacco, and physical finding of arrhythmia were risk factors for ischaemic stroke.¹⁷ In Hong Kong, which is highly urbanized, hypertension was similarly found to be a risk factor for both haemorrhagic and ischaemic strokes, while diabetes mellitus (which occurred rarely in the rural Chinese) was

a risk factor for lacunar infarction only. Total triglyceride was a significant risk factor for strokes collectively, but not for any specific subtype; and total cholesterol was not a risk factor at all in that study.¹⁸ The Hong Kong study further demonstrated that for ischaemic strokes, atrial fibrillation and ischaemic heart disease were risk factors in subjects ≥ 70 years old, while diabetes mellitus, smoking, and left ventricular hypertrophy were risk factors in subjects < 70 years old. Although hypertension was a significant risk factor for ischaemic strokes in both age groups, for haemorrhagic stroke it was significant only in the younger age group.¹⁹ These findings underpin the necessity, in the Chinese as in other races, for anticoagulating elderly patients in atrial fibrillation and for treating hypertension particularly in younger patients rigorously.

REFERENCES

1. Sacco RL. Current epidemiology of stroke. In: Fisher M, Bogousslavsky J, eds: *Current Review of Cerebrovascular Disease*. 1st ed. Philadelphia: Current Medicine, 1993:3-14.
2. Li SC, Schoenberg BS, Wang CC, Cheng XM, Bolis CL, Wang KJ. Cerebrovascular disease in the People's Republic of China: epidemiologic and clinical features. *Neurology* 1985; 35:1708-13.
3. Cheng XM, Ziegler DK, Lai YH, et al. Stroke in China, 1986 through 1990. *Stroke* 1995; 26:1990-4.
4. Hong Y, Bots ML, Pan X, Hofman A, Grobbee DE, Chen H. Stroke incidence and mortality in rural and urban Shanghai from 1984 through 1991. *Stroke* 1994; 25:1165-9.
5. Hu HH, Sheng WY, Chu FL, Lan CF, Chiang BN. Incidence of stroke in Taiwan. *Stroke* 1992; 23:1237-41.
6. Thorvaldsen P, Kuulasmaa K, Rajakangas AM, Rastenyte D, Sarti C, Wilhelmsen L. Stroke trends in the WHO MONICA project. *Stroke* 1997; 28:500-6.
7. Sudlow CLM, Warlow CP. Comparable studies of the incidence of stroke and its pathological types. *Stroke* 1997; 28:491-9.
8. Hung TP. Changes in mortality from cerebrovascular disease and clinical pattern of stroke in Taiwan. *J Formosa Med Assoc* 1993; 92:687-96.
9. Huang CY, Chan FL, Yu YL, Woo E, Chin D. Cerebrovascular disease in Hong Kong Chinese. *Stroke* 1990; 21:230-5.
10. Davis LE, Xie JG, Zou AH, et al. Deep cerebral infarcts in the People's Republic of China. *Stroke* 1990; 21:394-6.
11. Kay R, Woo J, Kreel L, Wong HY, Teoh R, Nicholls MG. Stroke subtypes among Chinese living in Hong Kong: The Shatin Stroke Registry. *Neurology* 1992; 42:985-7.
12. Venketasubramanian N, Tan AKY, Balaji S.

- Differences in stroke subtype among the major ethnic groups in Singapore (abstract). *J Neuroimaging* 1997; 7:262.
13. Yip PK, Jeng JS, Lee TK, et al. Subtypes of ischemic stroke: a hospital-based stroke registry in Taiwan (SCAN-IV). *Stroke* 1997; 28:2507-12.
 14. Leung SY, Ng THK, Yuen ST, Lauder IJ, Ho FC. Pattern of cerebral atherosclerosis in Hong Kong Chinese. Severity in intracranial and extracranial vessels. *Stroke* 1993; 24:779-86.
 15. Huang YN, Gao S, Li SW, et al. Vascular lesions in Chinese patients with transient ischemic attacks. *Neurology* 1997; 48:524-5.
 16. Wong KS, Huang YN, Gao S, Lam WWM, Chan YL, Kay R. Intracranial stenosis in Chinese patients with acute stroke. *Neurology* 1998; 50:812-3.
 17. Li SC, Wang CC, Fu YG, et al: Risk factors for stroke in rural areas of the People's Republic of China: Results of a case-control study. *Neuroepidemiology* 1990; 9:57-67.
 18. Woo J, Lau E, Lam CWK, et al: Hypertension, lipoprotein (a) and apolipoprotein A-I as risk factors for stroke in the Chinese. *Stroke* 1991; 22:203-8.
 19. Woo J, Lau E, Kay R: Elderly subjects aged 70 years and above have different risk factors for ischemic and hemorrhagic strokes compared to younger subjects. *J Am Geriatr Soc* 1992; 40:124-9.