



CARDIOVASCULAR MORTALITY OF CHINESE IN NEW YORK CITY

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ABSTRACT To determine cardiovascular disease mortality among Chinese migrants in New York City and compare it to both that of residents in China and whites in New York City, mortality records for 1988 through 1992 for New York City and the 1990 US census data for New York City were linked. Age-specific death rates for urban China, reported by the World Health Organization, were used for comparison. The results show that male and female Chinese residents in New York City had lower mortality rates for all causes and total cardiovascular disease than did either New York City whites or Chinese in China. Coronary heart disease deaths among New York City Chinese were intermediate between Chinese in China (lowest) and New York City whites (highest). Stroke death rates for New York City Chinese were substantially lower than those in China and, in general, were similar to those for New York City whites. However, New York City Chinese had higher death rates for hemorrhagic stroke and lower for atherosclerotic stroke than did New York City whites. In conclusion, cardiovascular mortality rates among Chinese migrants in New York City fall below those of both Chinese in China and whites in New York City.

The health status of migrants usually differs from that of nonmigrants.^{1,2} These differences often provide clues to environmental contributions to disease.³ Comparisons of migrants to those left behind, as well as to natives of their adapted land, may identify potential preventive interventions that might be useful in both settings.

For example, early Japanese male migrants to Hawaii had significantly greater coronary heart disease incidence and mortality compared to those remaining in Japan, albeit lower rates than corresponding rates in US whites.^{1,4} Chinese migrants to Hawaii also had a greater proportion of coronary heart disease mortality than did New York City Chinese. Moreover, in New York City, US-born Chinese

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had a greater proportion of deaths due to coronary heart disease than did foreign-born Chinese.⁵ These experiences of Asian immigrants were similar to those reported for other ethnic groups who have migrated from regions with low coronary heart disease to the US⁶ and other countries^{2,7} with high rates.

Previous comparisons of Chinese migrants to the US population were limited by the inability to calculate event rates because of absence of information about the population.⁵ Based on census data and death certificates, we now are able to report cardiovascular disease mortality rates in New York City Chinese and compare them to rates for New York City whites and Chinese in China.

DATA AND METHODS

DATA SOURCE

This analysis was based on New York City census data obtained from the 1990 US Census Public Use Microdata Sample⁸ and mortality records for 1988 through 1992 obtained from the New York City Department of Health.⁹ The mortality data, as well as population data, from China were based on a report by the World Health Organization (WHO).¹⁰

Census data. Census data for New York City were obtained from the 1990 Census Public Use Microdata Sample.⁸ This is the largest available census database and contains a roughly 1 in 20 sample. A weighted variable was assigned by the Census Bureau to extrapolate from the sample to establish all characteristics for the total population.

The variables included in the census data set were borough of residence, race, age in years, gender, place of birth, and education. The definition of race represents self-classification according to the race with which the respondent identified most closely. During direct interviews conducted by enumerators, if a person could not provide a single response to the race question, he or she was asked to select the group that best described his or her racial identity. The racial definition for Chinese in the 1990 census data includes persons who indicated their race as Chinese or who identified themselves as Cantonese, Tibetan, or Chinese-American. For whites, it included persons who indicated their race as white or reported entries such as Canadian, German, Italian, Lebanese, Near Easterner, Arab, or Polish.

Mortality data. Death certificates for the five years 1988 through 1992 were obtained on computer tape provided by the New York City Department of Health, on which all vital events in New York City are stored.⁹ Personal identifying

information from all death certificates was eliminated to preserve confidentiality. Deaths were recorded by borough, age, sex, ZIP code, education, race, place of birth, and underlying causes of death, which were coded according to the ninth revision of the International Classification of Diseases (ICD-9). Races of deceased were established by the funeral directors involved in individual cases. Cardiovascular mortality in this analysis was defined the same way as in the WHO statistics annual report.¹⁰ The following causes of death were included in this analysis: total cardiovascular disease (ICD-9 390–459), coronary heart disease (ICD-9 410–414), cerebrovascular disease (ICD-9 430–438), and hypertensive disease (ICD-9 401–404). Furthermore, cerebrovascular disease was subdivided into hemorrhagic stroke (ICD-9 430–432) and atherosclerotic stroke (ICD-9 433–437) on mortality records for New York City Chinese and whites.

World Health Organization report. The WHO mortality report¹⁰ for Chinese in China was drawn from the National Mortality Statistics sample; it represents about 10% of the total population and yields at least 600,000 deaths annually. Causes of death were classified according to ICD-9 with the same definitions as mortality records. Type of stroke (hemorrhagic and atherosclerotic), however, was not specified in the WHO report. Urban and rural sample sites were reported separately. In the comparison with New York City, we used the 1990 data for the urban population of China.¹⁰

DATA ANALYSIS

All-cause mortality rates, as well as cause-specific cardiovascular mortality rates, were calculated by dividing the number of deaths from 1988 to 1992 by the population (from census data) in 1990 for New York City Chinese and whites. For Chinese in urban China, the age-specific deaths and population numbers for 1990 reported by WHO were used to calculate mortality rates.

Sex- and age-specific death rates of Chinese and whites in New York City and Chinese in urban China were compared. Furthermore, sex-specific age-adjusted death rates of the three groups were computed by direct standardization using the 1990 world standard population reported by WHO.

For New York City Chinese and whites, death rates are based on the aggregate of 5-year figures (1988–1992), and annual mortality rates were computed by dividing the 5-year rates by five. For Chinese in urban China, death rate was based on 1990 data reported by WHO. Age-adjusted death rates of the three groups were compared by computing relative risks and their 95% confidence intervals.

RESULTS

Chinese comprised about 3.4% of the total New York City population (7,289,839). Compared with whites, New York City Chinese were younger, more likely to be male, had a lower educational attainment, and had a lower proportion in professional/ administrative and sales/technical positions (Table I). They were also more likely to be unemployed than whites. Similar data for Chinese in urban China were not available.

For all three groups, circulatory diseases were the leading causes of death, accounting for 39.9%, 51.8%, and 37.9% of all deaths for New York City Chinese, New York City whites, and Chinese in China, respectively.

New York City Chinese had sharply lower death rates (less than half) for all causes and total cardiovascular-associated deaths than did New York City whites or Chinese in China (Table II). The total cardiovascular-associated death rates, including both genders, were the same for New York City whites and Chinese in China (426.2 per 100,000 and 426.0 per 100,000, respectively), and both were sharply higher than New York City Chinese (192.6 per 100,000). New York City Chinese had death rates from coronary heart disease (61.0 and 56.1 for males and females, respectively) between New York City whites (highest) (161.7 for males and 143.9 for females) and Chinese in China (lowest) (45.4 for males and 46.1 for females).

Death from stroke in both genders and hypertensive disease among female

TABLE I Baseline Characteristics of Chinese and Whites in New York City, 1990

	Chinese	Whites
Population	245,565	3,165,172
Age, years*	34.8 ± 19.9	41.8 ± 22.9†
<25, %	32.2	24.0†
25-64, %	58.7	55.3
≥65, %	9.1	20.7
Males, %	49.8	47.1†
Education, ≥high school, %	63.8	82.5†
Occupation, %		
Professional/administrative	18.8	34.3†
Sales/technical	25.8	30.6
Service	16.2	8.6
Operator	24.0	13.3
Unemployed	15.3	13.1

*Mean ± standard deviation.

† $P < .05$.

TABLE II Age-Adjusted Annual Death Rates* (1/100,000) for Chinese and Whites in New York City, 1988–1992, and Urban Chinese in China, 1990

	Chinese		Whites, NYC	RR (95% CI) (NY Chinese/ China)	RR (95% CI) (NY Chinese/ Whites)	RR (95% CI) (China/Whites)
	China	NYC				
Males						
All causes	591.5	282.5	610.6	0.48 (0.45–0.51)	0.46 (0.43–0.49)	0.97 (0.92–1.02)
CVD (ICD 390–459)	204.4	96.3	227.2	0.47 (0.42–0.53)	0.42 (0.38–0.47)	0.90 (0.83–0.98)
Stroke (ICD 430–438)	115.9	13.4	12.9	0.12 (0.09–0.15)	1.08 (0.77–1.53)	9.06 (7.00–11.73)
CHD (ICD 410–414)	45.4	61.0	161.7	1.34 (1.13–1.60)	0.38 (0.33–0.43)	0.28 (0.24–0.33)
HT (ICD 401–404)	9.6	3.3	6.5	0.35 (0.20–0.62)	0.52 (0.29–0.92)	1.45 (0.98–2.35)
Females						
All causes	559.7	233.7	444.5	0.42 (0.39–0.45)	0.53 (0.49–0.56)	1.30 (1.26–1.33)
CVD (ICD 390–459)	221.6	96.3	199.0	0.43 (0.39–0.48)	0.48 (0.43–0.46)	1.11 (1.02–1.21)
Stroke (ICD 430–438)	116.7	17.7	14.9	0.15 (0.12–0.19)	1.19 (0.87–1.62)	7.89 (6.20–10.05)
CHD (ICD 410–414)	46.1	56.1	143.9	1.22 (1.02–1.45)	0.39 (0.34–0.45)	0.32 (0.28–0.37)
HT (ICD 401–404)	12.8	4.0	4.9	0.31 (0.19–0.52)	0.83 (0.46–1.51)	2.67 (1.67–4.26)

CHD, coronary heart disease; CI, confidence interval; HT, hypertension; CVD, total cardiovascular disease; RR, relative risk.

*Standard Population: World Standard Population, 1990.¹⁰

New York City Chinese did not differ significantly from those of New York City whites, and both were significantly lower than for Chinese in China. Deaths associated with hypertensive disease in males were lowest for New York City Chinese.

Overall, New York City Chinese males and females were significantly better off than Chinese in China in terms of total cardiovascular disease, stroke, and hypertension, but the reverse was true for coronary heart disease. On the other hand, New York City Chinese were better off than New York City whites in terms of total cardiovascular disease, coronary heart disease in both genders, and hypertension for males. Of note is the sharp difference in death rates from stroke among Chinese in New York City and those in China. In fact, Chinese in China had rates 6–8 times higher than Chinese in New York City and New York City whites, which, in fact, were similar.

Chinese in New York City had the lowest all-cause and total cardiovascular mortality compared with either Chinese in China or New York City whites in all age groups (Table III). These differences were most pronounced within the young and middle-aged group (aged 25–64). However, for coronary heart disease, stroke, and hypertension, the mortality differences among the three groups were much greater in middle (45–64 years) and old-age groups (65 years and above)

TABLE III Cardiovascular Mortality for New York City Chinese and Whites by Age and Sex

	Chinese Males		White Males	Chinese Females		White Females
	China	NYC		China	NYC	
25-44 years						
All causes	198.5	79.9	389.7	141.5	43.4	121.1
CVD	20.0	11.2	36.5	20.0	3.7	13.8
CHD	6.5	3.5	16.1	3.5	0.8	4.3
ST	6.5	4.3	3.7	5.5	2.1	2.3
HT	0.5	1.3	3.1	1.0	0.0	0.8
45-64 years						
All causes	1,094.5	454.2	1,215.3	670.5	229.8	649.3
CVD	250.5	124.4	482.2	190.5	61.4	202.3
CHD	40.5	73.2	328.1	25.0	24.1	130.9
ST	147.5	24.4	26.1	104.5	25.7	18.4
HT	16.0	3.9	20.2	11.5	4.1	8.8
≥65 years						
All causes	6,446.0	3,072.2	5,741.1	5,038.5	2,186.6	4,537.2
CVD	2,314.5	1,417.9	3,244.3	1,969.0	1,121.2	2,783.8
CHD	279.0	945.3	2,461.2	218.5	692.9	2,105.5
ST	1,359.0	165.6	174.8	1,162.5	175.8	189.4
HT	154.0	46.5	57.4	137.0	45.3	55.3

CHD, coronary heart disease; CVD, total cardiovascular disease; HT, hypertensive disease; ST, stroke.

than in the younger group. The sharply higher death rates for stroke and hypertensive disease among Chinese in China compared with New York City Chinese and whites were observed among those age 45 and above.

Although overall death rates for stroke for New York City Chinese and whites were similar, the type of stroke differed sharply (Table IV). New York City Chinese had significantly higher hemorrhagic stroke death rates than did New York City whites, both males and females. By contrast, death rates from atherosclerotic stroke among males were significantly higher in New York City whites than in Chinese. However, this difference did not achieve significance for females.

DISCUSSION

All-cause and total cardiovascular disease mortality are sharply lower for Chinese in New York City than for either New York City whites or Chinese in China. This variation is explained in substantial part by variation in cause-specific cardiovascular mortality. Specifically, while death rates from coronary heart

TABLE IV Age-Adjusted Mortality Rates for Stroke Among New York City Chinese and Whites

	NYC Whites	NYC Chinese	RR (95% CI) (Chinese/Whites)
Males			
Hemorrhagic stroke	4.4	7.9	1.79 (1.05–2.94)
Ischemic stroke	8.4	5.3	0.63 (0.39–0.97)
Females			
Hemorrhagic stroke	2.4	8.6	3.58 (2.62–4.88)
Ischemic stroke	12.4	9.0	0.72 (0.55–1.08)

CI, confidence; RR, relative risk.

disease for New York City Chinese were intermediate between Chinese in China (lowest) and New York City whites (highest), Chinese in New York City had dramatically lower deaths from stroke and hypertensive disease than did Chinese in China. Indeed, the so-called Eastern pattern of cardiovascular disease, in which stroke predominates,^{11,12} does not exist among Chinese in New York City.

These mortality differences in cardiovascular disease between natives and migrants probably reflect the varying influences of environment and genetics on the development of disease.¹⁻⁷ In comparing migrant mortality rates to those of nonmigrants and of natives of the migrants' destination, when the influence of environment predominates, nonmigrants differ from migrants, and migrant rates tend toward those of the country of adoption. On the other hand, when genetic factors predominate, death rates of nonmigrants and migrants tend to be similar, and both might differ from that of natives of the adoptive country.¹³

In China, coronary heart disease is rare, but stroke is common.^{14,15} In 1990, mortality from stroke and myocardial infarction for males in urban mainland China were 126.4 and 22.7 per 100,000 population, respectively, while in the US the respective rates were 46.8 and 106.8, respectively.¹⁰ Death rates from total cardiovascular disease for Chinese in China and New York City whites were indistinguishable. The specific components of these totals differed sharply, however. Mortality from coronary heart disease for Chinese in New York City was intermediate between that for China and for white neighbors of their adopted land. For stroke, New York City Chinese and whites both had similar and sharply lower rates than did Chinese in China.

Thus, in sharp contrast to coronary heart disease, Chinese promptly have acquired the low stroke mortality rate achieved in the US over decades. The same phenomenon was observed previously among Japanese migrants to Hawaii

and California.⁴ Perhaps the factors responsible for stroke deaths in migrant populations change more quickly in a Western environment than do the factors operating to increase coronary heart disease.

The low incidence of ischemic heart disease in China¹⁶ has been attributed to the low prevalence of hypercholesterolemia.¹⁷ Chinese have lower mean levels of total cholesterol and low-density lipoprotein cholesterol than do whites.¹⁸ On the other hand, some evidence suggests that low blood lipid levels (of both triglyceride and cholesterol) in the Chinese population actually may increase stroke risk, particularly from hemorrhagic strokes.¹⁸ In the Framingham Study, the low-density lipoprotein cholesterol level in women correlated inversely with the incidence of hemorrhagic stroke.¹⁹ In the Multiple Risk Factor Intervention Trial, mortality from hemorrhagic stroke also correlated inversely with total cholesterol levels in men.²⁰ Previous controversy regarding hypercholesterolemia as a stroke risk factor may have resulted from failure to analyze hemorrhagic and atherosclerotic strokes separately.²¹ Intracerebral hemorrhage, as seen here, which carries a higher mortality than does cerebral infarction, has been more common in Chinese²² than in whites.²³

Dietary intake is an environmental factor likely to change with migration. High intake of total calories and low intake of fiber are associated with increased atherosclerosis and coronary heart disease.²⁴ Americans derive an average of 43% of total calories from fat, compared to less than 20% of total calories from fat in the Chinese diet. In addition, in China, the consumption of cereals and vegetables, the primary sources of fiber, exceeds that in the US.²⁵ Presumably, New York City Chinese, as their diets accommodate, increase their blood lipids. This might reduce the incidence of hemorrhagic stroke before it increases atherosclerotic stroke and coronary heart disease, which would be consistent with the findings here.

Cardiovascular disease incidence and mortality rates in the Chinese migrant population, as in other settings, were expected to be intermediate between rates in the home and adopted countries.^{1,4,5} Instead, all-cause mortality, total cardiovascular disease mortality, and hypertension in males were lower among Chinese migrants than in either New York City whites or Chinese in China. Clearly, migrant mortality rates do not fall invariably between place of origin and destination. This might reflect the special characteristics of migrants. They may share the genetic pattern of China, but represent such a selected group that their life style might differ sharply from average Chinese in many important aspects. Migration requires financial resources and a certain level of health, which might provide an unmeasured health advantage.²⁶ Moreover, most Chinese in New

York City came primarily from Guangdong and elsewhere in South China,²⁷ where residents had a more favorable risk profile and lower rates of mortality and morbidity from cardiovascular disease than do those from other parts of China.^{28,29}

The stroke incidence rates for both China and Japan are among the highest of the world.³⁰ One explanation may be ethnic susceptibility.³¹ However, that stroke incidence in Asian populations residing in the US approximates that of whites, which argues against such a hypothesis.³¹ Nevertheless, the substantial difference in stroke mortality between Chinese in China and those in New York City is difficult to explain. Perhaps there are differences in definition of stroke in China and the US. However, the deaths reported to WHO were from the Center for Health Information and Statistics of the Ministry of Health of China and were compiled from a list of causes of death based on ICD-9.¹⁰ Furthermore, China participates in the WHO/MONICA* project, which employs a standard definition of stroke and diagnostic categories.¹² Thus, it is unlikely that different diagnostic definitions explain the results here.

The limitations of this study relate to the imperfection of both census and death records. Aliens, minorities, and illegal immigrants may have been undercounted in the census. However, undercounting is believed to be very low due to coverage improvement programs implemented during the 1990 census.⁸ On the other hand, mortality data are likely to be more complete. As a result, death rates in migrant groups might be inflated. However, there is no reason to believe that important systematic bias attends this process in regard to assignment of cause of death. Furthermore, the aggregation of 5-year deaths and the concentration on broad categories of mortality tend to increase our confidence in the overall directions presented here.

In summary, we have found that the overall cardiovascular disease experience of migrant Chinese violates the usual rule that the mortality of migrants falls between place of origin and place of destination. Moreover, the distribution of cardiovascular disease type differed sharply among the groups. New York City whites suffered most from coronary heart disease, which was less of a burden for Chinese regardless of their residence. Stroke, by contrast, so important in China, was a rare cause of death for Chinese in New York City. In fact, in contrast to China, where stroke mortality was 8–9 times that seen in the whites, stroke death rates of New York City Chinese were indistinguishable from that of New

*MONICA: Multinational monitoring of trends and determinants in cardiovascular disease.

York City whites. However, the greater rates of hemorrhagic disease occurrence in New York City Chinese resembled the stroke pattern in China. Available data do not explain the dramatic disappearance of stroke from the immigrant Chinese experience. They suggest, however, the association of a powerful protective factor of Chinese who have migrated to New York City.

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